

AIR FORCE T.O. 35C2-3-442-2  
ARMY TM5-6115-457-34  
NAVY NAVFAC P-8-627-34  
MARINE CORPS TM-07464A-35

This copy is a reprint which includes current pages from Changes 1 through 12.

TECHNICAL MANUAL

INTERMEDIATE [FIELD]  
[DIRECT AND GENERAL SUPPORT]  
AND DEPOT LEVEL MAINTENANCE

**GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL**

SKID MTD., 100 KW, 3 PHASE, 4 WIRE, 120/208 AND 240/416 VOLTS

<u>DOD MODELS</u>	<u>CLASS</u>	<u>HERTZ</u>	<u>NSN</u>
MEP007A	UTILITY	50/60	6115-00-133.9101
MEP106A	PRECISE	50/60	6115-00-133.9102
MEP116A	PRECISE	400	6115-00-133-9103

INCLUDING OPTIONAL KITS

<u>DOD MODELS</u>	<u>NOMENCLATURE</u>	<u>NSN</u>
MEP007AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9082
MEP007AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9084
MEP007ALM	DUMMY LOAD KIT	6115-00-463-9086
MEP007AWM	WHEEL MOUNTING KIT	6115-00-463-9089

Consolidated Diesel Electric Company

Contract Number FO4606-70-D-0192 and F04606-78-C-0363

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Published under authority of the  
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15 JUNE 1973



AIR FORCE TO 35C2-3-442-2  
ARMY TM5-6115-457-34  
NAVY NAVFAC P-8-627-34  
MARINE CORPS TM-07464A-34

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**TECHNICAL MANUAL**

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(DIRECT AND GENERAL SUPPORT)  
AND DEPOT LEVEL MAINTENANCE

GENERATOR SET, DIESEL ENGINE DRIVEN,  
TACTICAL SKID MTD., 100 KW, 3 PHASE,  
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CONSOLIDATED DIESEL ELECTRIC COMPANY

CONTRACT NUMBER F04606-70-D-0192 AND F04606-78-C-0363

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**PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE**

15 JUNE 1973  
CHANGE 12- 20 AUGUST 1991

**LIST OF EFFECTIVE PAGES**

**NOTE:** The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

Original . . . . .0. . . . .15 Mar 73	Change . . . . .6..... 2 Jun 81
Change . . . . .1 . . . . .31 Jun 75	Change . . . . .7..... 20 May82
Change . . . . .2..... 1 May 77	Change . . . . .8..... 4 Apr 84
Change . . . . .3..... 30 Jun 77	Change . . . . .9..... 18 Mar 86
Change . . . . .4..... 15 Apr 78	Change . . . . .10 . . . . .19 Oct 87
Change . . . . .5..... 21 Sep 79	Change . . . . .11 . . . . .10 May 89
	Change . . . . .12 . . . . .20 Aug 91

Total number of pages in this publication is 730 consisting of the following:

Page No.	Change *No.	Page No.	Change *No.	Page No.	Change *No.
Title . . . . .	12	1 - 14A Added . . . . .	3	1 - 85 . . . . .	10
A - B . . . . .	12	1 - 14B Blank Added . . . . .	3	1 - 86 Blank . . . . .	10
C . . . . .	11	1 - 15 . . . . .	0	1 - 87 . . . . .	0
01 Blank . . . . .	8	1 - 16 . . . . .	7	1 - 88 Blank . . . . .	0
02 Blank . . . . .	8	1 - 17 - 1 - 18 . . . . .	0	1 - 89 . . . . .	0
i - ii . . . . .	4	1 - 19 . . . . .	4	1 - 90 Blank . . . . .	0
iiA Added . . . . .	4	1 - 20 - 1 - 26 . . . . .	0	1 - 91 . . . . .	8
iiB Blank Added . . . . .	4	1 - 27 . . . . .	1	1 - 92 Blank . . . . .	8
iii - vi . . . . .	3	1 - 28 - 1 - 41 . . . . .	0	1 - 93 . . . . .	8
vii - x . . . . .	0	1 - 42 . . . . .	7	1 - 94 Blank . . . . .	8
xi . . . . .	2	1 - 43 - 1 - 47 . . . . .	0	1 - 95 . . . . .	3
xii . . . . .	6	1 - 48 . . . . .	3	1 - 96 Blank . . . . .	3
xiiA Added . . . . .	4	1 - 49 - 1 - 61 . . . . .	0	1 - 97 . . . . .	8
xiiB Blank Added . . . . .	4	1 - 62 Blank . . . . .	0	1 - 98 Blank . . . . .	8
xiii - xiv . . . . .	4	1 - 63 . . . . .	1	1 - 99 . . . . .	1
xv - xvi . . . . .	3	1 - 64 Blank . . . . .	1	1 - 100 Blank . . . . .	1
xvii . . . . .	0	1 - 65 . . . . .	11	1 - 101 . . . . .	1
xviii . . . . .	2	1 - 66 Blank . . . . .	11	1 - 102 Blank . . . . .	1
xix . . . . .	3	1 - 67 . . . . .	1	1 - 103 . . . . .	0
xx Blank . . . . .	3	1 - 68 Blank . . . . .	1	1 - 104 Blank . . . . .	0
xxi - xxii Deleted . . . . .	3	1 - 69 . . . . .	3	1 - 105 . . . . .	0
1-1 . . . . .	4	1 - 70 Blank . . . . .	3	1 - 106 Blank . . . . .	0
1-2 . . . . .	3	1 - 71 . . . . .	3	1 - 107 . . . . .	0
1 - 2A - 1 - 2B . . . . .	4	1 - 72 Blank . . . . .	3	1 - 108 Blank . . . . .	0
1 - 3 - 1 - 4 . . . . .	7	1 - 73 . . . . .	3	1 - 109 . . . . .	0
1 - 5 . . . . .	10	1 - 74 Blank . . . . .	3	1 - 110 Blank . . . . .	0
1 - 6 . . . . .	7	1 - 75 . . . . .	3	1 - 111 - 1 - 114 . . . . .	0
1 - 6A . . . . .	3	1 - 76 . . . . .	0	1 - 115 . . . . .	3
1 - 6B . . . . .	7	1 - 77 . . . . .	7	1 - 116 . . . . .	1
1 - 7 - 1 - 9 . . . . .	7	1 - 78 Blank . . . . .	7	1 - 117 - 1 - 118 . . . . .	0
1 - 10 . . . . .	0	1 - 79 - 1 - 80 . . . . .	0	2 - 1 . . . . .	1
1 - 11 . . . . .	4	1 - 81 . . . . .	1	2 - 2 - 2 - 4.....	0
1 - 12 . . . . .	1	1 - 82 Blank . . . . .	1	2 - 5 - 2 - 6 . . . . .	8
1 - 13 - 1 - 14 . . . . .	3	1 - 83 - 1 - 84 . . . . .	0	2 - 7 - 2 - 8 . . . . .	3

\*Zero in this column indicates an original page

## LIST OF EFFECTIVE PAGES (Cont)

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2-8A	Added	3		6-19-6-20	3
2-8B	Blank Added	3		6-20A	Added 3
2-9	- 2-10	8		6-20B	Blank Added 3
2-11		7		6-21	
2-12		0		6-22	
2-13-	2-14	8		6-23 - 6-24	8
2-15		9		6-25 - 6-26	0
2-16		8		6-27 - 6-28	8
2-17-	2-22	0		6-29 - 6-33	0
2-23	-2-24	7		6-34	
2-25		6		6-35 - 6-37	0
2-26	- 2-28	0		6-38	
2-29		1		6-39	
2-30		0		6-40 - 6-42	0
2-31		7		6-43 - 6-45	7
2-32		0		6-46 - 6-48	10
2-33		6		6-49 - 6-50	9
2-34-	2-46	3		6-51	
2-47-	2-48	0		6-52 - 6-59	0
2-49		1		6-60	
2-50-	2-56	0		6-61 - 6-64	8
2-57-	2-58	8		6-65	
2-59-	2-64	4		6-66 - 6-68	1
2-65-	2-66	8		6-69 - 6-74	0
3-1	-3-2	0		6-75 - 6-76	8
3-3-	3-6	8		6-77 - 6-81	0
3-7	- 3-10	3		6-82 - 6-83	3
4-1	- 4-4	8		6-84	
4-5	- 4-6	1		6-85 - 6-86	3
4-7	- 4-8	8		6-87 - 6-93	8
5-1	- 5-2	8		6-94 - 6-95	11
5-3	- 5-11	0		6-96	
5-12	- 5-13	3		6-97 - 6-100	3
5-14	- 5-16	0		6-101 - 6-103	8
6-1	- 6-4	0		6- 104	Blank 8
6-5	- 6-8	8		6-105 - 6-106	3
6-9		0		6-107 - 6-109	8
6-10		1		6-110	
6-11	- 6-12	8		6-111 - 6-116	3
6-13		0		6-117 - 6-118	8
6-14		3		6-119	
6-15		0		6-120	
6-16	Blank	0		6-120A - 6-120G	3
6-17		0		6-120H	Blank 3
6-18	Blank	0		6-120I - 6-120J	8
				6-120K	
				6-120L - 6-120M	3
				6-120N	Blank 3
				6-121 - 6-124	8
				6-125 - 6-129	3
				6-130	
				6-131 - 6-135	3
				6-136	Blank 3
				6-137	
				6-138	Blank 3
				6-139 - 6-150	3
				6-151	
				6-152	Blank 8
				6-153 - 6-159	3
				6-160	Blank 3
				6-161 - 6-162	8
				6-163 - 6-174	3
				6-175 - 6-176	8
				6-177 - 6-182	3
				6-182A	
				6-182B	Blank 12
				6-183 - 6-184	8
				6-185 - 6-188	3
				6-189 - 6-220	
				Deleted	3
				7-1	
				7-2 - 7-4	0
				7-5 - 7-6	8
				7-7 - 7-8	9
				7-8A	Added 9
				7-8B	Blank Added 9
				7-9 - 7-10	0
				7-11 - 7-12	8
				7-13 - 7-14	0
				7-15 - 7-16	8
				7-17	
				7-18 - 7-20	0
				7-21 - 7-22	8
				7-23 - 7-24	0
				7-25	
				7-26	Blank 1
				8- 1 - 8-2	8
				8-3-8-4	0
				8-5-8-6	8

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8-13 - 8-14 . . . . .	8	8-119 - 8-120 . . . . .	8	14-1 - 14-8	
8-15 - 8-16 . . . . .	1	8-121 - 8-122 . . . . .	0	Deleted . . . . .	1
8-17 - 8-26 . . . . .	8	8-123 . . . . .	9	A-1 . . . . .	7
8-26A Added . . . . .	8	8-124 - 8-130 . . . . .	8	A-2 - A-3 . . . . .	0
8-26B Blank Added . . . . .	8	8-131 - 8-134 . . . . .	0	A-4 Blank . . . . .	0
8-27 - 8-28 . . . . .	8	8-135 - 8-136 . . . . .	1	I-1 - I-2 . . . . .	3
8-29 - 8-30 . . . . .	7	8-137 - 8-138 . . . . .	8	I-3 - I-5 . . . . .	0
8-31 - 8-38 . . . . .	8	8-139 - 8-140 . . . . .	0	I-6 . . . . .	3
8-39 - 8-40 . . . . .	0	8-141 - 8-144 . . . . .	8	I-7 - I-9 . . . . .	0
8-41 - 8-42 . . . . .	8	8-145 - 8-146 . . . . .	0	I-10 . . . . .	3
8-43 - 8-44 . . . . .	0	8-147 - 8-148 . . . . .	2	I-11 . . . . .	0
8-45 . . . . .	1	9-1 - 9-8 . . . . .	8	I-12 . . . . .	3
8-46 . . . . .	0	9-9 . . . . .	0	I-13 . . . . .	7
8-47 - 8-50 . . . . .	8	9-10 Blank . . . . .	0	I-14 - 1-18 . . . . .	3
8-51 . . . . .	1	9A-1 . . . . .	6	I-19 . . . . .	7
8-52 - 8-54 . . . . .	0	9A-2 Blank . . . . .	6	I-20 Blank . . . . .	7
8-55 - 8-58 . . . . .	8	10-1 - 10-2 . . . . .	8		
8-59 . . . . .	1	10-3 - 10-6 . . . . .	0		
8-60 . . . . .	0	10-7 . . . . .	7		
8-61 - 8-62 . . . . .	8	10-8 . . . . .	0		
8-63 - 8-66 . . . . .	0	11-1 - 11-2 . . . . .	8		
8-67 - 8-68 . . . . .	8	11-3 . . . . .	1		
8-69 . . . . .	9	11-4 . . . . .	0		
8-70 . . . . .	2	11-5 - 11-6 . . . . .	8		
8-71 . . . . .	0	11-7 - 11-11 . . . . .	0		
8-72 - 8-74 . . . . .	2	11-12 Blank . . . . .	0		
8-74A - 8-74B . . . . .	2	12-1 - 12-2, . . . . .	0		
8-75 - 8-76 . . . . .	8	12-3 - 12-4 . . . . .	8		
8-77 - 8-78 . . . . .	0	12-5 - 12-6, . . . . .	0		
8-79 . . . . .	6	12-7 - 12-11 . . . . .	8		
8-80 - 8-84 . . . . .	0	12-12 Blank . . . . .	8		
8-85 - 8-86 . . . . .	2	13-1 - 13-2 . . . . .	8		
8-87 - 8-88 . . . . .	0	13-3 - 13-4 . . . . .	0		
8-89 - 8-92 . . . . .	8	13-5 - 13-6 . . . . .	8		
8-93 . . . . .	0	13-7 - 13-8 . . . . .	0		
8-94 - 8-96 . . . . .	1	13-9 - 13-10 . . . . .	8		
8-97 - 8-98 . . . . .	8	13-11 . . . . .	4		
8-99 - 8-100 . . . . .	0	13-12 . . . . .	1		
8-101 - 8-106 . . . . .	8	13-13 . . . . .	4		
8-107 . . . . .	7	13-14 - 13-16 . . . . .	0		
8-108 . . . . .	0	13-17 - 13-18 . . . . .	8		
8-109 - 8-114 . . . . .	8	13-19 . . . . .	0		
8-115 - 8-117 . . . . .	1	13-20 . . . . .	1		

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CONTRACT NUMBER F04606-70-D-0192 AND F04606-78-C-0363

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**15 JUNE 1973**  
**CHANGE 11 - 10 MAY 1989**

**LIST OF EFFECTIVE PAGES**

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Change . . . . .4..... 15 Apr 78	Change . . . . .10 . . . . .19 Oct 87
Change . . . . .5..... 21 Sep 79	Change . . . . .11 . . . . .10 May 89

Total number of pages in this manual is 730 consisting of the following:

Page No.	*Change No.	Page No.	'Change No.	Page No.	l Change No.
Title . . . . .	11	1-14A Added . . . . .	3	1-83 - 1-84 . . . . .	0
A - C . . . . .	11	1-14B Blank Added . . . . .	3	1-85 . . . . .	10
01 Blank . . . . .	8	1-15 . . . . .	0	1-86 Blank . . . . .	10
02 Blank . . . . .	8	1-16 . . . . .	7	1-87 . . . . .	0
i - ii . . . . .	4	1-17 - 1-18 . . . . .	0	1-88 Blank . . . . .	0
iiA Added . . . . .	4	1-19 . . . . .	4	1-89 . . . . .	0
iiB Blank Added . . . . .	4	1-20 - 1-26 . . . . .	0	1-90 Blank . . . . .	0
iii - vi . . . . .	3	1-27 . . . . .	1	1-91 . . . . .	8
vii - x . . . . .	0	1-28 - 1-41 . . . . .	0	1-92 Blank . . . . .	8
xi . . . . .	2	1-42 . . . . .	7	1-93 . . . . .	8
xii . . . . .	6	1-43 - 1-47 . . . . .	0	1-94 Blank . . . . .	8
xiiA Added . . . . .	4	1-48 . . . . .	3	1-95 . . . . .	3
xiiB Blank Added . . . . .	4	1-49 - 1-61 . . . . .	0	1-96 Blank . . . . .	3
xiii - xiv . . . . .	4	1-62 Blank . . . . .	0	1-97 . . . . .	8
xv - xvi . . . . .	3	1-63 . . . . .	1	1-98 Blank . . . . .	8
xvii . . . . .	0	1-64 Blank . . . . .	1	1-99 . . . . .	1
xviii . . . . .	2	1-65 . . . . .	11	1-100 Blank . . . . .	1
xix . . . . .	3	1-66 Blank . . . . .	11	1-101 . . . . .	1
xx Blank . . . . .	3	1-67 . . . . .	1	1-102 Blank . . . . .	1
xxi - xxii Deleted . . . . .	3	1-68 Blank . . . . .	1	1-103 . . . . .	0
1-1 . . . . .	4	1-69 . . . . .	3	1-104 Blank . . . . .	0
1-2 . . . . .	3	1-60 Blank . . . . .	3	1-105 . . . . .	0
1-2A - 1-2B . . . . .	4	1-71 . . . . .	3	1-106 Blank . . . . .	0
1-3 - 1-4 . . . . .	7	1-72 Blank . . . . .	3	1-107 . . . . .	0
1-5 . . . . .	10	1-73 . . . . .	3	1-108 Blank . . . . .	0
1-6 . . . . .	7	1-74 Blank . . . . .	3	1-109 . . . . .	0
1-6A . . . . .	3	1-75 . . . . .	3	1-110 Blank . . . . .	0
1-6B . . . . .	7	1-76 . . . . .	0	1-111 - 1-114 . . . . .	0
1-7 - 1-9 . . . . .	7	1-77 . . . . .	7	1-115 . . . . .	3
1-10 . . . . .	0	1-78 Blank . . . . .	7	1-116 . . . . .	1
1-11 . . . . .	4	1-79 - 1-80 . . . . .	0	1-117 - 1-118 . . . . .	0
1-12 . . . . .	1	1-81 . . . . .	1	2-1 . . . . .	1
1-13 - 1-14 . . . . .	3	1-82 Blank . . . . .	1	2-2 - 2-4 . . . . .	0

\*Zero in this column indicates an original page.



## LIST OF EFFECTIVE PAGES (Cont)

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2-7 - 2-8	3	6-18 Blank	0	6-120K	10
2-8 A Added	3	6-19 - 6-20	3	6-120L - 6-120M	3
2-8B Blank Added	3	6-20A Added	3	6-120N Blank	3
2-9 - 2-10	8	6-20B Blank Added	3	6-121 - 6-124	8
2-11	7	6-21	3	6-125 - 6-129	3
2-12	0	6-22	0	6-130	11
2-13 - 2-14	8	6-23 - 6-24	8	6-131 - 6-135	3
2-15	9	6-25 - 6-26	0	6-136 Blank	3
2-16	8	6-27 - 6-28	8	6-137	3
2-17 - 2-22	0	6-29 - 6-33	0	6-138 Blank	3
2-23 - 2-24	7	6-34	4	6-139 - 60-150	3
2-25	6	6-35 - 6-37	0	6-151	8
2-26 - 2-28	0	6-38	4	6-152 Blank	8
2-29	1	6-39	1	6-153 - 6-159	3
2-30	0	6-40 - 6-42	0	6-160 Blank	3
2-31	7	6-43 - 6-45	7	6-161 - 6-162	8
2-32	0	6-46 - 6-48	10	6-163 - 6-174	3
2-33	6	6-49 - 6-50	9	6-175 - 6-176	8
2-34 - 2-46	3	6-51	1	6-177 - 6-182	3
2-47 - 2-48	0	6-52 - 6-59	0	6-182A	9
2-49	1	6-60	9	6-182B Blank	9
2-50 - 2-56	0	6-61 - 6-64	8	6-183 - 6-184	8
2-57 - 2-58	8	6-65	0	6-185 - 6-188	3
2-59 - 2-64	4	6-66 - 6-68	1	6-189 - 6-220	
2-65 - 2-66	8	6-69 - 6-74	0	Deleted	3
3-1 - 3-2	0	6-75 - 6-76	8	7-1	7
3-3 - 3-6	8	6-77 - 6-81	0	7-2 - 7-4	0
3-7 - 3-10	3	6-82 - 6-83	3	7-5 - 7-6	8
4-1 - 4-4	8	6-84	7	7-7 - 7-8	9
4-5 - 4-6	1	6-85 - 6-86	3	7-8A Added	9
4-7 - 4-8	8	6-87 - 6-93	8	7-8B Blank Added	9
5-1 - 5-2	8	6-94 - 6-95	11	7-9 - 7-10	0
5-3 - 5-11	0	6-96	8	7-11 - 7-12	8
5-12 - 5-13	3	6-97 - 6-100	3	7-13 - 7-14	0
5-14 - 5-16	0	6-101- 6-103	8	7-15 - 7-16	8
6-1 - 6-4	0	6-104 Blank	8	7-17	7
6-5 - 6-8	8	6-105 - 6-106	3	7-18 - 7-20	0
6-9	0	6-107 - 6-109	8	7-21 - 7-22	8
6-10	1	6-110	9	7-23 - 7-24	0
6-11 - 6-12	8	6-111 - 6-116	3	7-25	1
6-13	0	6-117 - 6-118	8	7-26 Blank	1
6-14	3	6-119	3	8-1 - 8-2	8
6-15	0	6-120	9	8-3 - 8-4	0
6-16 Blank	0	6-120A - 6-120G	3	8-5 - 8-6	8
		6-120H Blank	3		

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8-7 - 8-12	0	8-118	0	13-21 - 13-22	8
8- 13 - 8-14	8	8-119 - 8-120	8	14-1 - 14-8	
8-15 - 8-16	1	8-121 - 8-122	0	Deleted	1
8-17 - 8-26	8	8-123	9	A-1	7
8-26A Added	8	8-124 - 8-130	8	A-2 - A-3	0
8-26B Blank Added	8	8-131 - 8-134	0	A-4 Blank	0
8-27 - 8-28	8	8-135 - 8-136	1	I-1 - I-2	3
8-29 - 8-30	7	8-137 - 8-138	8	I-3 - I-5	0
8-31 - 8-38	8	8-139 - 8-140	0	I-6	3
8-39 - 8-40	0	8-141 - 8-144	8	I-7 - I-9	0
8-41 - 8-42	8	8-145 - 8-146	0	I-10	3
8-43 - 8-44	0	8-147 - 8-148	2	I- 11	0
8-45	1	9-1 - 9-8	8	I- 12	3
8-46	0	9-9	0	I-13	7
8-47 - 8-50	8	9-10 Blank	0	I-14 - 1-18	3
8-51	1	9A-1	6	I-19	7
8-52 - 8-54	0	9A-2 Blank	6	I-20 Blank	7
8-55 - 8-58	8	10-1 - 10-2	8		
8-59	1	10-3 - 10-6	0		
8-60	0	10-7	7		
8-61 - 8-62	8	10-8	0		
8-63 - 8-66	0	11-1 - 11-2	8		
8-67 - 8-68	8	11-3	1		
8-69	9	11 -4	0		
8-70	2	11-5 - 11-6	8		
8-71	0	11-7 - 11-11	0		
8-72 - 8-74	2	11-12 Blank.	0		
8-74A - 8-74B	2	12-1 - 12-2	0		
8-75 - 8-76	8	12-3 - 12-4	8		
8-77 - 8-78	0	12-5 - 12-6	0		
8-79	6	12-7 - 12-11	8		
8-80 - 8-84	0	12-12 Blank	8		
8-85 - 8-86	2	13-1 - 13-2	8		
8-87 - 8-88	0	13-3- 13-4	0		
8-89 - 8-92	8	13-5 - 13-6	8		
8-93	0	13-7 - 13-8	0		
8-94 - 8-96	1	13-9- 13-10	8		
8-97 - 8-98	8	13-11	4		
8-99 - 8-100	0	13-12	1		
8-101 - 8-106	8	13-13	4		
8-107	7	13-14 - 13-16	0		
8- 108	0	13-17 - 13-18	8		
8-109 - 8-114	8	13-19	0		
8-115 - 8-117	1	13-20	1		

## TECHNICAL MANUAL

INTERMEDIATE (FIELD)  
(DIRECT AND GENERAL SUPPORT)  
AND DEPOT LEVEL MAINTENANCE

# GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL SKID MTD., 100 KW, 3 PHASE, 4 WIRE, 120/208 AND 240/416 VOLTS

DOD MODELS	CLASS	HERTZ	FSN
MEP007A	UTILITY	50/60	6115-00-133-9101
MEP106A	PRECISE	50/60	6115-00-133-9102
MEP116A	PRECISE	400	6115-00-133-9103

### INCLUDING OPTIONAL KITS

DOD MODELS	NOMENCLATURE	NSN
MEP007AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9082
MEP007AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9084
MEP007AWM	WHEEL MOUNTING KIT	6115-00-463-9089

CONSOLIDATED DIESEL ELECTRIC COMPANY

CONTRACT NUMBER F04606-70-D-0192 AND F04606-78-C-0363

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15 JUNE 1973

Change 10 – 19 OCTOBER 1987

# LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by

Dates of issue for original and changed pages are:

Original .....0 ..... 15 Mar 73	Change .....4 ..... 15 Apr 78	Change .....8 .....4 Apr 84
Change .....1 .....31 Jun 75	Change .....5 .....21 Sep 79	Change .....9 ..... 18 Mar 86
Change .....2 ..... 1 May 77	Change .....6 .....2 Jun 81	Change .....10 .....19 Oct 87
Change .....3 .....30 Jun 77	Change .....7 .....20 May 82	

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 30 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
Title .....	10	1-27 .....	1	1-97 .....	8
A - C .....	10	1-28-1-41 .....	0	1-98 Blank .....	8
01 Blank .....	8	1-42 .....	7	1-99 .....	1
02 Blank .....	8	1-43-1-47 .....	0	1-100 Blank .....	1
i - ii .....	4	1-48 .....	3	1-101 .....	1
iiA Added .....	4	1-49-1-61 .....	0	1-102 Blank .....	1
iiB Blank Added .....	4	1-62 Blank .....	0	1-103 .....	0
iii - vi .....	3	1-63 .....	1	1-104 Blank .....	0
vii - x .....	0	1-64 Blank .....	1	1-105 .....	0
xi .....	2	1-65 .....	3	1-106 Blank .....	0
xii .....	6	1-66 Blank .....	3	1-107 .....	0
xiiA Added .....	4	1-67 .....	1	1-108 Blank .....	0
xiiB Blank Added .....	4	1-68 Blank .....	1	1-109 .....	0
xiii - xiv .....	4	1-69 .....	3	1-110 Blank .....	0
xv - xvi .....	3	1-70 Blank .....	3	1-111-1-114 .....	0
xvii .....	0	1-71 .....	3	1-115 .....	3
xviii .....	2	1-72 Blank .....	3	1-116 .....	1
xix .....	3	1-73 .....	3	1-117- 1-118 .....	0
xx Blank .....	3	1-74 Blank .....	3	2-1 .....	1
xxi - xxii Deleted .....	3	1-75 .....	3	2-2- 2-4 .....	0
1-1 .....	4	1-76 .....	0	2-5- 2-6 .....	8
1-2 .....	3	1-77 .....	7	2-7- 2-8 .....	3
1-2A - 1-2B .....	4	1-78 Blank .....	7	2-8A Added .....	3
1-3-1-4 .....	7	1-79- 1-80 .....	0	2-8B Blank Added .....	3
1-5 .....	10	1-81 .....	1	2-9- 2-10 .....	8
1-6 .....	7	1-82 Blank .....	1	2-11 .....	7
1-6A .....	3	1-83-1-84 .....	0	2-12 .....	0
1-6B-1-9 .....	7	1-85 .....	10	2-13-2-14 .....	8
1-10 .....	0	1-86 Blank .....	1	2-15 .....	9
1-11 .....	4	1-87 .....	0	2-16 .....	8
1-12 .....	1	1-88 Blank .....	0	2-17-2-22 .....	0
1-13-1-14 .....	3	1-89 .....	0	2-23-2-24 .....	7
1-14A Added .....	3	1-90 Blank .....	0	2-25 .....	6
1-14B Blank Added .....	3	1-91 .....	8	2-26-2-28 .....	0
1-15 .....	0	1-92 Blank .....	8	2-29 .....	1
1-16 .....	7	1-93 .....	8	2-30 .....	0
1-17- 1-18 .....	0	1-94 Blank .....	8	2-31 .....	7
1-19 .....	4	1-95 .....	3	2-32 .....	0
1-20- 1-26 .....	0	1-96 Blank .....	3	2-33 .....	6

"Zero in this column indicates an original page

**LIST OF EFFECTIVE PAGES (cont)**

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2-47- 2-48	0	6-75- 6-76	8	7-17	7
2-49	1	6-77-6-81	0	7-18- 7-20	0
2-50- 2-56	0	6-82-6-83	3	7-21- 7-22	8
2-57-2-58	8	6-84	7	7-23-7-24	0
2-59- 2-64	4	6-85- 6-86	3	7-25	1
2-65- 2-66	8	6-87- 6-96	8	7-26 Blank	1
3-1- 3-2	0	6-97- 6-100	3	8-1- 8-2	8
3-3- 3-6	8	6-101- 6-103	8	8-3- 8-4	0
3-7- 3-10	3	6-104 Blank	8	8-5- 8-6	8
4-1- 4-4	8	6-105- 6-106	3	8-7- 8-12	0
4-5- 4-6	1	6-107- 6-109	8	8-13- 8-14	8
4-7- 4-8	8	6-110	9	8-15- 8-16	1
5-1- 5-2	8	6-111- 6-116	3	8-17- 8-26	8
5-3-5-11	0	6-117- 6-118	8	8-26A Added	8
5-12- 5-13,	3	6-119	3	8-26B Blank Added	8
5-14- 5-16	0	6-120	9	8-27- 8-28	8
6-1- 6-4	0	6-120A - 6-120G	3	8-29- 8-30	7
6-5- 6-8	8	6-120H Blank	3	8-31-8-38	8
6-9	0	6-120I- 6-120J	8	8-39- 8-40	0
6-10	1	6-120K	10	8-41- 8-42	8
6-11- 6-12	8	6-120L - 6-120M	3	8-43-8-44	0
6-13	0	6-120N Blank	3	8-45	1
6-14	3	6-121- 6-124	8	8-46	0
6-15	0	6-125- 6-135	3	8-47- 8-50	8
6-16 Blank	0	6-136 Blank	3	8-51	1
6-17	0	6-137	3	8-52-8-54	0
6-18 Blank	0	6-138 Blank	3	8-55-8-58	8
6-19- 6-20	3	6-139- 6-150	3	8-59	1
6-20A Added	3	6-151	8	8-60	0
6-20B Blank Added	3	6-152 Blank	8	8-61-8-62	8
6-21	3	6-153- 6-159	3	8-67-8-66	0
6-22	0	6-160 Blank	3	8-67-8-68	8
6-23- 6-24	8	6-161- 6-162	8	8-69	9
6-25- 6-26	0	6-163- 6-174	3	8-70	2
6-27- 6-28	8	6-175- 6-176	8	8-71	0
6-29-6-33	0	6-177- 6-182	3	8-72-8-74	2
6-34	4	6-182A	9	8-74A - 8-74B	2
6-35-6-37	0	6-182B Blank	9	8-75-8-76	8
6-38	4	6-183- 6-184,	8	8-77-8-78	0
6-39	1	6-185-6-188	3	8-79	6
6-40- 6-42,	0	6-189-6-220 Deleted	3	8-80 - 8-84	0
6-43- 6-45	7	7-1	7	8-85-8-86	2
6-46- 6-48	10	7-2- 7-4	0	8-87-8-88	0
6-49- 6-50,	9	7-5- 7-6	8	8-89-8-92	8
6-51	1	7-7-7-8	9	8-93	0
6-52- 6-59	0	7-8A Added	9	8-94-8-96	1
6-60	9	7-8B Blank Added	9	8-97-8-98	8
6-61-6-64	8	7-9- 7-10	0	8-99-8-100	0
6-65	0	7-11 - 7-12	8	8-101-8-106	8
6-66- 6-68	1	7-13-7-14	0	8-107	7

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8-109-8-114	.....8	10-7	.....7	13-14-13-16	.....0
8-115-8-117	.....1	10-8	.....0	13-17-13-18	.....8
8-118	.....0	11-1 -11-2	.....8	13-19	.....0
8-119-8-120	.....8	11-3	.....1	13-20	.....1
8-121-8-122	.....0	11-4	.....0	13-21-13-22	.....8
8-123	.....9	11-5 -11-6	.....8	14-1 - 14-8 Deleted	.....1
8-124-8-130	.....8	11-7-11-11	.....0	A-1	.....7
8-131-8-134	.....0	11-12 Blank	.....0	A-2 - A-3	.....0
8-135-8-136	.....1	12-1 -12-2	.....0	A-4 Blank	.....0
8-137 -8-138	.....8	12-3 -12-4	.....8	I-1 - I-2	.....3
8-139 -8-140	.....0	12-5 -12-6	.....0	I-3 - I-5	.....0
8-141-8-144	.....8	12-7-12-11	.....8	I-6	.....3
8-145-8-146	.....0	12-12 Blank	.....8	I-7 - I-9	.....0
8-147-8-148	.....2	13-1 -13-2	.....8	I-10	.....3
9-1 -9-8	.....8	13-3 -13-4	.....0	I-11	.....0
9-9	.....0	13-5 -13-6	.....8	I-12	.....3
9-10 Blank	.....0	13-7 -13-8	.....0	I-13	.....7
9A-1	.....6	13-9-13-10	.....8	I-14 - I-18	.....3
9A-2 Blank	.....6	13-11	.....4	I-19	.....7
10-1 -10-2	.....8	13-12	.....1	I-20 Blank	.....7

AIR FORCE TO 35C2-3-442-2  
ARMY TM5-6115-457-34  
NAVY NAVFAC P-8-627-34  
MARINE CORPS TM-07464A-35

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TECHNICAL MANUAL  
INTERMEDIATE (FIELD)  
(DIRECT AND GENERAL SUPPORT)  
AND DEPOT LEVEL MAINTENANCE

GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL  
SKID MTD. , 100 KW, 3 PHASE, 4 WIRE, 120/208 AND  
240/416 VOLTS

**DOD MODELS**  
MEP007A  
MEP106A  
MEP116A

**CLASS**  
UTILITY  
PRECISE  
PRECISE

**HERTZ**  
50/60  
50/60  
400

**FSN**  
6115-00-133-9101  
6115-00-133-9102  
6115-00-133-9103

**INCLUDING OPTIONAL KITS**

**DOD MODELS**  
MEP007AWF  
MEP007AWE  
MEP007ALM  
MEP007AWM

**NOMENCLATURE**  
WINTERIZATION KIT, FUEL BURNING  
WINTERIZATION KIT, ELECTRIC  
DUMMY LOAD KIT  
WHEEL MOUNTING KIT

**NSN**  
6115-00-463-9082  
6115-00-463-9084  
611540-463-9086  
6115-00-463-9089

CONSOLIDATED DIESEL ELECTRIC COMPANY  
CONTRACT NUMBER FO4606-70-D-0192 AND FO4606-78-C-0363

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**15 JUNE 1973**  
**CHANGE 9 - 18 MARCH 1986**

**LIST OF EFFECTIVE PAGES**

**INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.**

**NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.**

Dates of issue for original and changed pages are:

Original. .0. .15 Mar 73	Change. .4. .15 Apr 78	Change. .8. . 4 Apr 84
Change. . . .1. .31 Jun 75	Change. .5. .21 Sep 79	Change. .9. .18 Mar 86
Change. . . .2. . 1 May 77	Change. .6. . 2 Jun 81	
Change. . . .3. .30 Jun 77	Change. .7. .20 May 82	

**TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 724 CONSISTING OF THE FOLLOWING:**

Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
Title . . . . .	9	1 - 15 . . . . .	0	1-85 . . . . .	1
A - C . . . . .	9	1-16. . . . .	7	1-86. . . . .	1
01 . . . . .	8	1-17 - 1-18 . . . . .	0	1-87 . . . . .	0
02 Blank . . . . .	8	1-19 . . . . .	4	1-88 Blank . . . . .	0
i - i i . . . . .	4	1-20 - 1-26 . . . . .	0	1-89. . . . .	0
iiA Added . . . . .	4	1-27. . . . .	1	1-90 Blank . . . . .	0
iiB Blank Added . . . . .	4	1-28 - 1-41. . . . .	0	1-91 . . . . .	8
i i i - v i . . . . .	3	1-42. . . . .	7	1-92 Blank. . . . .	8
v i i - x . . . . .	0	1-43 - 147 . . . . .	0	1-93. . . . .	8
x i . . . . .	2	1-48 . . . . .	3	1-94 Blank . . . . .	8
xii . . . . .	6	1-49 - 1-61 . . . . .	0	1-95 . . . . .	3
xiiA Added . . . . .	4	1-62 Blank . . . . .	0	1-96 Blank . . . . .	3
xiiB Blank Added. . . . .	4	1-63 . . . . .	1	1-97 . . . . .	8
xiii - xiv . . . . .	4	1-64 Blank . . . . .	1	1-98 Blank . . . . .	8
xv - xvi. . . . .	3	1-65 . . . . .	3	1-99. . . . .	1
xvii . . . . .	0	1-66 Blank . . . . .	3	1-100 Blank. . . . .	1
xviii . . . . .	2	1-67 . . . . .	1	1-101 . . . . .	1
xix. . . . .	3	1-68 Blank . . . . .	1	1-102 Blank . . . . .	1
xx Blank . . . . .	3	149 . . . . .	3	1-103 . . . . .	0
xxi - xxii Deleted. . . . .	3	1-70 Blank. . . . .	3	1-104 Blank . . . . .	0
1-1 . . . . .	4	1-71 . . . . .	3	1-105 . . . . .	0
1-2 . . . . .	3	1-72 Blank . . . . .	3	1-106 Blank. . . . .	0
1-2A - 1-28 . . . . .	4	1-73. . . . .	3	1-107 . . . . .	0
1-3 - 1-6 . . . . .	7	1-74 Blank. . . . .	3	1-108 Blank. . . . .	0
1-6A. . . . .	3	1-75 . . . . .	3	1-109 . . . . .	0
1-6B - 1-9 . . . . .	7	1-76 . . . . .	0	1-110Blank . . . . .	0
1-10 . . . . .	0	1-77 . . . . .	7	1-111 - 1-114..000. . . . .	0
1-11 . . . . .	4	1-78 Blank . . . . .	7	1-115 . . . . .	3
1-12 . . . . .	1	1-79 - 1-80 . . . . .	0	1-116 . . . . .	1
1-13 - 1-14.0 . . . . .	3	1-81 . . . . .	1	1-117 - 1-118.0000. . . . .	0
1-14A Added . . . . .	3	1-82 Blank . . . . .	1	2-1 . . . . .	1
1-14B Blank Added. . . . .	3	1-83 - 1-84 . . . . .	0	2 - 2 - 2 - 4 . . . . .	0

\*Zero in this column indicates 1 original page.

USAF



**LIST OF EFFECTIVE PAGES (cont)**

Page No.	l Change No.	Page No.	*Change No.	Page No.	*Change No.
2-5 - 2-6	8	6-23 - 6-24	8	6-138 Blank	3
2-7 - 2-8	3	6-25 - 6-26	0	6-139 - 6-150	3
2-8A Added	3	6-27 - 6-28	8	6-151	8
2-8B Blank Added	3	6-29 - 6-33	0	6-152 Blank	8
2-9 - 2-10	8	6-34	4	6-153 - 6-159	3
2-11	7	6-35 - 6-37	0	6-160 Blank	3
2-12	0	6-38	4	6-161 - 6-162	8
2-13 - 2-14	8	6-39	1	6-163 - 6-174	3
2-15	9	640 - 642	0	6-175 - 6-176	8
2-16	8	643 - 645	7	6-177 - 6-182	3
2-17 - 2-22	0	646	0	6-182A	9
2-23 - 2-24	7	647 - 648.0.0000	7	6-182B Blank	9
2-25	6	6-49 - 6-50	9	6-183 - 6-184	8
2-26 - 2-28	0	6-51	1	6-185 - 6-188	3
2-29	1	6-52 - 6-59	0	6-189 - 6-220	
2-30	0	6-60	9	Deleted	3
2-31	7	6-61 - 6-64	8	7-1	7
2-32	0	6-65	0	7-2 - 7-4	0
2-33	6	6-66 - 6-68	1	7-5 - 7-6	8
2-34 - 2-46	3	6-69 - 6-74	0	7-7 - 7-8	9
2-47 - 2-48	0	6-75 - 6-76	8	7-8A Added	9
2-49	1	6-77 - 6-81	0	7-8B Blank Added	9
2-50 - 2-56	0	6-82 - 6-83	3	7-9 - 7-10	0
2-57 - 2-58	8	6-84	7	7-11 - 7-12	8
2-59 - 2-64	4	6-85 - 6-860.0	3	7-13 - 7-14	0
2-65 - 2-66	8	6-87 - 6-96	8	7-15 - 7-16	8
3-1 - 3-2	0	6-97 - 6-100	3	7-17	7
3-3 - 3-6	8	6-101 - 6-103	8	7-18 - 7-20	0
3-7- 3-10	3	6-104 Blank	8	7-21 - 7-22	8
4-1 - 4-4	8	6-105 - 6-106	3	7-23 - 7-24	0
4-5 - 4-6	1	6-107 - 6-109	8	7-25	1
4-7 - 4-8	8	6-110	9	7-26 Blank	1
5-1 - 5-2	8	6-111 - 6-116	3	8-1 - 8-2	8
5-3 - 5-11	0	6-117 - 6-1180	8	8-3 - 84	0
5-12 - 5-13	3	6-119	3	8-5 - 8-6	8
5-14 - 5-16	0	6-120	9	8-7 - 8-12	0
6-1 - 6-40	0	6-120 - 6-120G	3	8-13 - 8-14	8
6-5 - 6-8	8	6-120H Blank	3	8-15 - 8-16	1
6-9	0	6-1201 - 6-120J	8	8-17 - 8-26	8
6-10	1	6-120K- 6-120M	3	8-26A Added	8
6-11 - 6-12	8	6-10N Blank	3	8-26B Blank Added	8
6-13	0	6-121 - 6-124	8	8-27 - 8-28	8
6-14	3	6-125 - 6-130	3	8-29 - 8-30	7
6-15	0	6-130A - 6-130D		8-31 - 8-38	8
6-16 Blanke	0	Deleted	3	8-39 - 840	0
6-17	0	6-131 - 6-132C		841 - 842	8
6-18 Blank	0	Deleted	3	843-844	0
6-19 - 6-20	3	6-132D Blank		845	1
6-20A Added	3	Deleted	3	8-46	0
6-208 Blank Added	3	6-133 - 6-135	3	847 - 8-50	8
6-21	3	6-136 Blank	3	8-51	1
6-22	0	6-137	3	8-52 - 8-54	0

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8-59	1	8-124 - 8-130	8	13-5 - 13-6	8
8-60	0	8-131 - 8-134	0	13-7 - 13-8	0
8-61 - 8-62	8	8-135 - 8-136	1	13-9 - 13-10	8
8-63 - 8-66	0	8-137 - 8-138	8	13-11	4
8-67 - 8-68	8	8-139 - 8-140	0	13-12	1
8-69	9	8-141 - 8-144	8	13-13	4
8-70	2	8-145 - 8-146	0	13-14 - 13-16	0
8-71	0	8-147 - 8-148	2	13-17 - 13-18	8
8-72 - 8-74	2	9-1 - 9-8	8	13-19	0
8-74A - 8-74B	2	9-9	0	13-20	1
8-75 - 8-76	8	9-10 Blank	0	13-21 - 13-22	8
8-77 - 8-78	0	9A-1	6	14-1 - 14-8	
8-79	6	9A-2 Blade	6	Deleted	1
8-80 - 8-84	0	10-1 - 10-2	8	A-1	7
8-85 - 8-86	2	10-3 - 10-6	0	A-2 - A-3	0
8-87 - 8-88	0	10-7	7	A-4 Blank	0
8-89 - 8-92	8	10-8	0	I-1 - I-2	3
8-93	0	11-1 - 11-2	8	I-3 - I-5	0
8-94 - 8-96	1	11-3	1	I-6	3
8-97 - 8-98	8	11-4	0	I-7 - I-9	0
8-99 - 8-100	0	11-5 - 11-6	8	I-10	3
8-101 - 8-106	8	11-7 - 11-11	0	I-11	0
8-107	7	11-12 Blank	0	I-12	3
8-108	0	12-1 - 12-2	0	I-13	7
8-109 - 8-114	8	12-3 - 12-4	8	I-14 - I-18	3
8-115 - 8-117	1	12-5 - 12-6	0	I-19	7
8-118	0	12-7 - 12-11	8	I-20 Blank	7
8-119 - 8-120	8	12-12 Blank	8		
8-121 - 8-122	0	13-1 - 13-2	8		

AIR FORCE TO 35C2-3-442-2  
ARMY TM5-6115-457-34  
NAVY NAVFAC P-8-627-34  
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MEP007A	UTILITY	50/60	6115-00-133-9101
MEP106A	PRECISE	50/60	6115-00-133-9102
MEP116A	PRECISE	400	6115-00-133-9103

INCLUDING OPTIONAL KITS

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MEP007AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9082
MEP007AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9084
MEP007ALM	DUMMY LOAD KIT	6115-00-463-9086
MEP007AWM	WHEEL MOUNTING KIT	6115-00-463-9089

Consolidated Diesel Electric Company  
Contract Number FO4606.70.D.0192 and FO4606-78-C.-0363  
This publication incorporates PCN numbers 1 through 1302 and 1318

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15 JUNE 1973  
CHANGE 8 - 4 APRIL 1984

**LIST OF EFFECTIVE PAGES**

**INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.**

**NOTE:** The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature

Dates of issue for original and changed pages are:

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Title .....	8	1-17 - 1-18 .....	0	1-87 .....	0
A - C .....	8	1-19 .....	4	1-88 Blank .....	0
i - ii .....	4	1-20- 1-26 .....	0	1-89 .....	0
iiA Added .....	4	1-27 .....	1	1-90 Blank .....	0
iiB Blank Added .....	4	1-28 - 1-41 .....	0	1-91 .....	8
iii - vi .....	3	1-42 .....	7	1-92 Blank .....	8
vii - x .....	0	1-43- 1-47 .....	0	1-93 .....	8
xi .....	2	1-48 .....	3	1-94 Blank .....	8
xii .....	6	1-49- 1-61 .....	0	1-95 .....	3
xiiA Added .....	4	1-62 Blank .....	0	1-96 Blank .....	3
xiiB Blank Added..	4	1-63 .....	1	1-97 .....	8
xiii - xiv .....	4	1-64 Blank .....	1	1-98 Blank .....	8
xv - xvi .....	3	1-65 .....	3	1-99 .....	1
xvii .....	0	1-66 Blank .....	3	1-100 Blank .....	1
xviii .....	2	1-67 .....	1	1-101 .....	1
xix .....	3	1-68 Blank .....	1	1-102 Blank .....	1
xx Blank .....	3	1-69 .....	3	1-103 .....	0
xxi - xxii Deleted.	3	1-70 Blank .....	3	1-104 Blank .....	0
1-1 .....	4	1-71 .....	3	1-105 .....	0
1-2 .....	3	1-72 Blank .....	3	1-106 Blank .....	0
1-2A - 1-2B .....	4	1-73 .....	3	1-107 .....	0
1-3 - 1-6 .....	7	1-74 Blank .....	3	1-108 Blank .....	0
1-6A .....	3	1-75 .....	3	1-109 .....	0
1-6B - 1-9 .....	7	1-76 .....	0	1-110 Blank .....	0
1-10 .....	0	1-77 .....	7	1-111 - 1-114 .....	0
1-11 .....	4	1-78 Blank .....	7	1-115 .....	3
1-12 .....	1	1-79- 1-80 .....	0	1-116 . . . . .	1
1-13- 1-14 .....	3	1-81 . . . . .	1	1-117 - 1-118 .....	0
1-14A Added .....	3	1-82 Blank .....	1	2-1 .....	1
1-14B Blank Added..	3	1-83 - 1-84 .....	0	2-2 - 2-4 .....	0
1-15 .....	0	1-85 .....	1	2-5 - 2-6 .....	8
1-16 .....	7	1-86 Blank .....	1	2-7 - 2-8 .....	3

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2-8B Blank Added	3	6-34	4	6-160 Blank	3
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2 - 1 1	7	6-38	4	6-163 - 6-174	3
2-12	0	6-390	1	6-175 - 6-176	8
2-13 - 2-16	8	6-40 - 6-42	0	6-177 - 6-182	3
2-17 -2-22	0	6-43 - 6-45	7	6-182A	8
2-23 - 2-24	7	6-46	0	6-182B Blank	8
2-25	6	6-47 - 6-48	7	6-183 - 6-184	8
2-26 - 2-28	0	6-49 - 6-50	8	6-185- 6-219	3
2-29	1	6-51	1	6-220 Deleted	3
2-30	0	6-52 - 6-59	0	7-1	7
2-31	7	6-60	1	7-2 - 7-4	0
2-32	0	6-61 - 6-64	8	7-5 - 7-8	8
2-33	6	6-65	0	7-9 - 7-10	0
2-34 - 2-46	3	6-66-6-68	1	7-11 - 7-12	8
2-47 - 2-48	0	6-69 - 6-74	0	7-13 - 7-140	0
2-49	1	6-75 - 6-76	8	7-15- 7-16	8
2-50 - 2-56	0	6-77 - 6-81	0	7-17	7
2-57 - 2-58	8	6-82 - 6-83	3	7-18 - 7-20	0
2-59 - 2-64	4	6-84	7	7-21 - 7-22	8
2-65 - 2-66	8	6-85 - 6-86	3	7-23 - 7-24	0
3-1 - 3-2	0	6-87 - 6-96	8	7-25	1
3-3 - 3-6	8	6-97 - 6-100	3	7-26 Blank	1
3-7 - 3-10	3	6-101 - 6-103	8	8-1 - 8-2	8
4-1 - 4-4	8	6-104 Blank	8	8-3 - 8-4	0
4-5 - 4-6	1	6-105 - 6-106	3	8-5 - 8-6	8
4-7 - 4-8	8	6-107 - 6-110	8	8-7 - 8-12	0
5-1 - 5-2	8	6-111 - 6-116	3	8-13 - 8-14	8
5-3 - 5-110	0	6-117 - 6-118	8	8-15 - 8-16	1
5-12 - 5-13	3	6-119 - 6-120	3	8-17 - 8-26	8
5-14 - 5-16	0	6-120A - 6-120G	3	8-26A Added	8
6-1 - 6-4	0	6-120H Blank	3	8-26B Blank Added	8
6-5 - 6-8	8	6-120I- 6-120J	8	8-27 - 8-28	8
6-9	0	6-120K - 6-120M	3	8-29 -8-30	7
6-10	1	6-120N Blank	3	8-31 - 8-38	8
6-11 - 6-12	8	6-121 - 6-124	8	8-39 - 8-40	0
6-13	0	6-125 - 6-130	3	8-41 - 8-42	8
6-14	3	6-130A - 6-130D		8-43 - 8-44	0
6-15	0	Deleted	3	8-45	1
6-16 Blank	0	6-131 - 6-132C		8-46	0
6-17	0	Deleted	3	8-47 - 8-50	8
6-18 Blank	0	6-132D Blank		8-51	1
6-19 - 6-20	3	Deleted	3	8-52 - 8-54	0
6-20A Added	3	6-133 - 6-135	3	8-55 - 8-58	8
6-20B Blank Added	3	6-136 Blank	3	8-59	1
6-21	3	6-137	3	8-60	0
6-22	0	6-138 Blank	3	8-61 - 8-62	8
6-23 - 6-24	8	6-139 - 6-150	3	8-63 - 8-66	0
6-25 - 6-26	0	6-151	8	8-67 - 8-68	8
6-27 - 6-28	8	6-152 Blank	8	8-69	0

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8-72 - 8-74	2	8-145 - 8-146	0	13-13	4
8-74A - 8-74B	2	8-147 - 8-148	2	13-14 - 13-16	0
8-75 - 8-76	8	9-1 - 9-8	8	13-17 - 13-18	8
8-77 - 8-78	0	9 - 9	0	13-19	0
8-79	6	9-10 Blank	0	13-20	1
8-80 - 8-84	0	10-1 - 10-2	8	13-21 - 13-22	8
8-85 - 8-86	2	10-3 - 10-6	0	14-1 - 14-8	
8-87 - 8-88	0	10-7	7	Deleted	1
8-89 - 8-92	8	10-8	0	A-1	7
8-93	0	11-1 - 11-2	8	A-2 - A-3	0
8-94 - 8-96	1	11-3	1	A-4 Blank	0
8-97 - 8-98	8	11-4	0	I-1 - I-2	3
8-99 - 8-100	0	11-5 - 11-6	8	I-3 - 1-5	0
8-101 - 8-106	8	11-7 - 11-110	0	I-6	3
8-107	7	11-12 Blank	0	I-7 - 1-9...	0
8-108	0	12-1 - 12-2	0	I-10	3
8-109 - 8-114	8	12-3- 12-4	8	I-11	0
8-115 - 8-117	1	12-5 - 12-6	0	I-12	3
8 - 118	0	12-7 - 12-11	8	I-13	7
8-119 - 8-120	8	12-12 Blank	8	I-14 - 1-18	3
8-121 - 8-122	0	13-1- 13-2	8	I-19	7
8-123 - 8-130	8	13-3 - 13-4	0	I-20 Blank	7
8-131 - 8-134	0	13-5- 13-6	8		
8-135 - 8-136	1	13-7 - 13-8	0		
8-137 - 8-138	8	13-9 - 13-10	8		

AIR FORCE T. O. 35C2-3-442-2  
ARMY TM5-6115-457-34  
NAVY NAVFAC P-8-627-34  
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MEP007AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9082
MEP007AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9084
MEP007ALM	DUMMY LOAD KIT	6115-00-463-9086
MEP007AWM	WHEEL MOUNTING KIT	6115-00-463-9089

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**15 JUNE 1973**  
**CHANGE 7-20 MAY 1982**

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NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 724 consisting of the following:

Page No.	# Change No.	Page No.	# Change No.	Page No.	# Change No.
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A	7	1-28 - 1-41	0	1-99	1
B	7	1-42	7	1-100 Blank	0
C	7	1 - 4 3 - 1 - 4 7	0	1-101	1
i - i i	4	1-48	3	1-102 Blank	0
iiA Added	4	1-49 - 1-61	0	1 - 1 0 3	0
iiB Blank Added	4	1-62 Blank	0	1-104 Blank	0
iii-vi	3	1-63	1	1-105	0
vii-x	0	1-64 Blank	0	1-108 Blank	0
xi	2	1-65	3	1-107	0
CFL	6	1-66 Blank	0	1-108 Blank	0
xiiA Added	4	1-67	1	1-108	0
xiiB Blank Added	4	1-68 Blank	0	1-110 Blank	0
xiii-xiv	4	1-69	3	1-111 - 1-114	0
xv-xvi	3	1-70 Blank	0	1-115	3
xvii	0	1-71	3	1-116	1
xviii	2	1-72 Blank	0	1-117-1-118	0
xix	3	1 - 7 3	3	2-1	1
xx Blank	3	1-74 Blank	0	2-2 - 2-4	0
xxi-xxii Deleted	3	1-75	3	2-5	7
1-1	4	1-76	0	2-6 - 2-8	3
1-2	3	1-77	7	2-8A Added	3
1-2A - 1-2B	4	1-78 Blank	0	2-8B Blank Added	3
1-3 - 1-6	7	1-79 - 1-80	0	2-9 - 2-10	7
1-6A	3	1-81	1	2-11	0
1-6B	7	1-82 Blank	0	2-12	1
1-7 - 1-9	7	1-83-1-64	0	2-13	0
1-8 - 1-9	1	1-65	1	2-14	1
1-10	0	1-86 Blank	0	2-15	0
1 - 1 1	4	1-87	0	2-16 - 2-23	7
1-12	1	1-88 Blank	0	2-24	6
1-13-1-14	3	1-89	0	2-25	0
1-14A Added	3	1-90 Blank	0	2-26 - 2-28	0
1-14B Blank Added	3	1-91	3	2-29	1
1-15	0	1-92 Blank	0	2-30	0
1-16	7	1-93	3	2-31	7
1-17-1-18	0	1-96 Blank	0	2-32	0
1-19	4	1-64 Blank	0	2-33	6
1-20 - 1-26	0	1 - 9 5	3	2-34 - 2-46	3
		1-97	3	2-47-2-48	0
				2-49	1
				2-50 - 2-56	0
				2-57 - 2-66	4
				3-1 - 3-6	0

**NOTE: THE CORRECT DEPARTMENT OF NAVY NUMBER IS NAVFAC P-8-627-34.**

# Zero in this column indicates an original page.



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MEP007AWM	WHEEL MOUNTING KIT	6115-00-463-9089

THIS PUBLICATION REPLACES TO 35c2-3-442-2s-2 DATED 8 JULY 1980 AND TO 3502-3-442-2C DATED 29 AUGUST 1978.

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vii - x	0	1-64 Blank	0	1-106 Blank	0
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xii	6	1-66 Blank	0	1-108 Blank	0
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xiiB Blank Added	4	1-68 Blank	0	1-110 Blank	0
xiii - xiv	4	1-69	3	1-111 - 1-114	0
xv - xvi	4	1-70 Blank	0	1-115	3
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A4 Blank . . . . .	0
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SAFETY STATEMENT

**WARNING**

All specific cautions and warnings contained in this manual shall be strictly adhered to. Otherwise, severe injury, death and/or damage to the equipment may result.

HIGH VOLTAGE

is produced when this generator set is in operation.

DEATH

or severe burns may result if personnel fail to observe safety precautions. Do not operate this generator set until the ground terminal stud has been connected to a suitable ground. Disconnect the battery ground cable before removing and installing components on the engine or in the electrical control panel system.

Do not attempt to service or otherwise make any adjustments, connections or reconnection of wires or cables until generator set is shut-down and completely de-energized.

CLEANING SOLVENT

Compressed air used for cleaning and dry cleaning purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig and use only with adequate chip guards and chipping goggles.

Solvent, Dry Cleaning P-D-680, Type II is flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

DANGEROUS GASES

Batteries generate explosive gas during charging; therefore, utilize extreme caution, do not smoke, or use open flame in vicinity when servicing batteries.

DANGEROUS GASES (Cont)

Exhaust discharge contains noxious and deadly fumes. Do not operate generator sets in inclosed areas unless exhaust discharge is properly vented to the outside.

When filling fuel tank, maintain metal to metal contact between filler nozzle and fuel tank. Do not smoke or use an open flame in the vicinity.

Use extreme care, should a selenium rectifier malfunction, to avoid inhalation of poisonous fumes.

LIQUIDS UNDER PRESSURE

are generated as a result of operation of the generator set. Do not expose any part of the body to a high pressure leak in the fuel or hydraulic system of the generator set.

Relieve pressure from radiator before removing radiator cap.

NOISE

operating level of this generator can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near this set.

**CAUTION**

DAMAGE

to the equipment may result if personnel fail to observe the cautions contained in this manual.

If generator set is shutdown by the operation of a safety device, do not attempt to operate the unit until the cause has been determined and eliminated.



## CHAPTER 1

### INTRODUCTION

#### Section I. GENERAL

##### 1-1. SCOPE.

a. This manual contains instructions for the use of intermediate (field) (direct and general support) and depot maintenance personnel maintaining the 100 KW Diesel Engine Generator Set, Models MEP007A, ME P106A, and MEP1 16A, as allocated by the Maintenance Allocation Chart. It provides information on the maintenance of equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to operator and organizational level of maintenance. This manual is to be used in conjunction with the Operator and Organizational Maintenance Manual.

b. THIS TECHNICAL MANUAL IS USED BY THE ARMY, AIR FORCE, NAVY, AND MARINE CORPS. THE USE OF FORMS AND COMPLIANCE WITH DIRECTIVES AS STATED HEREIN WILL BE ACCOMPLISHED ONLY BY PERSONNEL OF THE SERVICE TO WHICH THEY APPLY.

##### 1-2. FORMS AND RECORDS.

a. Forms and Records used by the Army will be only those prescribed by TM38-750. Those used by the Marine Corps

will be those prescribed by TM4700-15/1, Other service users should refer to appropriate specifications/publications for equipment maintenance forms and records.

b. Report of errors, omissions, and recommendations for improvement of this publication by the individual users is encouraged. Reports should be submitted as follows :

1. Air Force - AFTO Form 22 in accordance with T. O. 00-5-1 and direct to Commander, Sacramento Air Logistics Center, ATTN: MMEDT, McClellan AFB, California 95652.

2. Army - DA Form 2028 direct to: Commanding General, U.S. Army Troop Support and Aviation Material Readiness Command, ATTN: DRSTS-MTP, 4300 Goodfellow Blvd., St. Louis, Missouri 63120.

3. Marine Corps - by letter direct to: Commandant, U.S. Marine Corps, ATTN: Code LME, Washington, D. C. 20380.

4. Navy - by letter direct to: Commanding Officer, U.S. Navy Ships Parts Control Center, ATTN: Code 783, Mechanicsburg, Pennsylvania 17055.

1-2A. RECORD OF APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS.

T.O. No.	Date	Title	Changes/Revisions/Supplement Date
35C2-3-442-503	15 July 77	Modification of Generator Set, DED, 100 KW, 400 Hz, DOD Model ME P116A, for comparability with E3A-AWACS Program, (ECP 76CE2122).	15 July 77



Section II. DESCRIPTION AND DATA

1-3. DESCRIPTION.

A general description of the generator sets and information pertaining to the identification plates are contained in the Operator and Organizational Maintenance Manual. A more detailed description of specific components and assemblies is contained in the applicable section(s) of this manual. Detailed descriptions of the components of the generator set are provided in the applicable maintenance paragraphs of this manual.

Operating temperature range:

without external heat + 125 °F to -25° F  
 with external heat + 125° F to -65° F

Voltage Output 120/208 volts and 240/416 volts, 3 phase 4 wire, WYE connected at reconnection terminals.

Power Factor 0.8

1-4. TABULATED DATA.

This paragraph contains all maintenance data pertinent to intermediate (field) (direct and general support) and depot maintenance personnel.

Capacities:

Fuel System 90 gallons  
 Cooling System 11 gallons  
 Hydraulic System 6.5 quarts  
 (precise generator sets only)

- a. GENERATOR SET MANUFACTURER Consolidated Diesel Electric Company Old Greenwich, Connecticut

Dimensions and Weights:

Model	Mode	Class
MEP 007A	50/60 Hertz	utility
ME P106A	50/60 Hertz	Precise
MEP116A	400 Hertz	Precise

Overall Length 106 inches  
 Overall Width 40 inches  
 Overall Height 65 inches  
 Net Weight Empty 6680 pounds  
 Net Weight Filled 7500 pounds  
 Shipping Weight 6680 pounds

- b. SAFETY DEVICES.

- 1. Over speed Switch.

DOD Drawing Number	70-4058 or 70-1105
Manufacturer	Synchro-Start Products, Inc. Skokie, Illinois
	International Signal and Control Corp. Lancaster, Pennsylvania

Type	Centrifugal, 3-element
Manufacturers Part Number	50/60 Hz; SA897-3DOB (Synchro-Start) 72-2203-1 (International Signal)
	400 Hz; SA1644-3DOB (Synchro-Start) 72-2203-2 (International Signal)

Operating Temperature Range	+ 150° F to -65° F
Functions	Disconnects starter, flashes generator field, and energizes precise governor on precise generator sets.
Operating speed	Switch rotates at half of engine speed.
Element 1	Starter disconnect and field flash. SPDT contact arrangement. Contacts transfer at 290-310 RPM rising switch speed. Automatic reset 100 RPM maximum below trip speed. Contact rating 3 ampere inductive at 28 VDC.
Element 2	Energizes precise governor on precise generator sets. Not utilized on utility generator sets. SPST contacts close at 590-610 RPM rising switch speed on 60 hertz sets, and 825-850 RPM rising switch speed on 400 hertz sets. Automatic reset 100 RPM maximum below trip speed. Contact rating 10 amperes inductive at 28 VDC.
Element 3	Overspeed. Two separate SPST contact sets; one open, one closed. Transfers at 1200-1225 RPM rising switch speed. Manual reset by button on rear of switch. Contact rating 10 amperes inductive at 28 VDC.
Weight	1.50 pounds (approx.)
Overall dimensions	2.60 dia. x 8.00 inches (approx.)
2. Over Voltage Relay	
DOD Drawing Number	70-1138
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Manufacturer's Part Number	11486
Nominal Voltage	120 volts, 50 to 450 hertz
Voltage Trip Point	
50 to 100 hertz operation	Trip at 156 volts $\pm \frac{0}{2}$ volts
350 to 450 hertz operation	Trip at 151 volts $\pm \frac{0}{2}$ volts
Weight	1 pound (approx.)
Overall dimensions	3.09 x 3.44 x 2.66 inches (approx.)

Time Delay	0.18 to 0.8 second
Contact Rating	10 amperes, 28.5 VDC resistive
Temperature Limits	-85° F to + 185° F
Temperature Effect On Pull-In Voltage	Changes $\pm 1$ volt at -85°F Changes $\pm 1$ volt at + 185° F

### 3. Under Voltage Relay

DOD Drawing Number	70-1120
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Manufacturer's Part Number	11636
Nominal Input	120 volts, 50 to 400 Hz, 100 milliamperes maximum
Dropout Voltage	99 volts
Dropout Voltage Tolerance	$\pm 1$ volt at 60 hertz and 75° F, $\pm 4$ volts at any combination of frequency and temperature within specified limits.
Frequency Range	50 to 400 hertz. Frequency trip effect $\pm 1.5$ volt
Temperature Limits	-65°F to + 170° F. Temperature trip effect $\pm 1.5$ volt
Time Delay	6 $\pm$ 2 seconds above 72 volts, instantaneous below 48 volts
Pull In Voltage	112 volts
Contact Arrangement	DPDT. Terminals 3, 4 and 5 isolated from terminals 6, 7 and 8. Normally closed contacts are terminals 3 to 4 and terminals 6 to 7.
Contact Rating	10 ampere resistive or 5 ampere inductive, 28 VDC.
Service Life	5, 000 hours minimum
Weight	1 pound (approx. )
Overall dimensions	4.28 x 3.375 x 3.53 inches (approx.)

4. Under Frequency Relays

(a) 400 hertz generator sets

DOD Drawing Number	70-1141
Manufacturer	Electromagnetic Industries Inc. Clearwater, Florida  Wilmar Electronics Inc. Torrance, California
Manufacturer's Part Number	23370 (Electromagnetic Ind.) 20-350-1 (Wilmar Electronics)
Nominal Input	120 volt, 400 hertz, 200 milliamperes, maximum
Trip Frequency	370 ± 0.5 hertz at 120 volt and 75%
Temperature Range	-65° F to +170° F
Service Life	5000 hours minimum
Contact Arrangement	Contacts 3 and 4 normally closed. Contacts 5 and 6 normally open.
Contact Rating	10 ampere resistive or 5 ampere inductive, 28 VDC.
Weight	1 pound (approx.)
Overall dimensions	3.09 x 3.44 x 2.66 inches (approx.)

(b) 50/60 hertz generator sets

DOD Drawing Number	70-1119
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida  Wilmar Electronics, Inc. Torrance, California
Manufacturer's Part Number	11638 (Electromagnetic Ind.) 20-050-5 (Wilmar Electronics)
Nominal Input	120 volt, 50 or 60 hertz, 200 milliamperes, max.
Trip Frequency	46 hertz for 50 hertz operation or 55 hertz for 60 hertz operation at 120 volts and 75° F
Trip Frequency Selections	Switching between terminals 7 and 8. Switch closed for 50 hertz operation and open for 60 hertz operation.
Voltage Input Limits	± 10 percent of nominal

Voltage Trip Effect	± 0.2 hertz
Temperature Range	-65° F to + 170° F
Temperature Trip Effect	±0.2 hertz
Service Life	5000 hours minimum
Contact Arrangement	Contact 3 and 4 normally closed. Contact 5 and 6 normally open.
Contact Rating	10 ampere resistive or 5 ampere inductive, 28 VDC
Weight	1 pound (approx.)
Overall dimensions	3.09 x 3.44 x 2.66 inches (approx.)
5. Short Circuit Relay	
(a) 50/60 hertz generator sets	
DOD Drawing Number	70-1137
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida Wilmar Electronics, Inc. Torrance, California
Manufacturer's Part Number	21380C 1 (Electromagnetic Ind.) 800 (Wilmar Electronics)
Function	Trips if generator set output current exceeds 425 ± 25 percent of generator set rated current.
Trip Voltage	24 volts at 60 hertz and 75° F on any phase to neutral
Trip Voltage Tolerance	±0.3 volt at 60 hertz and 75° F, ±1.5 volt at any combination of frequency and temperature deviation within specified limits.
Frequency Range	50 to 400 hertz. Frequency trip effect ±0.6 volt
Temperature Limits	-65° F to + 170°F. Temp. trip effect ±0.6 volt
Operating Time	Instantaneous
Contact Arrangement	Contacts 5 and 6 normally closed. Contacts 7 and 8 normally open.
Contact Rating	10 amperes resistive, 28 VDC
Service Life	5000 hour minimum
Weight	1 pound (approx.)
Overall dimensions	3.09 x 3.44 x 2.66 inches (approx.)

(b) 400 hertz generator sets

DOD Drawing Number	76-4181
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Manufacturer's Part Number	63030-230-50
Function	Trips if generator set output current exceeds 180 $\pm$ 25 percent of generator set rated current.
Trip Voltage	10 volts at 60 hertz and 75° F on any phase to neutral
Trip Voltage Tolerance	$\pm$ 0.3 volt at 60 hertz and 75°F, $\pm$ 1.5 volt at any combination of frequency and temperature devia- tion within specified limits.
Frequency Range	50 to 400 hertz. Frequency trip effect $\pm$ 0.6 volt.
Temperature Limits	-65° F to +170°F. Temperature trip effect $\pm$ 0.6 volt.
operating Time	Instantaneous.
Contact Arrangement	Contact 5 and 6 normally closed. Contacts 7 and 8 normally open.
Contact Rating	10 amperes resistive, 28 VDC.
Service Life	5000 hour minimum.
Weight	1 pound (approx.).
Overall Dimensions	3.09 x 3.44 x 2.66 inches (approx.).

6. Reverse Power Relay

(a) 50/60 hertz generator sets

DOD Drawing Number	70-1136	
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida	Wilmar Electronics, Inc. Torrance, California
Manufacturer's Part Number	21690-1 (Elect. Ind. ) 700-2 (Wilmar Elect. )	
Function	Trips when reverse power into generator set exceeds 20 percent of rated output.	
DC Input Voltage	0-10 VDC with AC signal superimposed on DC input, 20 volts maximum.	
External Power	24 VDC across terminals 3 and 4, terminal 3 is positive.	
Trip Voltage	2 VDC across terminals 1 and 2, terminal 1 is positive. (Corresponds to approximately 20 percent reverse power. )	
Trip Voltage Tolerance	±0.1 VDC under standard conditions. ±1 VDC with any combination of superimposed AC frequency and temperature within specified limits.	
Frequency Range	50 to 400 hertz. Frequency trip effect ±.4 VDC.	
Temperature Limits	-65° F to +170°F. Temperature trip effect ±0.5 volt.	
Contact Arrangement	Contacts 5 and 6 normally open. Contacts 7 and 8 normally closed.	
Contact Rating	10 amperes resistive, 28 VDC.	
Service Life	5000 hour minimum.	
Weight	1 pound (approx. )	
Overall Dimensions	3.09 x 3.44 x 2.66 inches (approx. )	



6. Reverse Power Relay

(b) 400 hertz generator sets

DOD Drawing Number	76-4194
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Manufacturer's Part Number	63030-240-50 (El. Ind.)
Function	Trips when reverse power into generator set exceeds 50 percent of rated output.
DC Input Voltage	0-10 VDC with AC signal superimposed on DC input, 50 volts maximum.
External Power	24 VDC across terminals 3 and 4, terminal 3 is positive.
Trip Voltage	5 VDC across terminals 1 and 2, terminal 1 is positive. (Corresponds to approximately 50 percent reverse power.)
Trip Voltage Tolerance	$\pm 0.1$ VDC under standard conditions. $\pm 1$ VDC with any combination of superimposed AC frequency and temperature within specified limits.
Frequency Range	50 to 400 hertz. Frequency trip effect $\pm 0.4$ VDC.
Temperature Limits	-65° F to +170°F. Temperature trip effect $\pm 0.5$ volt.
Contact Arrangement	Contacts 5 and 6 normally open. Contacts 7 and 8 normally closed.
Contact Rating	10 amperes resistive, 28 VDC
Service Life	5,000 hour minimum.
Weight	1 pound (approx.)
Overall dimensions	3.09 x 3.44 x 2.66 inches (approx.)

7. Overload Relay

DOD Drawing Number	70-1135
Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Conn.

Manufacturer's Part Number	00000-4857
Function	Trips if current in anyplace exceeds 110 percent of rated current on an inverse time principle.
AC Input (Signal)	3 wire, 3 phase 50/60 and 400 Hz 0.75 ampere per phase (at 100 percent rated load)
DC Input	28 VDC 0.1 ampere maximum.
Time Delay	Operates in a minimum of 8 minutes $\pm$ 2 minutes after the current in any phase remains at 130 percent of rated current.
Temperature Limits	-65° F to +140°F
Contact Arrangement	Two contacts, 1 normally open, 1 normally closed
Contact Rating	10 ampere resistive or 5 ampere inductive, 28 VDC
Service Life	5,000 hour minimum
Weight	1 pound (approx.)
Overall dimensions	3.87 x 2.68 x 3.62 inches (approx.)

#### 8. Permissive Paralleling Relay

DOD Drawing Number	70-1118
Manufacturer	Electromagnetic Industries Inc. Clearwater, Florida
Manufacturer's Part Number	23390
External Power Required	24 VDC, 200 milliamperes maximum.
Input Signal AC Burden	0-20 VAC, 60 to 400 hertz. At 300 VAC, 40 milliamperes maximum.
Contact Operation	5 and 6 normally closed with AC signal above 10 volts. 7 and 8 normally open with AC signal above $8 \pm 1$ volt.
Contact Rating	28 VDC, 10 amperes resistive, 5 amperes inductive.
Life Expectancy	5,000 hours minimum
Weight	1 pound (approx.)
Overall dimensions	2.56 x 3.38 x 3.00 inches (approx.)

c. RADIATOR

DOD Drawing Number 70-4088  
 Manufacturer G & O Manufacturing Company,  
 New Haven Corm.  
 Manufacturer's Part Number X-1817  
 Coolant Capacity 21.3 quarts

Heat Rejection:

Water GPM flow	Engine RPM speed	Heat BTU/rein. rejection
62	1500	35
70	1800	34
80	2000	37

Air Test Pressure 15 PSI  
 Operating Pressure 7 PSI  
 Weight 115 pounds (approx.)  
 Overall dimensions 28.25 x 39.0 x 10.00 inches (approx.)

d. RADIATOR SHUTTER AND CONTROL ASSEMBLY.

DOD Drawing Number 70-4092  
 Manufacturer Evans Products Company  
 Coldwater, Michigan  
 Manufacturer's Part Number 1 G 409  
 Type 16 vanes with left hand manual control  
 handle, thermostat operated  
 Control Element Setting Nominal 170° F (158° F crack open, 173° F  
 full open)  
 Weight 10 pounds (approx.)  
 Overall dimensions 30.56 x 32.25 x 2.5 inches (approx.)

e. GENERATOR CONTROL ASSEMBLY

1. DC Circuit Breaker

DOD Drawing Number MS25244-7.5  
 Rating 24 VDC 7.5 amperes

Circuit Breaker Reset	Manual
Contact Arrangement	SPST
Weight	0.25 pounds (approx.)
Overall dimensions	2.00 x 1.80 x 0.75 inches (approx.)

## 2. Convenience Receptacle Box Assembly

### (a) 50/60 hertz generator sets

DOD Drawing Number	70-4101
Number of Receptacles	1 duplex
Voltage	120 VAC
Current	15 amperes
Circuit Breaker Reset	Manual
Weight	5 pounds (approx.)
Overall dimensions	9.62 x 3.0 x 5.50 inches (approx.)

### (b) 400 hertz generator sets

DOD Drawing Number	70-4107
Number of Receptacles	2
Receptacle 1 rating	125/250 VAC, 30 amperes
Receptacle 2 rating	125 VAC, 15 amperes
Circuit breaker Reset	Manual
Weight	5 pounds (approx.)
Overall dimensions	9.62 x 3.0 x 5.50 inches (approx.)

## 3. Exciter Regulator (Voltage)

DOD Drawing Number	70-4145 (50/60 Hertz generator sets) 70-4235 (400 Hertz generator sets)
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Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Connecticut
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<b>Type</b>	Solid state, with capability to automatically flash field of generator.
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### Voltage Regulation:

Precise Sets	1 percent of rated voltage
Utility Sets	3 percent of rated voltage

Voltage Stability:

Short Term (30 seconds)

Precise Sets	within bandwidth equal to 1 percent of rated voltage.
Utility Sets	within bandwidth equal to 2 percent of rated voltage.

Long Term (4 hours)

Precise Sets	within bandwidth equal to 2 percent of rated voltage.
Utility Sets	within bandwidth equal to 4 percent of rated voltage.

Voltage Drift (8 hours) 1 percent

Transient performance  
(application or rejection  
of load).

Resumption of steady  
state condition :

Precise Sets	within 0.5 seconds
Utility Sets	within 3 seconds

Overshoot and Undershoot:

Precise Sets (50/60 Hertz)	15 percent of rated voltage
Precise Sets (400 Hertz)	12 percent of rated voltage
Utility Sets	20 percent of rated voltage
Weight	40 pounds (approx.)
Overall dimensions	20.0 x 6.50 x 9.88 inches (approx.)

4. Load Contactor (CB2) (50/60 hertz generator sets)

DOD Drawing Number	70-501
Manufacturer	Hartman Electric Manufacturing Mansfield, Ohio  HB Electrical Mfg. Co. Mansfield, Ohio
Manufacturer's Part Number	B-301E (Hartman Electric) HB200A (HB Electrical)

KVA Rating	125 KVA
Mechanism	Electrically held
Main Contacts	3 PST double break
AC Voltage	120/208-240/416 Volts
Frequency	50/60 and 400 Hertz
Continuous Current	350 amperes at 120/208 volts 50/60 and 400 hertz
Second Current	750 amperes at 120/208 volts 50/60 and 400 hertz
Interrupting Capacity	5000 amperes at 120/208 volts 50/60 and 400 hertz 2500 amperes at 240/416 volts 50/60 and 400 hertz
Auxiliary Contacts	4 SPST normally open, 2 SPST normally closed and 1 SPDT.
DC Voltage	32 Volts
Current	2.5 amperes maximum resistive or inductive
AC Voltage	120 Volts
Current	2.0 amperes maximum
Lamp Current	
DC	4.0 amperes maximum
50/60 Hertz	1.5 amperes maximum
400 Hertz	3.0 amperes maximum
Auxiliary Contacts Trip Time	Within 0.004 seconds of main contacts activation.
Coil Data	
Operating Voltage	32 VDC Maximum 16 VDC Minimum (without external series resistance)
Main Contacts Maximum Operating Time	
Close	0.050 Seconds at 24 to 32 VDC with 0.25 ohms resistance in series with coil.
Open	0.035 Seconds at 24 to 32 VDC with 0.25 ohms resistance in series with coil.

Duty Cycle	Continous
Maximum Holding Current	0.75 amperes at 32 VDC after 30 minutes warmup.
Pulling Current	Contactora shall close with 24 VDC applied across the operating coil and a 5.0 ohm resistor in series.
Electrical Life	10,000 cycles at a duty cycle of not less than 325 make and break operations per hour. With the ON portion of the cycle not less than 1.0 seconds and the OFF portion of the cycle not more than 10.0 seconds.
Mechanical Life	100,000 cycles
Weight	4 pounds (approx.)
Overall dimensions	4.80 x 6.06 x 4.80 inches (approx.)
4A. Circuit Breaker Assembly (CB2) (400 hertz generator sets)	
DOD Drawing Number	76-4191
Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Connecticut
Main Contacts	3 pole normally open, 400 ampere
Current Rating (minimum)	350 amperes continuous at 208 volts and 175 amperes at 416 volts 1600 amperes for 4 seconds
Interrupting Capability	42,000 amperes 30,000 amperes at 416 volts
Auxiliary Contacts	SPST normally open contacts, 3 rated 10 amperes; 1 rated 5 amperes
Temperature Range	-65°F to +135° F
Weight	25 pounds (approx.)
Overall Dimensions	7.75 x 8.50 x 16.00 inches (approx.)

5. Current Transformer Assembly

(a) Current transformer (CT1, CT2, and CT3)

DOD Drawing Number	70-4084
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Manufacturing Part Number	51
Primary Current	464 amperes
Secondary Current	1 ampere
Turns Ratio	1 primary to 464 secondar
Frequency	50/60 and 400 hertz
Burden	12. 5VA minimum at 1 ampere secondary current.
Temperature Range	-65° F to +155° F
Weight	3 pounds (approx.)
Overall Dimensions	3.75 x 3.75 x 2,19 inches (approx.)

(b) Current Transformer Exciter CT 4 (400 Hertz Generator Sets)

DOD Drawing Number	71-4891
Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Connecticut



Manufacturing Part Number	00000-4928
Total Turns	94
Rated Voltage	40VAC
Rated Current	3.7 amperes
Resistance	0.15 ohms $\pm$ 20 percent
Frequency	400 hertz
Excitation Current	With 40 volts RMS applied exciting current is 0.5 amperes RMS maximum
High Potential Rating	2,000 volts between winding and core.
Temperature Range	-65° F to + 155° F
Weight	3 pounds (approx.)
Overall dimensions	5.00 x 4.20 x 2.75 inches (approx.)

(c) Current Transformer CT 4 (50/60 Hertz Generator Sets)

DOD Drawing Number	70-4067
Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Connecticut
Manufacturing Part Number	00000-4921
Total Turns	260
Rated Voltage	60 VAC
Rated Current	2.7 amperes
Resistance	0.83 ohms
Frequency	60 hertz
Excitation Current	With 60 volts RMS applied, exciting current is 0.30 amperes maximum
Temperature Range	-65° F to +155° F
Weight	3 pounds (approx.)
Overall dimensions	5.38 x 5.38 x 3.50 inches (approx.)

(d) Current Transformer Exciter CT5 and CT6 (400 Hertz Generator Sets)

DOD Drawing Number	71-4892
Manufacturer	Consolidated Diesel Electric Co. Old Greenwich, Connecticut



Manufacturing Part Number	00000-4929
Total Turns	47
Rated Voltage	35 VAC
Rated Current	7.4 amperes
Resistance	0.05 ohms $\pm$ 20 percent
Frequency	400 hertz
Excitation Current	With 35 volts RMS applied exciting current is 1.0 amperes RMS maximum
High Potential Rating	2000 volts between winding and core
Temperature Range	-65° F to +155° F
Weight	2 pounds (approx.)
Overall dimensions	5.00 x 4.12 x 3.25 inches (approx.)

(e) Current transformer CT5 and CT6 (50/60 Hertz Generator Sets)

DOD Drawing Number	70-4086
Manufacturer	Consolidated Diesel Electric Company Old Greenwich, Connecticut
No Load Voltage	60 volts
Current	8.0 amperes
Resistance	0.22 ohms
Frequency	50/60 Hertz
Excitation Current	0.90 amperes maximum
Total Turns	87
Temperature Range	-65° F to + 155° F
Weight	3 pounds (approx.)
Overall dimensions	5.38 x 5.63 x 6.0 inches (approx.)

(f) Current transformer CT7

DOD Drawing Number	70-4085
Manufacturer	Electromagnetic Industries Inc. Clearwater, Florida

Manufacturing Part Number	6 (400/1 ratio)
Primary Current	600 amperes
Secondary Current	1.5 amperes
Turns Ratio	1 primary to 400 secondary
Frequency	50/60 and 400 hertz
Burden	25VA minimum
Temperature Range	-65° F to + 155° F
Weight	3 pounds (approx.)
Overall dimensions	3.94 x 1.25 inches (approx.)

6. Precise Governor System (LEH GOVERNOR)

Type Closed loop feedback system

(a) Governor control unit

Type Solid state

DOD Drawing Number 400 Hertz Generator Sets 69-800  
50/60 Hertz Generator Sets 69-700

Manufacturer Electromagnetic Industries, Inc.  
Clearwater, Florida

Manufacturer Part Number 400 Hertz Generator Sets 22910  
50/60 Hertz Generator Sets 22810

Input Voltage 24 VDC and single phase  
120 VAC from generator output

Weight 7 pounds (approx.)

Overall dimensions 10.41 x 10 x 4.06 inches (approx.)

(b) Governor actuator unit

DOD Drawing Number 69-790-3

Manufacturer Electromagnetic Industries, Inc.  
Clearwater, Florida

Type Hydraulic, differential pressure operated

Manufacturer Part Number 23600-3

Piston Position Variable reluctance type  
Transducer

Input Pressure	300 to 320 PSI
Hydraulic Fluid Type	MIL-H-5606
Input Voltage	120 volts
Frequency	50/60 or 400 hertz
Weight	3 pounds (approx)
Overall dimensions	6.00 x 2.91 x 4.90 inches (approx.)

(c) Hydraulic Pump

DOD Drawing Number	70-4038
Manufacturer	John S. Barnes Corp. Rockford, Illinois
Type	Gear driven, positive displacement
Manufacturer's Part Number	GC5100 - A-82-A
Rating	2 GPM
Drive Type	Tang with drive coupling
Relief Valve Type	Adjustable plunger
Pressure	320 ± 10 PSI
Drive Speeds	1500 to 2116 RPM
Rotation	Clockwise (viewed from drive end)
Weight	10 pounds (approx.)
Overall dimensions	3.56 x 3.56 x 2.81 inches (approx.)

(d) Hydraulic Tank Assembly

DOD Drawing Number	71-4476
Type	Welded with filler cap level gauge.
Capacity	6 quarts
Type Fluid	MIL-H-5606
Weight	12 pounds (approx.)
Overall dimensions	3.75 x 16 x 8.50 inches (approx.)

7. Load Measuring Unit

DOD Drawing Number	69-785
Manufacturer	Electromagnetic Industries, Inc. Clearwater, Florida
Type	Electrical, three phase load sensing
Manufacturer's Part Number	69-500

Frequency Regulation	Isochronous $\pm 1/4$ of 1 percent.
Frequency Stability:	
Short Term (30 Seconds)	Within bandwidth equal to $1/2$ of 1 percent of rated frequency.
Long Term (4 Hours)	within bandwidth equal to 1 percent of rated frequency.
Frequency Drift (8 Hours)	$1/2$ of 1 percent.
Transient performance (application or rejection of load).	
Stable Operation	within 2 seconds.
Overshoot or Undershoot	4 percent of rated frequency
Weight	3 pounds (approx.)
Overall dimensions	6.00 x 3.80 x 4.38 inches (approx.)

f. GENERATOR

DOD Drawing Number	50/60 Hertz Generator Sets 70-4001 400 Hertz Generator Sets 70-4002
Manufacturer	Lima Electric Motor Company
Type	2 Types: 50/60 Hertz or 400 Hertz. Both are synchronous, brushless, with integral exciter.
Operating Speed:	
50 Hertz	1500 RPM
60 Hertz	1800 RPM
400 Hertz	2000 RPM
Kilowatt Rating (KW): (At 0.8 P. F.)	
50 Hertz	83.3
60 and 400 Hertz	100

Kilovolt Ampere  
 Rating (KVA):

50 Hertz	104
60 and 400 Hertz	125

Current rating for 3 phase  
 balanced rated load with  
 generator coils connected in  
 WYE at reconnection terminals.

50 Hertz:

120/208 Volts	288
240/416 Volts	144

60 and 400 Hertz:

120/208 Volts	346
240/416 Volts	173

Weight 1,500 pounds (approx.)

Overall dimensions 34 x 36 x 30 inches (approx.)

g. ENGINE

DOD Drawing Number	*70-4013
Manufacturer	Caterpillar Tractor Company Peoria, Illinois
<b>Type</b>	Four stroke cycle, liquid cooled, turbo charged, compression ignition, diesel.
Model	*D333C(T)
Number of Cylinders	six
Piston Displacement	638 cubic inches
Rotation	Counterclockwise from flywheel end.
Lubricating Oil Capacity	30 quarts
Weight	2,200 pounds (approx.)
Overall dimensions	53.19 x 40.00 x 35.50 Inches (approx.)

\*At time of engine replacement, the D333C(T) engine is to be used until stock of these engines is exhausted; at which point the D3306(T), (76-4106) engine will be used. Refer to paragraph 2-10 for engine change instructions. Refer to Generator Set "B" Model Manual for maintenance of the D3306(T) engine.

h. ENGINE ACCESSORIES

1. Battery Charging Alternator

DOD Drawing Number	69-780-2
Manufacturer	Motorola, Inc. Franklin Park, Ill.
Type	Alternator with integral voltage regulator and transient voltage suppressor
Manufacturers Part Number	70 D44672B02
Rating	0-35 amperes at any speed from 1900 to 4000 RPM within temperature limits
Temperature limits	-65° F to + 175° F
Drive	V-belt, 0.500 nominal width
Maximum voltage under load removal or other condition	32 volt average, 50 volt spikes or transients
Fuse rating	Style 4AG, 32 volts, 40 amperes
Field (rotor) current	1.25 to 1.75 amperes at 24.0 volts
Brush Spring Tension	4 to 6 ounces.
Rotor Assembly Resistance	11 to 14 ohms.
Weight	13.5 pounds (approx.)
Overall dimensions	8.34 x 7.40 x 5.50 inches (approx.)

2. Starter Motor

DOD Drawing Number	70-4046
Manufacturer	The Prestolite Company Toledo, Ohio
<b>Type</b>	Heavy Duty
Manufacturer Part Number	MFY-6501E UT
Operating voltage	24 VDC
Brushes	8 brushes in 4 brush holders
Rotation	Clockwise, drive end
Engagement	Indexing type



Actuation	Shifting solenoid, mounted on motor
No load readings	20.0 volts, 65 maximum amperes 5000 minimum RPM
Stall readings	4.0 volts, 400 maximum amperes 22 minimum foot pounds.
Solenoid shunt winding draw (70° F)	4.1 to 4.8 amperes at 12.0 volts
Solenoid series winding draw (70° F)	23.2 to 26.6 amperes at 12.0 volts
Weight	6.5 pounds (approx.)
Overall dimensions	19.32 x 9.00 inches (approx.)
3. Day Tank Fuel Level Switch	
DOD Drawing Number	70-4082
Manufacturer	Rucker Precision Santa Ana, California 92705
Manufacturer Part Number	1145-0055.
Contact Rating	6 to 32 VDC, 50 watts maximum, 3.0 amperes maximum.
Operating Pressure	0 to 150 PSI
Temperature Limits	-65° F to + 200° F
Fuel Type	JP4 or W-F-800
Switch Arrangement	2 switches upper and lower NO
Switch Operation	At full level switches are NO. At low level switches are NC. At middle level upper switch NC and lower switch open..
Weight	1 pound (approx.)
Overall dimensions	2.00 x 10.00 inches (approx.)
4. Tachometer Drive	
Manufacturer	Caterpillar Peoria, Illinois
Manufacturer Part Number	5R 1944
Operating Speed	One half engine RPM
Drive Connection	S.A. E. Heavy duty 3/16 pin and tang.
Weight	1 pound (approx.)
Overall dimensions	3.00 x 2.00 x 2.50 inches (approx.)

5, Fuel Transfer Pump

Manufacturer	Caterpillar
Manufacturer Part Number	7L543
RPM	One half engine RPM
Flow Rate	50 GPM
Discharge	20 PSI
Weight	1.5 pounds (approx.)
Overall dimensions	2.75 x 3.40 x 2.75 inches (approx.)

6. Turbocharger

Manufacturer	Air Research Manufacturing Corporation Los Angeles, California
Part Number	407640-3
RPM at Rated Load	52,000 RPM at 1800 RPM
Method of Lubrication	Engine oil system 1 to 2 GPM
Intake Manifold Pressures at Rated Load	8 to 10 inches mercury at 1800 RPM
Weight	60 pounds (approx.)
Overall dimensions	16.00 x 12.00 x 11.81 inches (approx.)

7. Oil Cooler

Manufacturer	Caterpillar Peoria, Illinois
Part Number	7L7749
Coolant Flow	Engine jacket water through tubes
Oil Flow	Baffled flow around outside diameter of tubes.
Weight	75 pounds (approx.)
Overall dimensions	7.50 x 7.00 x 7.00 inches (approx.)

8. Water Pump

Manufacturer	Caterpillar
Part Number	5R1612
Type	Centrifugal

Type of Drive	Gear driven
Water Flow Rate	70 GPM at one half engine RPM engine speed.
Weight	15 pounds (approx.)
Overall dimensions	5.40 x 7.75 x 4.00 inches (approx.)
9. Utility Governor	
Manufacturer	Woodward Governor Company Rockford, Illinois
Type	Hydraulic speed droop.
Frequency Regulation	Adjustable from 1-1/2 to 3 percent of rated frequency.
Part Number	8510-212
Frequency Stability:	
Short Term (30 Seconds)	within bandwidth equal to 2 percent of rated frequency.
Long Term (4 Hours)	within bandwidth equal to 3 percent of rated frequency.
Frequency Drift (8 Hours)	1 percent.
Transient Performance: (application or rejection of load).	
Stable Operation	within 2 seconds
Overshoot	4 percent of rated frequency.
Undershoot	3 percent of rated frequency.
Weight	7.00 pounds (approx.)
Overall dimensions	5.30 x 7.50 x 6.25 inches (approx.)
10. Fuel Injection Pump	
Manufacturer	Caterpillar Peoria, Illinois
Part Number	5R1739
Firing Order	1-5-3-6-2-4.
Injection Timing	13 degrees, 30 minutes before top dead center

Number of Individual Pumps	6
Type of Drive	Gear driven.
Speed	One half engine RPM
Weight	20 pounds (approx.)
Overall dimensions	9.50 x 7.00 x 5.00 inches (approx.)

i. FUEL BURNING WINTERIZATION KIT (Optional)

DOD Drawing Number	71-4410
Manufacturer	Consolidated Diesel Electric Company Old Greenwich, Connecticut

1. Engine Heater

DOD Drawing Number	69-775
Manufacturer	Test Institute Corporation Benmar Heater Division Cleveland, Ohio
Manufacturer Part Number	CP 3050-24
Fuel	JP 4 Arctic diesel fuel
Fuel Rate	21 to 23 cc per minute
Fuel Pressure	3 to 15 PSI
Relief valve setting	30 to 35 PSI
Voltage	24 VDC
Radio Interference Suppression	0.15 to 1000 mega-cycles
Coolant Circulation	80-100 GPH at 10 PSI
output	
Transfer to Coolant	30,000 BTU per hour maximum
Usable Exhaust Heat	10,000 BTU per hour maximum

### Operating Power Requirements

Above + 30°F	
Start	14.5 amperes
Run	5.0 amperes
Below + 30°F	
Start	17.0 amperes
Run	7.5 amperes
Weight	20 pounds (approx.)
Overall dimensions	19.82 x 10.12 x 6.32 inches (approx.)

### 2. Coolant Thermostat Switch

DOD Drawing Number	70-4044
Manufacturer	NASON Company Clarkston, Michigan.
Mfr. Part Number	TC-125B-50M-2AN.
Contacts Rating	28 VDC, 15 amperes resistive, 10 amperes inductive.
Contacts Arrangement	2 contacts normally closed
Contacts Operation	contacts open at + 125 ± 5° F, contacts close at + 50 ± 5° F
Temperature Limits	-65° F to + 230° F.
Life Expectancy	1 year or 5,000 operating hours.
Weight	1 pound (approx.)
Overall dimensions	2.43 x 4.75 inches (approx.)

### 3. Control Box

DOD Drawing Number	69-650
Circuit Breaker Type	Manual reset.
Circuit Breaker Current	15 amperes
Switch Arrangement	2 PST normally open
Control Box Function	Protects heater circuitry against overload, in OFF position heater will continue to operate for 4 1/2 minutes.
Weight	1 pound (approx.)
Overall dimensions	5.75 x 4.50 x 3.00 inches (approx.)

### j. ELECTRIC WINTERIZATION KIT (Optional)

DOD Drawing Number	71-4430
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Manufacturer	Consolidated Diesel Electric Company
1. Electric coolant heater 2500 Watts	
DOD Drawing Number	70-4073
Manufacturer	Kim Hotstart Manufacturing Co. Spokane Washington.
Mfg. Part Number	BC 220
Rating	2500 watts at 230 volts (nominal, 50/60 and 400 hertz
Operating Voltage	205 to 240 volts.
Flow Rate	30 to 40 gallons per hour maximum
Type	Gravity flow, and must have head pressure.
Operating Life	1500 hours minimum at -65° F ambient.
Coolant	Arctic anti-freeze per MIL-A-11755.
Duty Cycle	Continuous
Weight	1.5 pounds (approx.)
Overall dimensions	3.50 x 18.00 x 4.50 inches (approx.)
2. Pump motor assembly	
DOD Drawing Number	70-4048
Manufacturer	Welton Tool Company Cleveland, Ohio
Manufacturer Part Number	P400-E (Rev B)
Rating	80 GPH Minimum at 2 PSI
Voltage	24 VDC
Duty classification	Continuous
Motor	
Voltage	20-32V DC
Amperes	3.3 maximum at 80° F
RPM	7500
Coolant	Mil-A-11755
Relief Valve	Opens at 30 to 35 PSI
Weight	2.5 pounds (approx.)
Overall dimensions	3.62 x 3.69 x 7.5 inches (approx.)

3. Control Box

DOD Drawing Number	70-4196
Voltage	205 to 240 VAC
Frequency	50/60 or 400 Hz
Phase	Single
Current	30 amperes
Operation	Manual
Weight	1 pound (approx.)
Overall dimensions	9.50 x 3.25 x 5.56

4. Electric heater coolant thermostat

DOD Drawing Number	70-4074
Manufacturer	Kim Hotstart Manufacturing Co. Spokane, Washington.
Manufacturer Part Number	KS 1012
Switch Type	SPST
Switch Rating	25 amperes at 240 volts, 50/60 and 400 hz.
Cycling Operation	At -65° F ambient contact to open at 120° F (increasing temperature) and close at 100° F (decreasing temperature)
Weight	1 pound (approx.)
Overall dimensions	2.00 x 2.38 x 3.90 inches (approx.)

k. DUMMY LOAD KIT

DOD Drawing Number	71-4636
Manufacturer	Consolidated Diesel Electric Company Old Greenwich, Connecticut
Type	Resistive, 3 phase, 4 wire
Voltage	120/208 and 240/416
Kilowatt Rating (KW)	48
Increments of change	12 KW
Weight	300 pounds (approx)
Overall dimensions	96,00 x 23.5 x 19.12 inches (approx.)

1. Power Transformer

DOD Drawing Number	71-4837
Manufacturer	Consolidated Diesel Electric Company Old Greenwich, Connecticut
Manufacturer Part Number	00000-4842
No Load Voltage	230 volts .
Frequency	50, 60, and 400 hertz
Rating	
Primary terminals 1 and 2, 3 and 4	230 volts and 6.5 ohms
Secondary terminals 5 and 6	35 volts, 0.06 ohms, and 6.0 amperes
Total Turns	
primary terminals 1 and 2	460
3 and 4	460
secondary terminals 5 and 6	70
Temperature limits	-65° F to + 155° F.
Weight	2 pounds (approx.)
Overall dimensions	4.50 x 3.81 x 4.56 inches (approx.)

2. Load Dump Relay Assembly

DOD Drawing Number	71-4716
Manufacturer	Consolidated Diesel Electric Company Old Greenwich, Connecticut
Manufacturer Part Number	00000-4938
External Power Required	20 to 32 VDC.
Input Signal	0 to 10 VDC.
Trip Voltage	5.28 VDC ± 5 percent
Contact Rating	26 VDC, 10 amperes resistive, 5 amperes inductive
Weight	0.50 pounds (approx.)
Overall dimensions	3.25 x 2.62 x 3.00 inches (approx.)



3. Electrical Heating Element

DOD Drawing Number	70-4047
Manufacturer	General Electric Company Shelbyville, Indiana
Manufacturer Part Number	2A838B101
Voltage Rating	120 volts
Power Rating	1000 watts
Watts per Square Inch	7.8 watts
Life Expectancy	10,000 hours
Skin Temperature	1,000° F
Weight	2 pounds (approx.)
Overall dimensions	38.50 x 1.50 x 1.00 inches (approx.)

4. Load Contactor

DOD Drawing Number	71-4828
Manufacturer	Rowan Controller Co. Westminster, Maryland
Manufacturer Part Number	2200-EBH 330JA-11
Contact Arrangement	3 pole normally open
Contact Rating at 50/60 and 400 Hz.	42 amperes resistive at 208 volts and 21 amperes at 416 volts
Coil Data	
Voltage Rating	24 to 32 VDC
Input Current	4.5 amperes
Holding Current	0.9 amperes
Temperature Range	-65° F to + 125° F
Mounting Position	Vertical only.
Weight	1 pound (approx.)
Overall dimensions	3.15 x 2.50 x 3.75 inches (approx.)

1. REPAIR AND REPLACEMENT STANDARDS. Table 1-1 list manufacturer's dimensions, tolerances, desired clearances, and maximum allowable wear and clearances.

m. TORQUE DATA. Components not listed in table 1-2 should be tightened to standard torque values. Table 1-2 lists components that require special torques.

n. TIME STANDARDS. Table 1-3 lists the number of man-hours required under normal conditions to perform the indicated maintenance and repair for the generator sets. Components are listed under the appropriate functional index. The times listed are not intended to be rigid standards, Under adverse conditions, the operations will take longer, but under ideal

conditions with highly skilled mechanics, most of the operations can be accomplished in considerably less time.

o. SCHEMATICS AND WIRING DIAGRAMS. Figures 1-1 through 1-31 show the schematic and wiring diagrams for the 50/60 and 400 hertz generator sets, their components and auxiliaries.

Table 1-1. Repair and Replacement Standards

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Starting Motor Assembly:					
Brush length	0.7500	-			0.3750
Thrust washer thickness (Commutator end of armature shaft).	0.0312	0.0930			0.0250
Thrust washer thickness (Drive end of armature shaft).	0.0950				0.0900
Thrust washer thickness (Intermediate bearing)	0.0312				0.0280
Maximum end play of armature	0.0300				0.0500
Thrust washer thickness (Outer washers)	0.0650				*
Yoke pin diameter	0.2790	0.2810			0.2740
Yoke bore for pin	0.2820	0.2830			*
Fit of pin in yoke			0.0010L	0.0040L	*
Fit of pin in cover			0.0010L	0.0050L	*

\* - L - T - See footnotes at end of table.

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER' S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Starting Motor Assembly: (continued)					
Cover bore for pin	0.2820	0.2840			*
Commutator end head bronze bearing I.D.	0.6260	0.6270			0.6320
Armature shaft diameter at commutator end	0.6230	0.6250			0.6200
Fit of shaft in bearing			0.0010L	0.0040L	*
Commutator end head bronze bearing O.D.	0.7540	0.7550			*
Fit of bearing in end head			0.0020T	0.0040T	*
Intermediate housing bronze bearing I.D.	0.8740	0.8760			0.8780
Armature shaft diameter (Between spline and armature).	0.8700	0.8720			0.8670
Fit of armature shaft in bronze bearing			0.0020L	0.0060L	0.0080L
Runout of shaft bearing with end bearing					0.0050TIR
intermediate housing bore	0.9990	1.0000			*
Intermediate housing sleeve bearing O.D.	1.0030	1.0040			*
Fit of bearing in housing			0.0030T	0.0050T	*
Pinion housing bearing I.D.	0.7470	0.7480			0.7520

\* - L - T - See footnotes at end of table.

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Starting Motor Assembly: (continued)					
Armature shaft diameter (Drive end)	0.7450	0.7460			0.7420
Fit of shaft in bearing (Drive end)			0.0010L	0.0030L	0.0060L
Pinion housing bore	0.8740	0.8750			*
Pinion housing bronze bearing O.D.	0.8770	0.8780			
Fit of bearing in housing			0.0020T	0.0040T	*
Pinion housing bearing I.D.	0.7500	0.7530		0.7550	
Fit of shaft in intermediate housing bearing	0.0020L	0.0060L			0.0080L
Commutator diameter	1.6800				1.6480
Commutator minimum turned diameter	1.6700				1.6470
Commutator diameter T.I. R. runout with shaft diameters at bearings			0.0020		0.0030

\* - L - T - See footnotes at end of table.

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
<b>Fuel Pump Group:</b>					
Bearing bore	0.4950	0.4956			
Body bore depth	0.3747	0.3753			
Gear to cover total clearance			0.001	0.003	0.0035
Shaft diameter	0.4936	0.4938			
Shaft bearing bore	0.4950	0.4956			0.003
<b>Turbocharger Group:</b>					
Bearing bore I.D.	0.6268	0.6272			
Shaft bearing journal diameter	0.6250	0.6254			
Housing bore	0.9827	0.9832			
Bearing diameter O. D.	0.9780	0.9785			
Oil seal ring gap			0.001	0.006	
<b>Utility Governor Group:</b>					
Terminal lever I.D.	0.352	0.356			0.0005
Power piston O. D.	0.7486	0.7490			0.0005
<b>Pilot valve:-</b>					
Larger lands (3) O. D.	0.2490	0.2495			0.0005
Small land (1) O. D.	0.2485	0.2495			0.0005
<b>Pilot valve bushing:-</b>					
Bushing O.D.	0.5635	0.5645			0.0005
Spline end O. D.	0.504	0.504			0.0005
Large diameter I.D.	0.281	0.281			0.0005
Small diameter I.D.	0.2475	0.2485			0.0005

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Utility Governor Group: (continued)					
Gearlands (3) O.D.	0.5675	0.5685			0.0005
Bushing (2) I.D.	0.376	0.377			0.0005
Speed adjusting shaft O. D.	0.373	0.3735			0.001
Terminal shaft O.D.	0.373	0.374			0.001
Relief valve sleeve I.D.	0.187	0.188			0.0005
Relief valve sleeve O.D.	0.4370	0.4373			0.0005
Idler gear stud O.D.	0.3130	0.3133			0.0005
Idler gear O.D.	1.120	1.216			0.0005
Idler gear 1. D. (measured over 0.148 diameter pins)	0.3140	0.3150			
Drive gear O. D.	1.120	1.126			0.001
Relief valve plunger O. D.	0.182	0.184			0.0005
Fuel Injection Group:					
Rack bearing bore	0.5007	0.5013			
Fuel rack diameter	0.4983	0.4987			
Fuel rack bearing clearance					0.005
Pump plunger length	2.5931	2.5937			2.5881
Cam shaft bearing bore	1.875	1.876			
Camshaft bearing journal diameter	1.8725	1.8735			
Camshaft bearing clearance					0.010
Accessory Drive Group:					
Idler gear end clearance			0.004	0.016	0.018
Idler gear bearing bore	1.376	1.381			
Idler gear shaft diameter	1.3736	1.3746			0.009

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Oil Pump Group:					
Drive shaft diameter	0.8745	0.8749			0.005
Gear to cover clearance			0.002	0.004	
Drive idler gear shaft diameter	1.1220	1.1230			0.008
Idler gear shaft diameter	0.8745	0.8749			0.008
Relief valve pressure spring O. D.	0.770	---			
Valve Mechanism Group:					
Rocker arm bearing bore	0.7260	0.7266			
Shaft diameter	0.7240	0.7250			0.008
Cylinder Head:					
Valve spring O.D.	1.386	---			
Valve stem O.D.	0.3712	0.3722			0.0010
Valve lip thickness:-					
Exhaust valve					0.070 (rein
Inlet valve					0.057 (rein
Valve face angle					29-1/4 degree
Inlet valve head diameter	2.015	2.025			
Exhaust valve head diameter	1.891	1.901			
Valve guide bore	0.3736	0.3756			0.0010
Valve spring free length					2.05
Valve guide projection above head (measure from valve spring seat to top of guide)					0.875
Valve seat insert bore depth	0.448	0.450			

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Cylinder Head: (continued)					
Inlet valve seat insert diameter	2.1280	2.1290			
Bore in head for seat insert	2.1250	2.1260			
Exhaust valve seat insert	2.0030	2.0040			
Bore in head for seat insert	2.0000	2.0010			
Valve seat face angle					30 degrees
Exhaust valve seat width					0.076
Inlet valve seat width					0.076
Maximum permissible closed valve projection:					
Inlet valve					0.134
Exhaust valve					0.154
Inlet valve seat face diameter					1.934 (Min) 1.984 (Max)
Exhaust valve seat face diameter					1.810 (Min) 1.860 (Max)
Angle to grind insert seat face to reduce maximum seat diameter					15 degrees
Lifter diameter	1.3100	1.3110			
Lifter bore in block	1.3135	1.3155			0.012
Camshaft Group:					
Camshaft bearing journal diameter	2.3105	2.3115			
Camshaft bearing to shaft clearance			0.002	0.006	0.008
Camshaft end clearance			0.004	0.010	0.025



Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Connecting Rods:					
Pin bearing bore	1.7009	1.7012			0.006
Center to center length	9.594	9.596			
Bore in rod forbearing	3.2495	3.2505			
Pin diameter	1.6997	1.7000			
Crankshaft journal bearing bore	3.002	3.006			0.010
Piston Group:					
Top ring to groove clearance			0.0028	0.0046	0.006
Intermediate ring to groove clearance			0.0023	0.0041	0.006
Oil control ring to groove clearance			0.0015	0.0033	0.006
Pin bore	1.6999	1.7001			0.006
Ring gap measured in unworn portion of liner bore size 4.750 in. **					
Top ring			0.017	0.023	
Intermediate ring			0.017	0.023	
Oil control ring			0.013	0.023	
*Increase in ring gap for each 0.001 in increase in liner bore					0.003

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Crankshaft Group:					
Connecting rod journal diameter	2.999	3.000			0.007
Maximum out of roundness					0.004
Main bearing journal diameter	3.499	3.500			0.008
Bearing to crankshaft clearance			0.0030	0.0059	0.010
Main bearing bore in cylinder block	3.8155	3.8165			
End play			0.0025	0.0145	0.025
Cylinder Block:					
Liner counterbore depth	0.400	0.402			
Camshaft bearing bore	2.5625	2.5635			
Camshaft bearing to block clearance			0.002	0.006	
Main bearing bore	3.8155	3.8165			
Cylinder liner bore	4.750	4.752			
Maximum permissible bore (worn) measured near top of piston ring travel					4.758
Cylinder liner flange thickness	0.4040	0.4056			

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Generator:-					
Bearing inside diameter	2.7551	2.7559			
Bearing outside diameter	5.9047	5.9055			
Shaft bearing surface diameter	2.7560	2.7565			
Endbell bearing contact surface	5.9055	5.9062			
Fuel Burning Winterization it:					
Heater Coolant Pump:					
ROTOR head diameter	0.904	0.906			
ROTOR head length	0.246	0.248			
ROTOR bore diameter	0.3033	0.3038			
Rotor blade slot width	0.0935	0.0945			
Rotor blade slot depth	0.263	0.268			
Blade:					
Height	0.247	0.249			
Thickness	0.091	0.093			
Width	0.247	0.249			
Adapter bore diameter	0.315	0.318			

Table 1-1. Repair and Replacement Standards (continued)

COMPONENT	MANUFACTURER'S DIMENSIONS AND TOLERANCES IN INCHES		DESIRED CLEARANCE		MAXIMUM ALLOWABLE WEAR AND CLEARANCE
	MIN	MAX	MIN	MAX	
Fuel Burning Winterization Kit:					
Heater Coolant Pump (continued):					
Relief valve spring free length					1.164
Heater Motor Endplay			0.010	0.025	
Heater fuel orifice assembly opening				0.012	
Electric Winterization Kit Coolant Pump:					
Relief valve spring free length					1, 164
Seal spring free length					0.470
Shaft diameter	0.3075	0.3175			
Rotor head diameter	0.904	0.906			
Rotor head length	0.246	0.248			
Rotor bore diameter	0.3033	0.3038			
Rotor blade slot width	0.0935	0.0945			
Rotor blade slot depth	0.262	0.268			
Blade:					
Height	0.247	0.249			
Thickness	0.091	0.093			
Width	0.247	0.249			
Adapter bore diameter	0.315	0.318			
Cam ringbore diameter	1.000	1.002			
Cam ring width	0.249	0.255			
Motor Endplay			0.010	0.025	

Table 1-2. Special Torque Data

COMPONENT	TORQUE VALUE
GENERATOR:	
Generator Mount to Skid Base Screws	600 foot pounds
Shaft Coupling to Flywheel Mounting Screws	150 foot pounds
Generator Frame to Flywheel Housing Mounting Screws	75 foot pounds
Main Stator Assembly Setscrews	5 foot pounds
Rectifier Assembly Setscrews	20 foot pounds
Spacer Setscrews	20 foot pounds
Shaft Coupling Screws	50 foot pounds
STARTER MOTOR	
Intermediate to Pinion Housing Screws	8 foot pounds
Mounting Screws	200 foot pounds
Valve Cover Screws	8 ± 2 foot pounds
Tachometer Drive Group Mounting Bolts	8 ± 2 foot pounds
Exhaust Manifold Mounting Bolts	29 to 35 foot pounds
Fuel Injection Pump Bushings	140 to 160 foot pounds
Fuel Injection Pump Nozzle Retaining Nuts	100 to 110 foot pounds
Fuel Injection Pump Fuel Line Nuts	25 to 35 foot pounds

Table 1-2. Special Torque Data (continued)

COMPONENT	TORQUE VALUE
ENGINE (continued)	
Cylinder Head Plug	96 to 144 inch pounds
Cylinder Head Chamber Assemblies	140 to 160 foot pounds
*Cylinder Head Bolts:	
Numerical Bolts	170 to 180 foot pounds
Alphabetical Bolts	27 to 37 foot pounds
Connecting Rod Cap Bolts	27 to 33 foot pounds (wet)
Accessory Drive Gear Retaining Nut	90 to 110 foot pounds
Timing Gear Cover Bolts	27 to 33 foot pounds
Crankshaft Pulley Bolt	210 to 250 foot pounds
Flywheel Housing Bolts	100 foot pounds
Flywheel Bolts	150 foot pounds
Water Pump Impeller Nut	25 to 35 foot pounds
Oil Pump Gear Retaining Nut	60 foot pounds
Main Bearing Cap Bolts	27 to 33 foot pounds (wet)
Turbocharger Wheel Retaining Nut	120 inch pounds (with shaft heated to 350°F) (when shaft is cooled to less than 150°F) 20 inch pounds (wet)
Turbocharger Collar Screws	30 to 40 inch pounds
Hydraulic Pump Elbow Fittings	65 to 75 inch pounds
*See figure 8-56 for cylinder head tightening sequence	

Table 1-3. Time Standards

MAINTENANCE OPERATIONS	MAN-HOURS
03 Generator Set Housing	
(to replace)	5.0
(to repair)	3.0
Doors	
(to repair)	1.0
Covers	
(to repair)	1.0
Panels	
(to repair)	1.0
04 Radiator Assembly	
(to repair)	2.0
(to overhaul)	5.0
Shutters Assembly	
(to repair)	2.0
Radiator	
(to test)	2.0
(to repair)	2.0
Radiator Core	
(to replace)	3.0
(to repair)	3.0
05 Engine Wiring	
(to overhaul)	2.0
Wire Harness	
(to rebuild)	4.0
06 Generator Control Assembly	
(to test)	3.0
(to adjust)	1.0
(to replace)	5.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
(to repair)	3.0
(to overhaul)	4.0
(to rebuild)	4.0
Generator Wire Harness	
(to replace)	1.0
(to rebuild)	4.0
Control Cubicle Controls and Instrument Panel	
(to replace)	0.50
AC Wattmeter	
(to test)	0.5
AC Ammeter	
(to test)	0.5
Frequency Meter	
(to test)	1.0
Frequency Transducer	
(to test)	0.5
Precise Governor Assembly	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.5
(to rebuild)	2.0
Precise Governor Electric Control Unit	
(to test)	1.0
(to adjust)	0.5
(to replace)	0.2
(to repair)	1.0
(to overhaul)	3.0
(to rebuild)	5.0



Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Precise Governor Load Measurement Unit	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
(to rebuild)	1.0
Precise Governor Electro-Hydraulic Actuator	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.5
(to repair)	1.0
(to overhaul)	1.0
(to rebuild)	1.0
Exciter Regulator	
(to inspect)	0.5
(to test)	1.0
(to adjust)	0.2
(to replace)	0.5
(to repair)	2.0
(to overhaul)	2.0
(to rebuild)	2.0
Fault Locating Indicator Box	
(to test)	1.0
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.5

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
DC Circuit Breaker Box	
(to test)	0.2
(to replace)	0.1
(to repair)	0.5
(to overhaul)	0.5
Tactical Relay Box	
(to replace)	0.2
(to repair)	2.0
(to overhaul)	2.0
Over Voltage Relay	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Reverse Power Relay	
(to test)	0.2
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Short Circuit Relay	
(to test)	0.2
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Precise Relay Box	
(to replace)	0.5
(to repair)	2.0
(to overhaul)	2.0
Under Voltage Relay	
(to test)	0.2
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Under Frequency Relay (50/60 Hertz)	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Permissive Paralleling Relay	
(to test)	0.5
(to adjust)	0.2
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Mode I Relay Box	
(to test)	1.0
(to adjust)	0.2
(to replace)	0.5
(to repair)	2.0
(to overhaul)	2.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Mode II Relay Box (add times of Precise and Mode I Relay Box for each category)	
Under Frequency Relay (400 Hertz)	
(to test)	0.2
(to adjust)	0.2
(to repair)	2.0
(to overhaul)	2.0
Load Contactor, Motor Operated Circuit Breaker, Current Transformer, and Load and Reconnection Terminal Boards	
(to test)	0.2
(to replace)	4.0
(to repair) - 50/60 Hertz units	2.0
(to repair) -400 Hertz units	2.5
(to overhaul) - 50/60 Hertz units	2.0
(to overhaul) -400 Hertz units	3.0
AC Output Receptacle Box	
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.0
Convenience Receptacle Box	
(to replace)	0.2
(to repair)	0.5
(to overhaul)	0.5
07 Generator Assembly	
(to test)	3.0
(to replace)	4.0
(to repair)	4.0
(to overhaul)	40.0
(to rebuild)	40.0
Bearing	
(to replace)	2.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Rotating Rectifier	
(to inspect)	1.0
(to test)	1.5
(to replace)	2.0
(to repair)	2.0
(to overhaul)	2.0
Generator Fan	
(to inspect)	1.0
(to replace)	4.0
Rotor Assembly	
(to inspect)	2.0
(to test)	1.0
(to replace)	4.0
(to repair)	20.0
(to overhaul)	20.0
(to rebuild)	
Exciter Rotor	
(to inspect)	2.0
(to test)	1.0
(to repair)	8.0
(to replace)	4.0
(to overhaul)	20.0
(to rebuild)	20.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Main Stator Assembly	
(to inspect)	1.0
(to test)	1.0
(to replace)	4.0
(to repair)	20.0
(to overhaul)	20.0
(to rebuild)	20.0
Exciter Stator	
(to inspect)	1.0
(to test)	1.0
(to replace)	4.0
(to repair)	20.0
(to overhaul)	20.0
(to rebuild)	20.0
08 Engine	
Engine Assembly	
(to replace)	6.0
(to repair)	15.0
(to overhaul)	30.0
(to rebuild)	106

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Alternator Assembly	
(to repair)	1.0
(to overhaul)	2.0
(to rebuild)	4.0
Diodes	
(to inspect)	0.2
(to test)	0.5
(to replace)	1.0
Rotor	
(to test)	0.5
(to replace)	0.5
(to overhaul)	2.0
Starter Assembly	
(to repair)	2.0
(to overhaul)	8.0
(to rebuild)	10.0
Starter Solenoid	
(to replace)	1.0
Starter Armature	
(to test)	1.0
(to replace)	1.0
(to repair)	3.0
(to overhaul)	6.0
Starter Drive	
(to replace)	1.0
(to repair)	1.0
Field Assembly	
(to test)	1.0
(to replace)	1.0
(to repair)	3.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Fan Mounting Group	
(to replace)	0.4
(to repair)	0.1
Day Tank Assembly	
(to adjust)	0.5
(to repair)	1.0
Over speed Governor Switch	
(to adjust)	0.5
(to repair)	1.0
(to overhaul)	2.0
(to rebuild)	2.0
Tachometer Drive	
(to replace)	0.2
(to repair)	1.0
Fuel Pump Group	
(to replace)	0.4
(to repair)	0.4
Turbocharger Group	
(to repair)	2.4
(to overhaul)	2.5
(to rebuild)	3.3
Oil Cooler Group	
(to replace)	2.0
(to repair)	4.0
Water Pump Group	
(to repair)	1.2



Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Hydraulic Oil Tank Assembly (used on Precise Generator Sets only)	
(to replace)	0.5
(to repair)	1.0
Hydraulic Pump (used on Precise Generator Sets only)	
(to test)	1.0
(to replace)	0.5
(to repair)	0.5
(to overhaul)	1.0
(to rebuild)	2.0
(to adjust)	0.5
Hydraulic Pump Drive Group	
(to replace)	0.2
(to repair)	1.0
(to overhaul)	1.2
Crankshaft Pulley	
(to replace)	
Damper	
(to replace)	3.0
Timing Gear Cover	
(to replace)	4.0
Timing Gears	
(to replace)	4.5
Utility Governor Group	
(to test)	0.5
(to replace)	0.5
(to repair)	1.0
(to overhaul)	3.0
(to rebuild)	4.0
(to adjust)	0.5

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Governor Linkage	
(to replace)	1.0
(to repair)	1.0
(to adjust)	0.2
Fuel Injection Lines	
(to replace)	0.5
Valve Assemblies	
(to test)	1.0
(to replace)	4.0
(to repair)	6.0
(to overhaul)	6.0
(to adjust)	0.5
Injection Pump	
(to test)	2.0
(to replace)	0.4
(to repair)	6.0
(to overhaul)	8.0
(to rebuild)	10.0
Accessory Drive Group	
(to replace)	0.7
(to repair)	1.0
(to overhaul)	1.2
Exhaust Manifold Group	
(to replace)	0.9
Oil Pan Group	
(to replace)	0.9
(to repair)	0.1

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN- HOURS
Oil Pump Group	
(to test)	0.3
(to replace)	1.0
(to repair)	1.5
Valve Mechanism Group	
(to replace)	0.5
(to repair)	0.8
Arm Assemblies	
(to replace)	0.5
(to adjust)	0.6
Push Rods	
(to replace)	0.5
Cylinder Head Group	
(to replace)	5.0
(to repair)	2.0
(to overhaul)	4.0
(to rebuild)	4.0
Intake and Exhaust Valves	
(to test)	0.5
(to replace)	1.6
(to repair)	2.0
Valve Springs	
(to test)	1.0
(to replace)	1.6
Intake and Exhaust Valve Inserts	
(to replace)	1.2
Valve Guides	
(to replace)	2.4
Flywheel and Flywheel Housing Group	
(to replace)	2.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Flywheel (to replace)	0.3
Flywheel Ring Gear (to replace)	0.9
Flywheel Housing (to replace)	1.7
Camshaft Group (to replace)	7.0
Connecting Rods and Pistons Group (to replace)	6.0
Connecting Rod (to replace)	0.2
Rod Bearings (to replace)	0.4
Piston Pins (to replace)	0.2
Piston Rings (to replace)	0.5
Crankshaft Group and Main Bearings (to replace)	5.0
Cylinder Block (to replace)	48.0
Cylinder Sleeves (to replace)	0.5
09 Fuel Burning Winterization Kit (Regular) (to repair)	1.0
(to overhaul)	2.0
Heater Control Assembly (to repair)	0.5

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Valve	
(to inspect)	0.2
(to replace)	0.5
Nozzle	
(to inspect)	0.5
(to replace)	0.5
Terminal Board	
(to replace)	0.2
Switch	
(to replace)	0.2
Burner Assembly	
(to replace)	0.5
(to repair)	0.5
Head Assembly	
(to inspect)	0.5
(to replace)	1.0
Blower Assembly	
(to replace)	1.0
(to repair)	2.0
Fan Motor Assembly	
(to replace)	1.0
(to repair)	1.0
Fan	
(to replace)	1.0
Motor	
(to replace)	0.5
Coolant Pump	
(to replace)	1.0
(to repair)	2.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
10 Sub Base Assembly	
(to replace)	6.0
(to repair)	2.0
Main Fuel Tank	
(to replace)	1.0
(to repair)	2.0
Fuel Transmitter	
(to test)	0.5
(to replace)	1.0
Fuel Burning Winterization Kits (Auxiliary)	
(to replace)	1.0
(to repair)	2.0
(to overhaul)	3.0
(to rebuild)	3.0
Fuel Pumps	
(to repair)	1.0
Control Assembly	
(to repair)	1.0
Terminal Board	
(to replace)	0.5
Heater Relay	
(to test)	0.5
(to replace)	0.2
Wire Harness	
(to rebuild)	2.0
Flame Switch	
(to replace)	0.5
Burner Assembly	
(to replace)	1.0

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Blower Assembly	
(to replace)	1.0
(to repair)	1.0
12 Electric Winterization Kit (Regular and Auxiliary)	
(to overhaul)	1.0
(to rebuild)	1.0
Heater Assembly	
(to replace)	1.0
(to repair)	1.0
(to overhaul)	1.0
Coolant Pumps	
(to replace)	1.0
(to repair)	1.0
Heat Exchange (Coil)	
(to inspect)	0.2
(to test)	0.2
(to replace)	0.5
(to repair)	1.0
Transformer	
(to test)	0.2
(to replace)	0.2
Semi-Conductors	
(to inspect)	0.2
(to test)	0.1
(to replace)	0.5

Table 1-3. Time Standards (continued)

MAINTENANCE OPERATIONS	MAN-HOURS
Wheel Mounting Kit	
(to install)	3.5
(to replace)	3.5
Load Bank	
(to test)	1.0
(to repair)	2.0
(to overall)	4.0
Wire Harness	
(to rebuild)	3.0



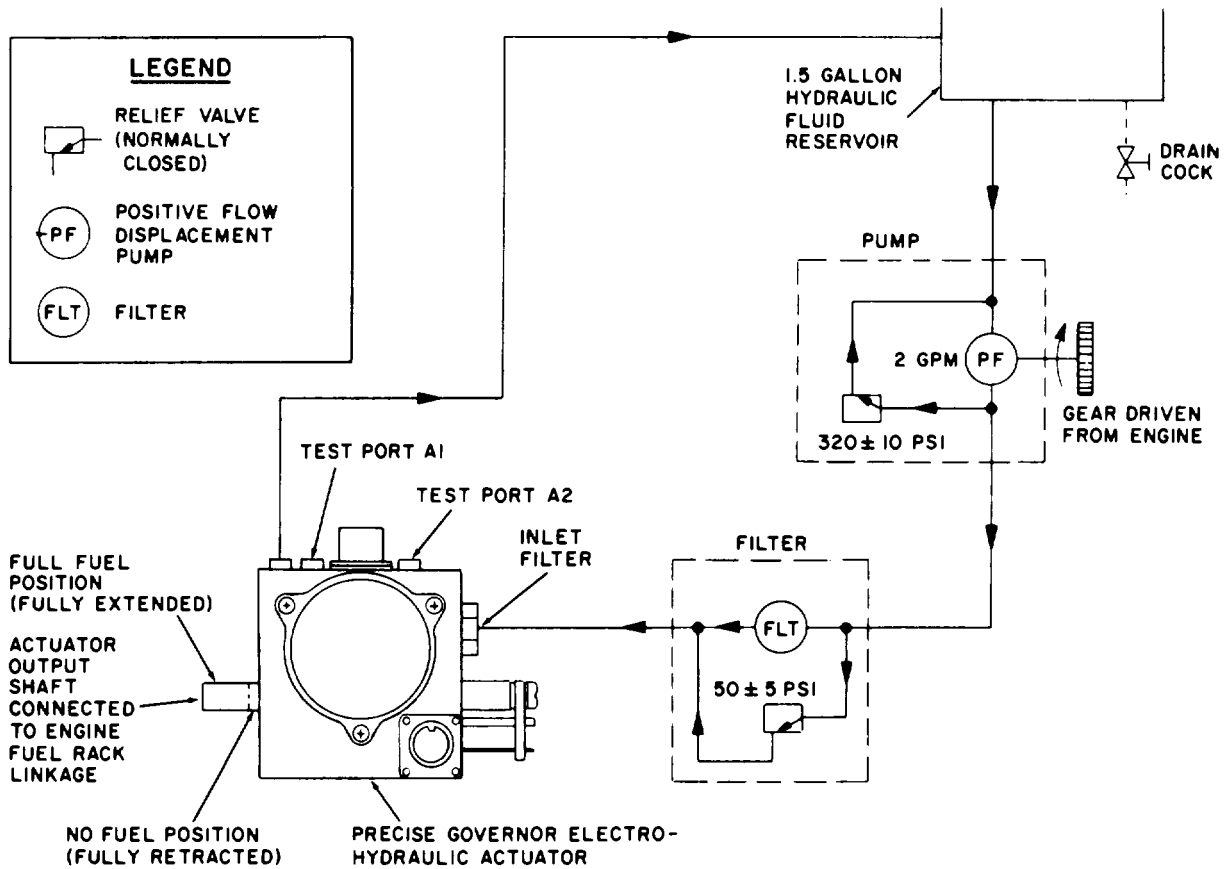
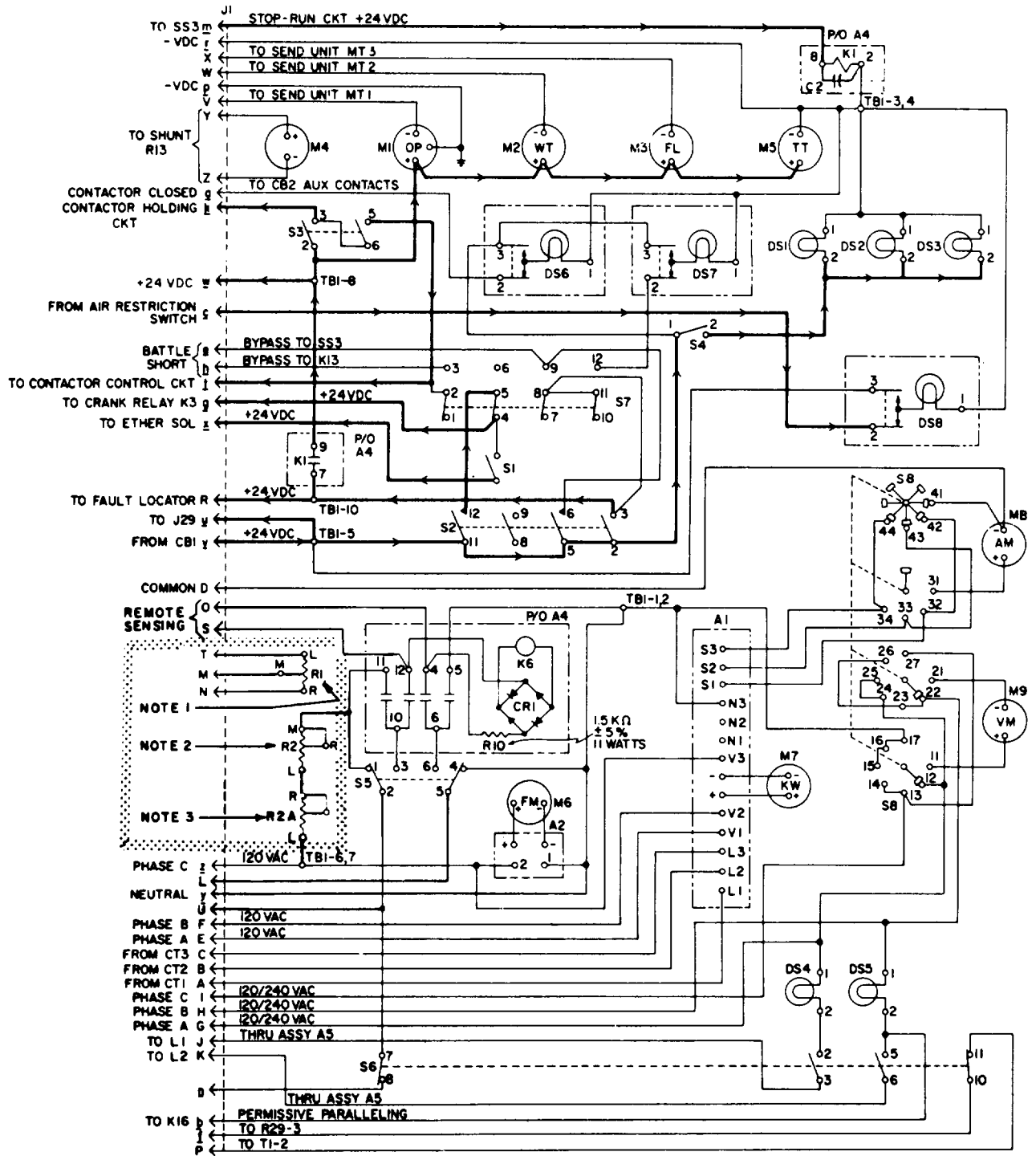


Figure 1-1. Hydraulic system schematic, precise generation sets.





NOTES

- |                     |                |                     |                |                             |
|---------------------|----------------|---------------------|----------------|-----------------------------|
| 1. 50/60 HERTZ SETS | 400 HERTZ SETS | 2. 50/60 HERTZ SETS | 400 HERTZ SETS | 3. USED ONLY 400 HERTZ SETS |
| 500Ω                | 500Ω           | 250Ω                | 75Ω            | 250Ω                        |
| ±10%                | ±10%           | ±10%                | ±10%           | ±10%                        |
| 12.5 WATTS          | 3 WATTS        | 25 WATTS            | 25 WATTS       | 25 WATTS                    |

Figure 1-6. Control cubicle (A3) schematic



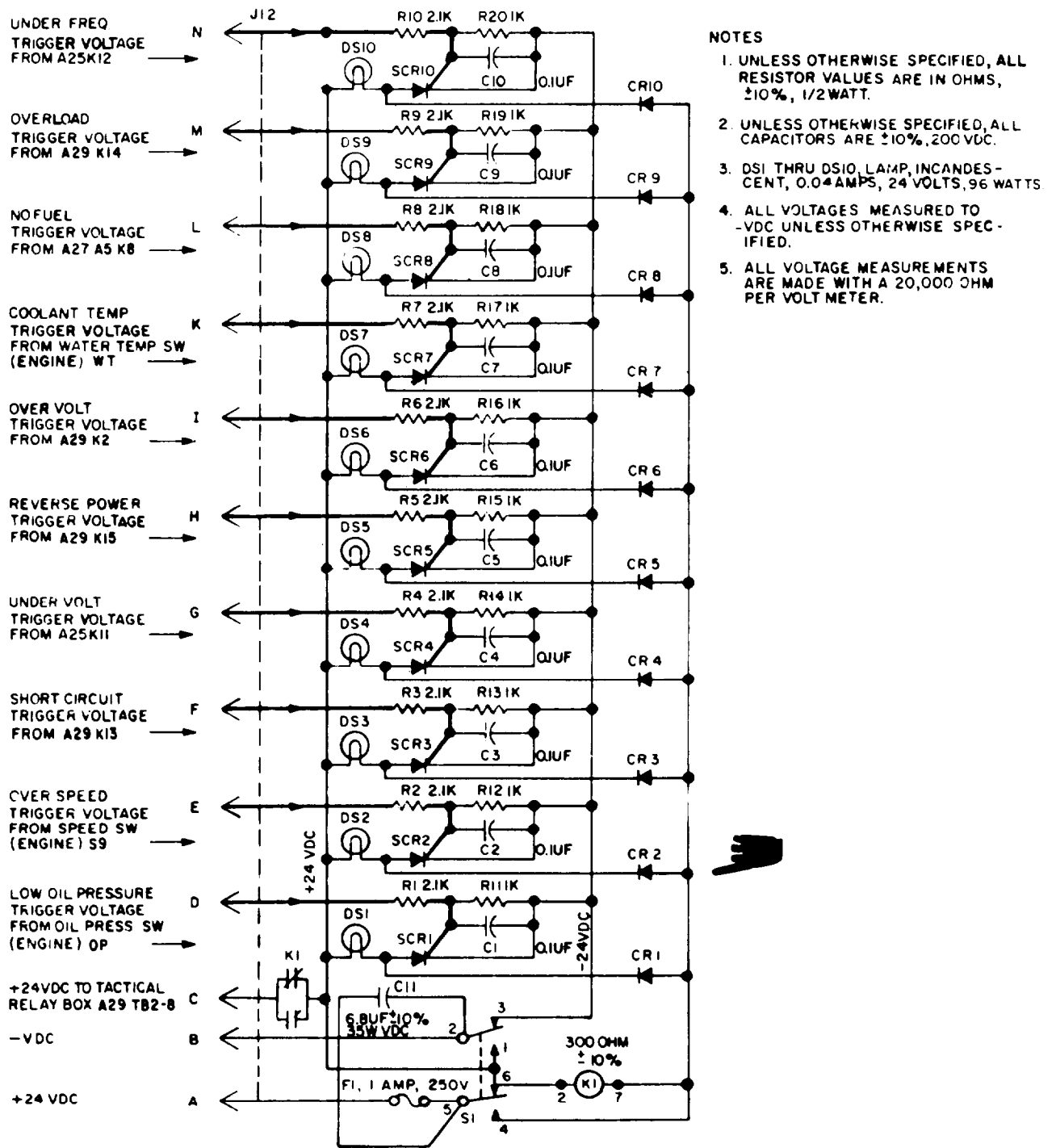


Figure 1-8. Fault locating indicator (A9) schematic

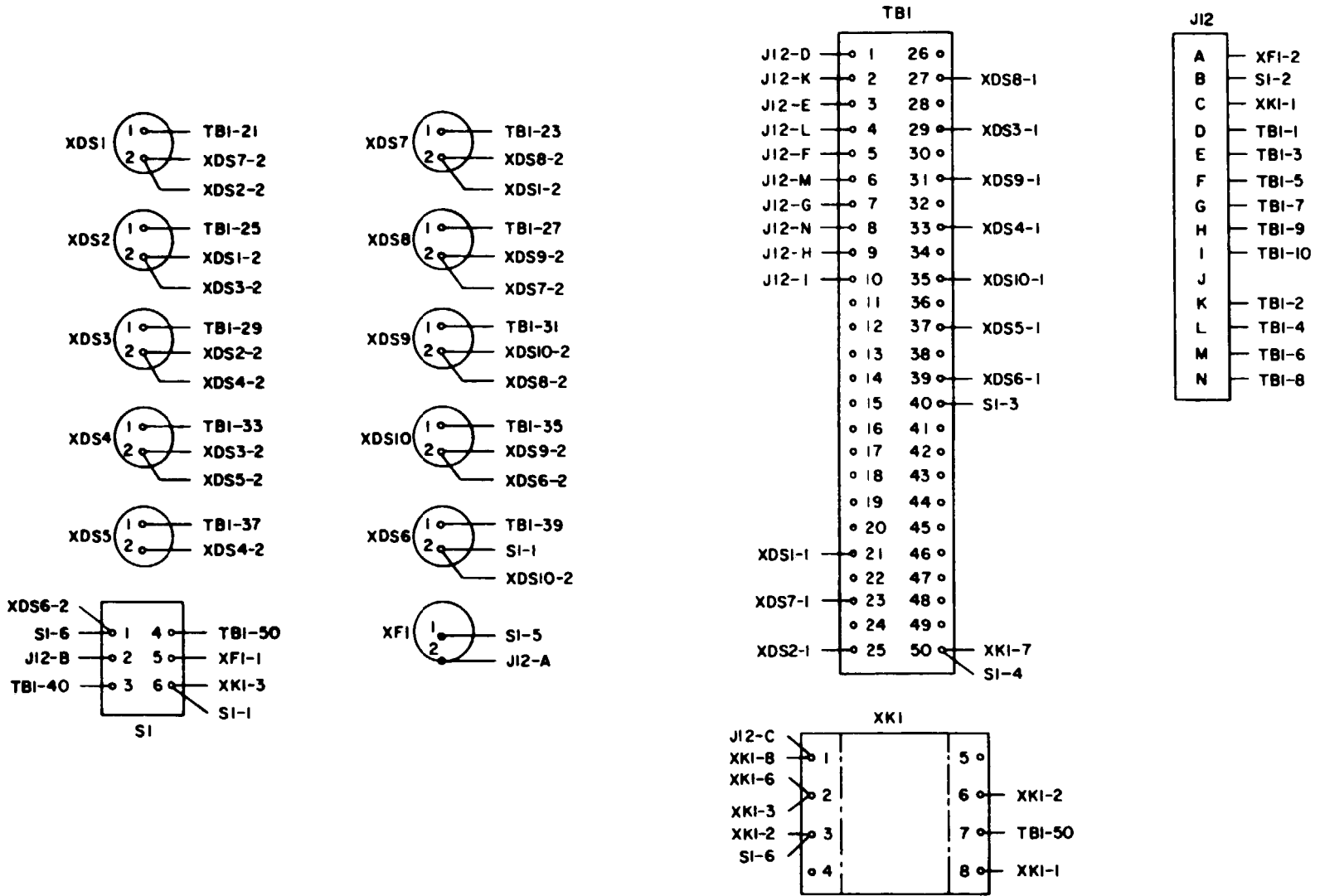


Figure 1-9. Fault locating indicator (A9) wiring diagram

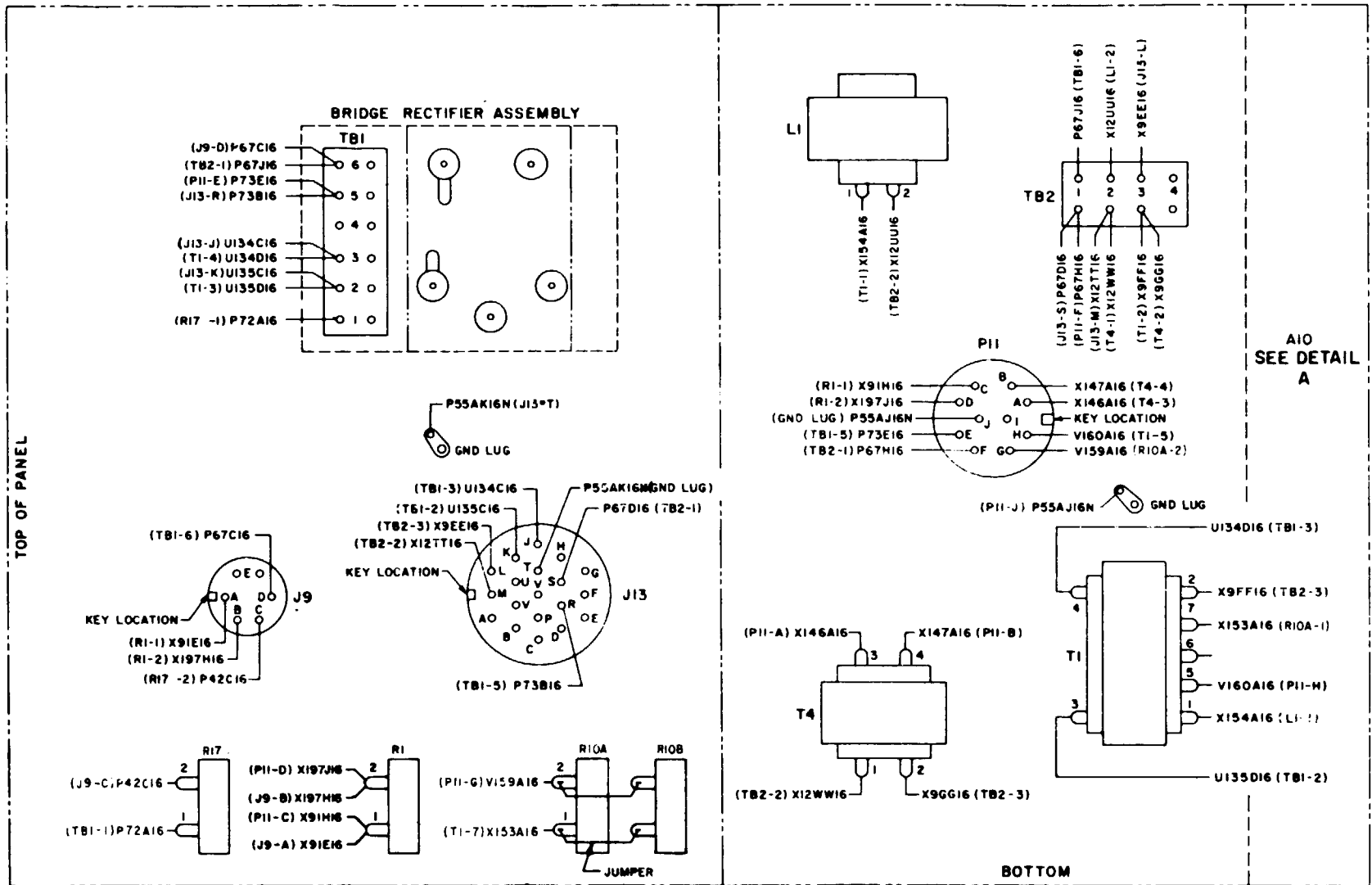


Figure 1-11. Exciter regulator (A10 and A11) 50/60 Hertz wiring diagram (sheet 1 of 2)

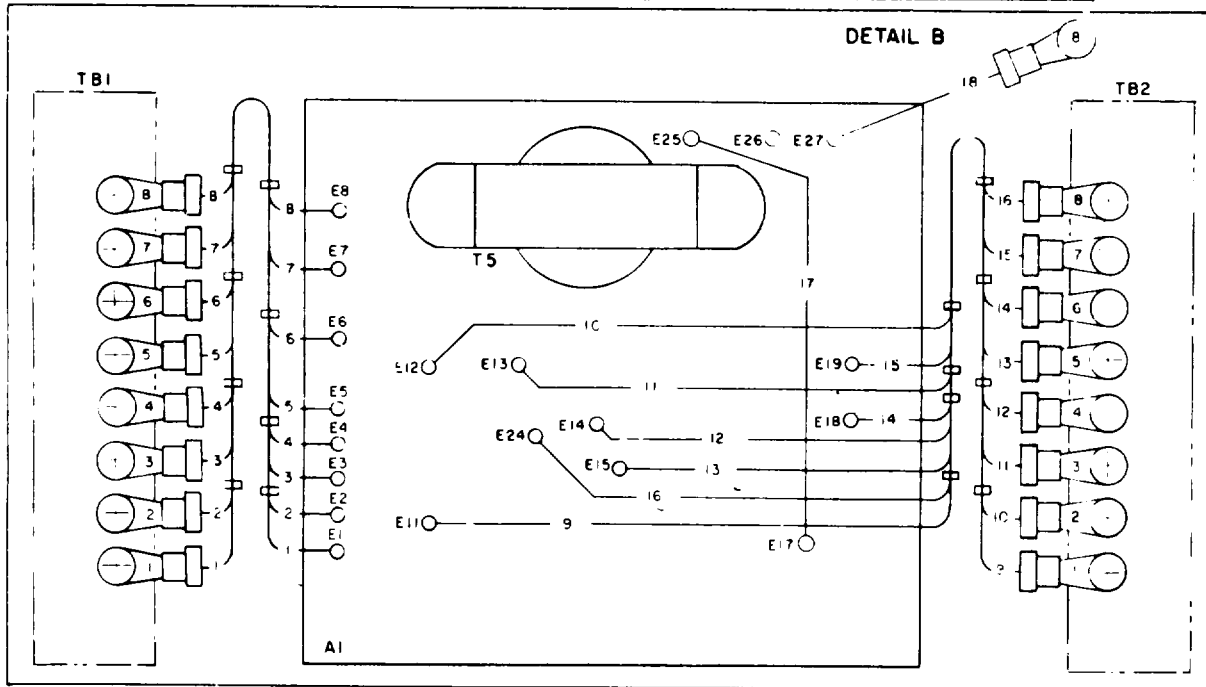
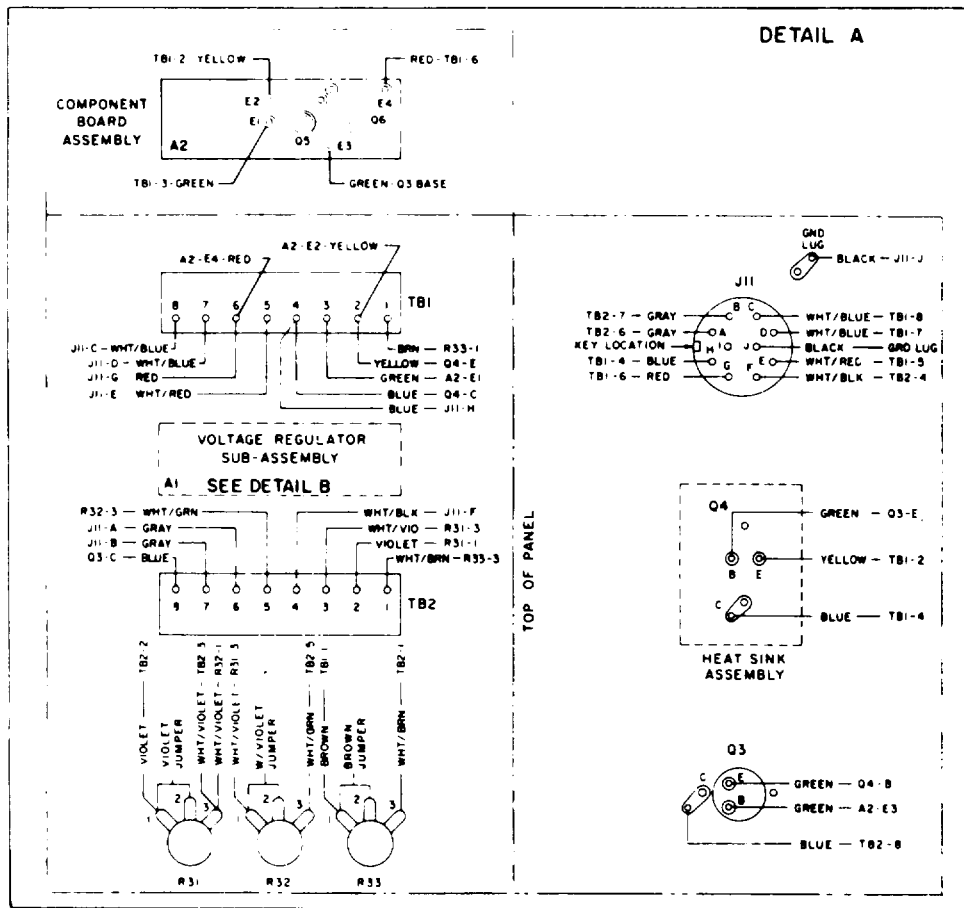


Figure 1-11. Exciter regulator (A10 and A11) 50/60 Hertz wiring diagram (sheet 2 of 2)



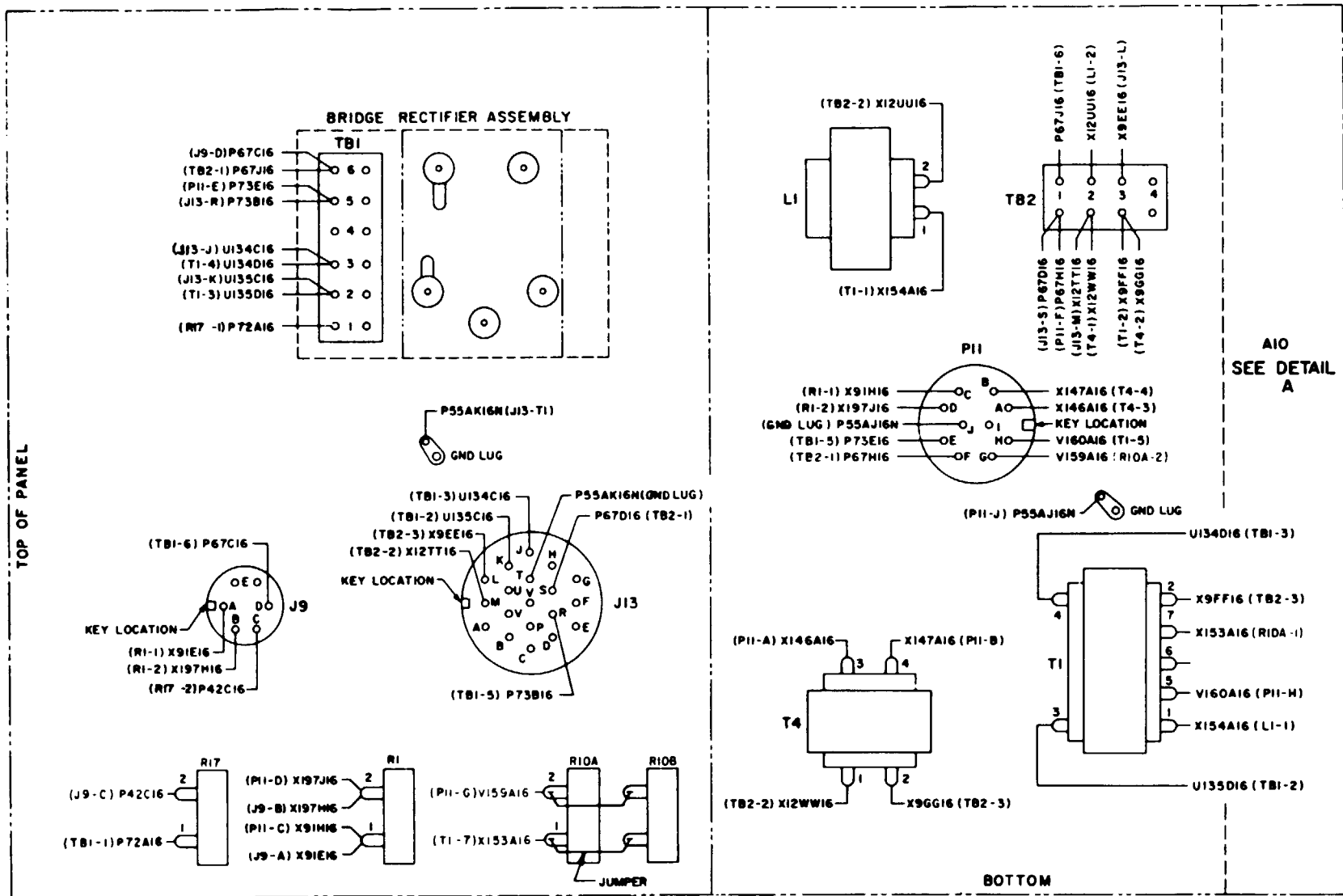
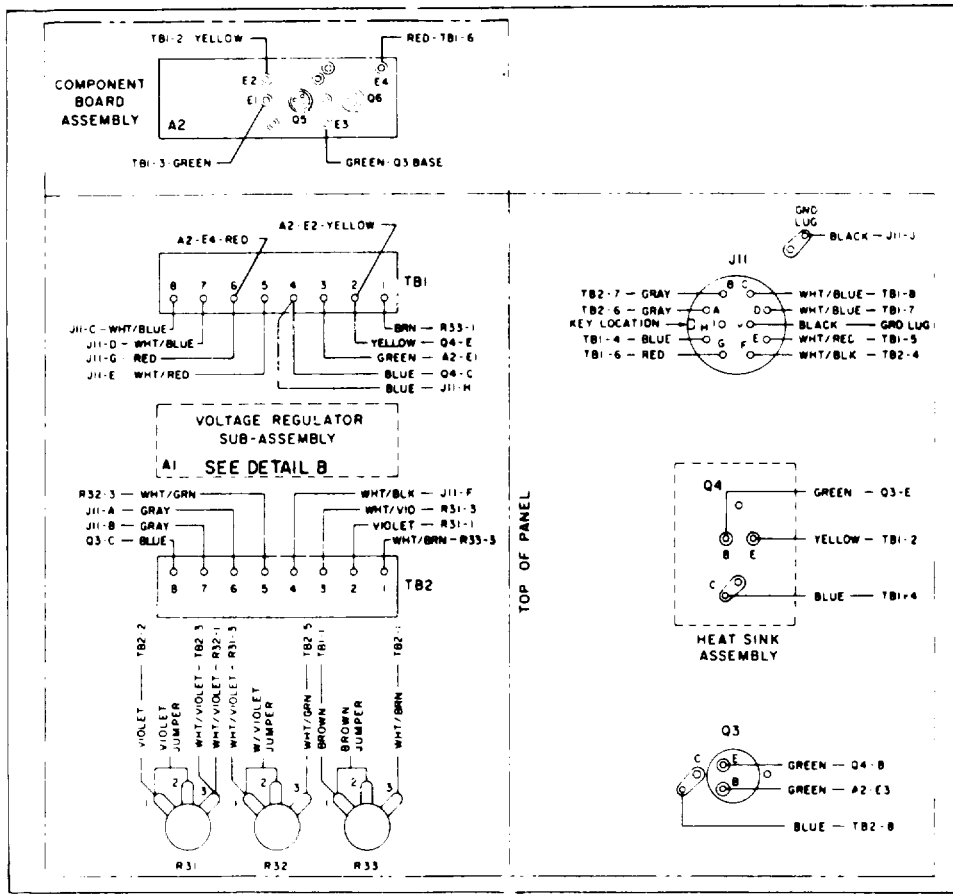
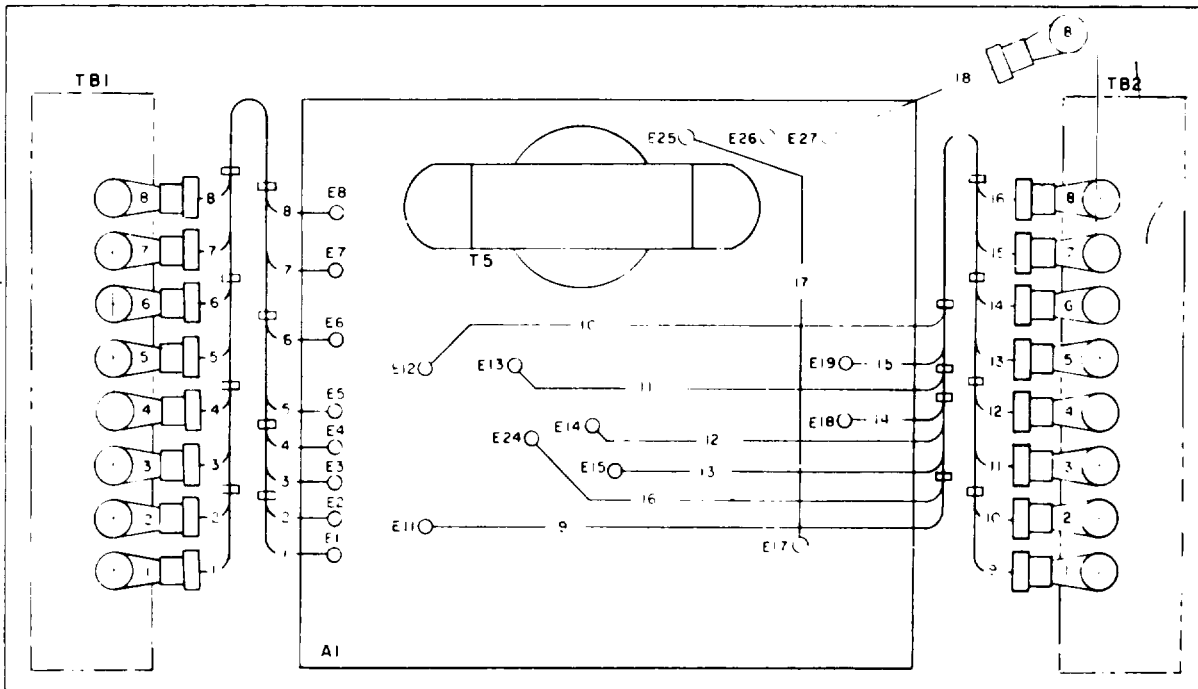


Figure 1-13. Exciter regulator (A10 and A11) 400 Hertz wiring diagram (sheet 1 of 2)



DETAIL A



DETAIL B

Figure 1-13. Exciter regulator (A10 and A11) 400 Hertz wiring diagram (sheet 2 of 2)

Change 1 1-101/(1-102 blank)

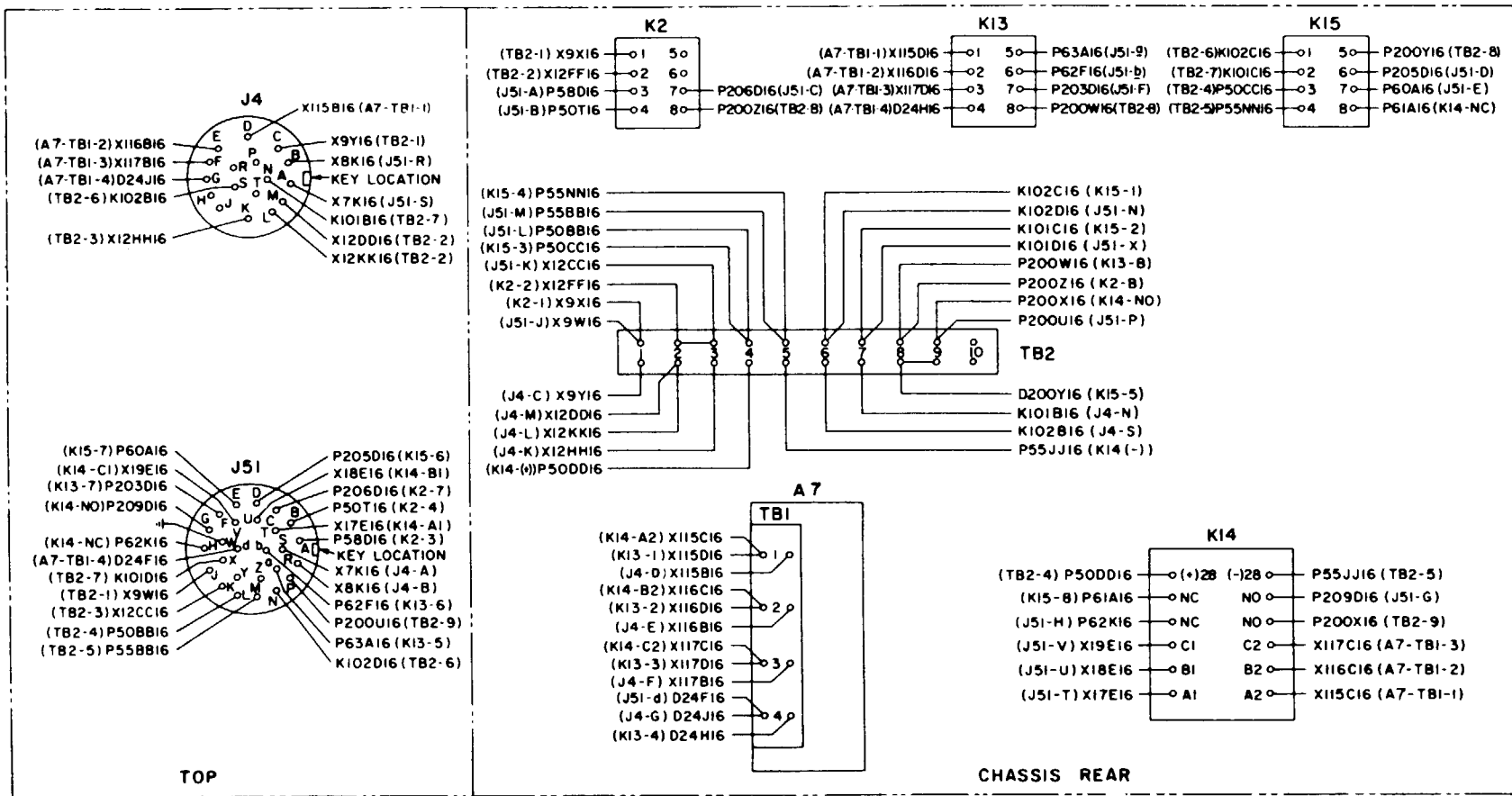


Figure 1-19. Tactical relay box (A29) wiring diagram



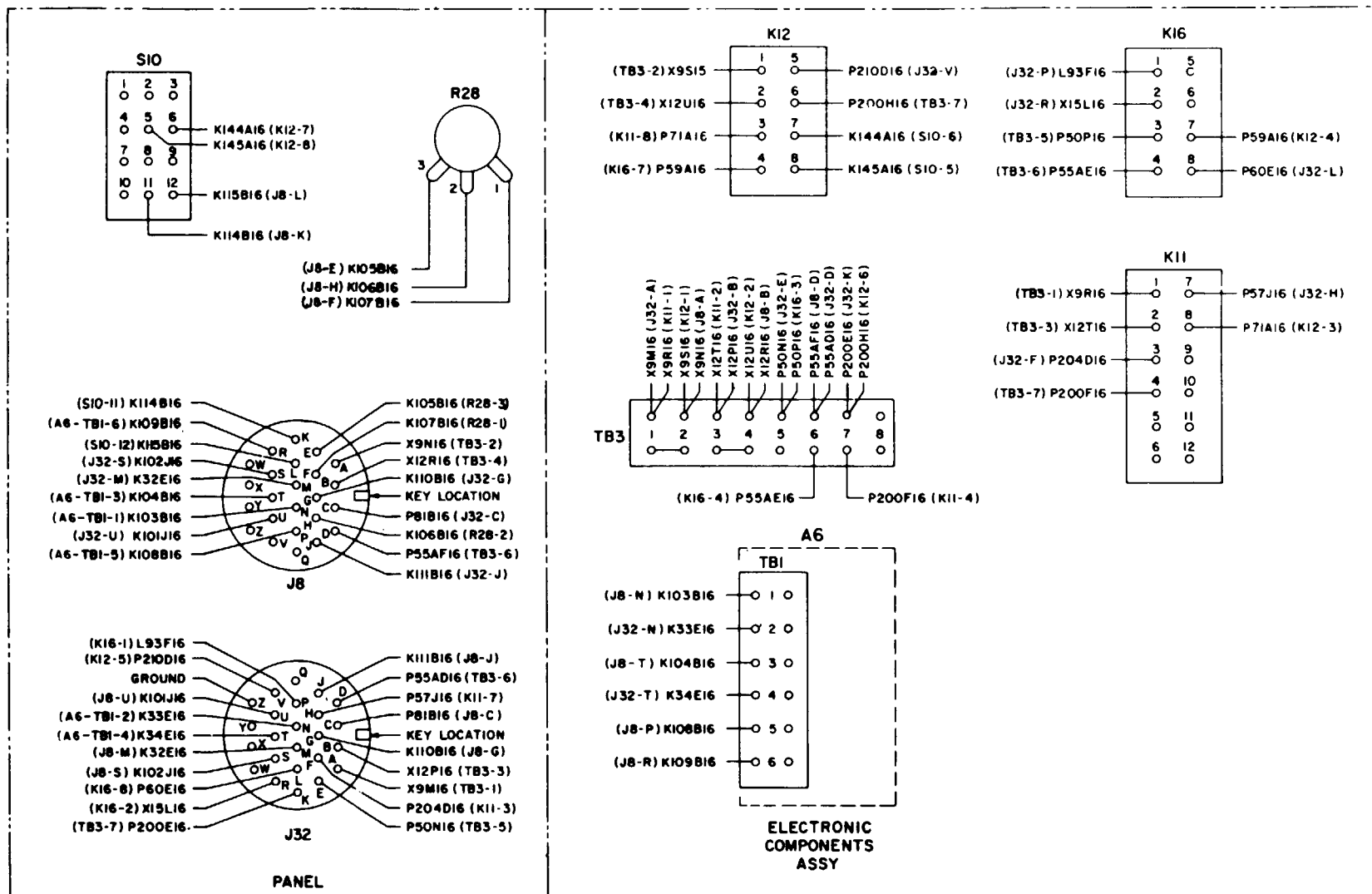


Figure 1-21. Precise relay box (A25) wiring diagram precise 50/60 Hertz generator sets



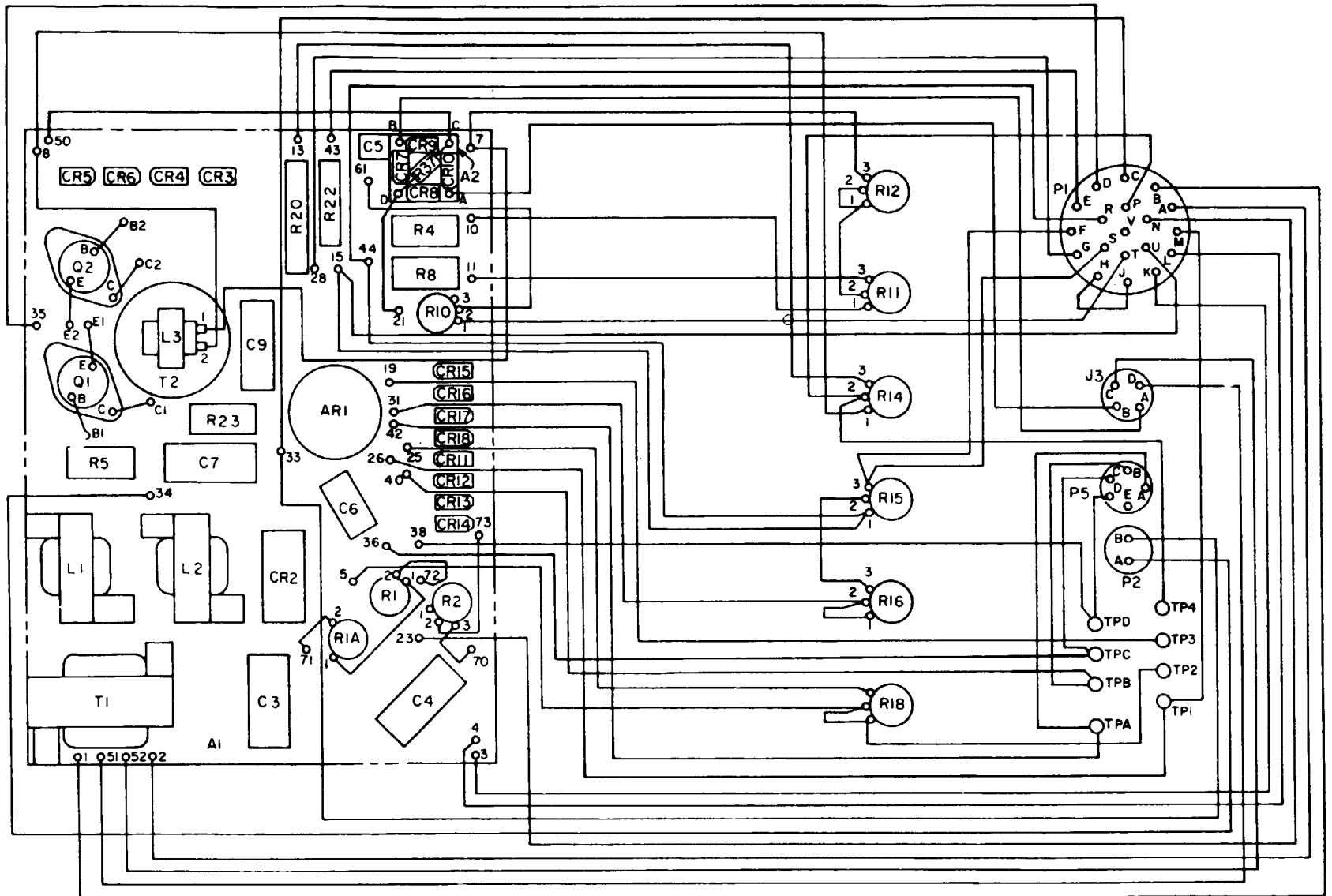


Figure 1-24. 50/60 Hertz precise governor control unit (A23) wiring diagram

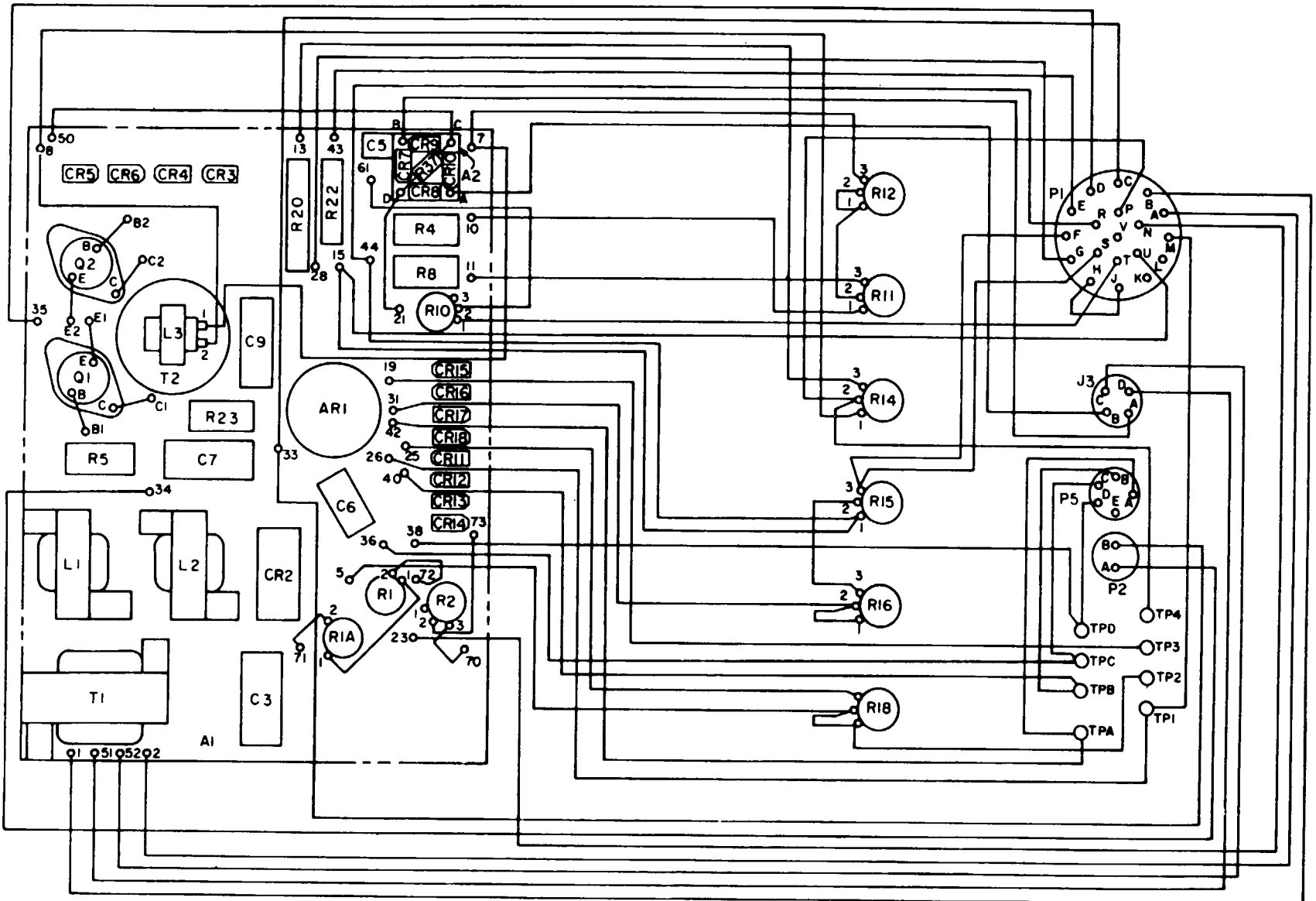


Figure 1-25. 400 Hertz precise governor control unit (A23) wiring diagram



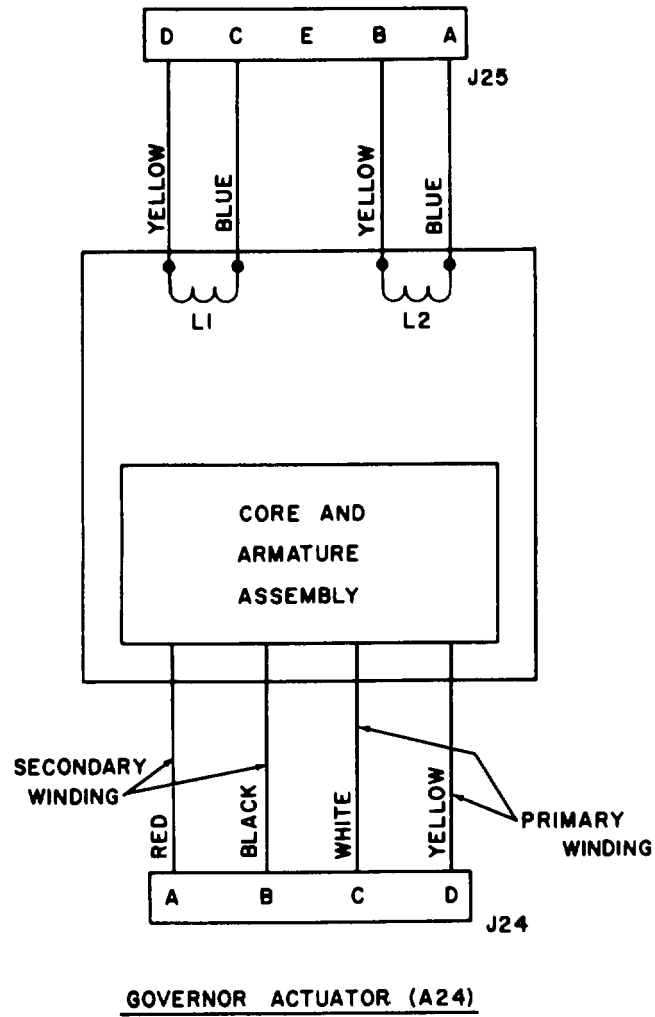


Figure 1-26. Precise governor actuator (A24) wiring diagram

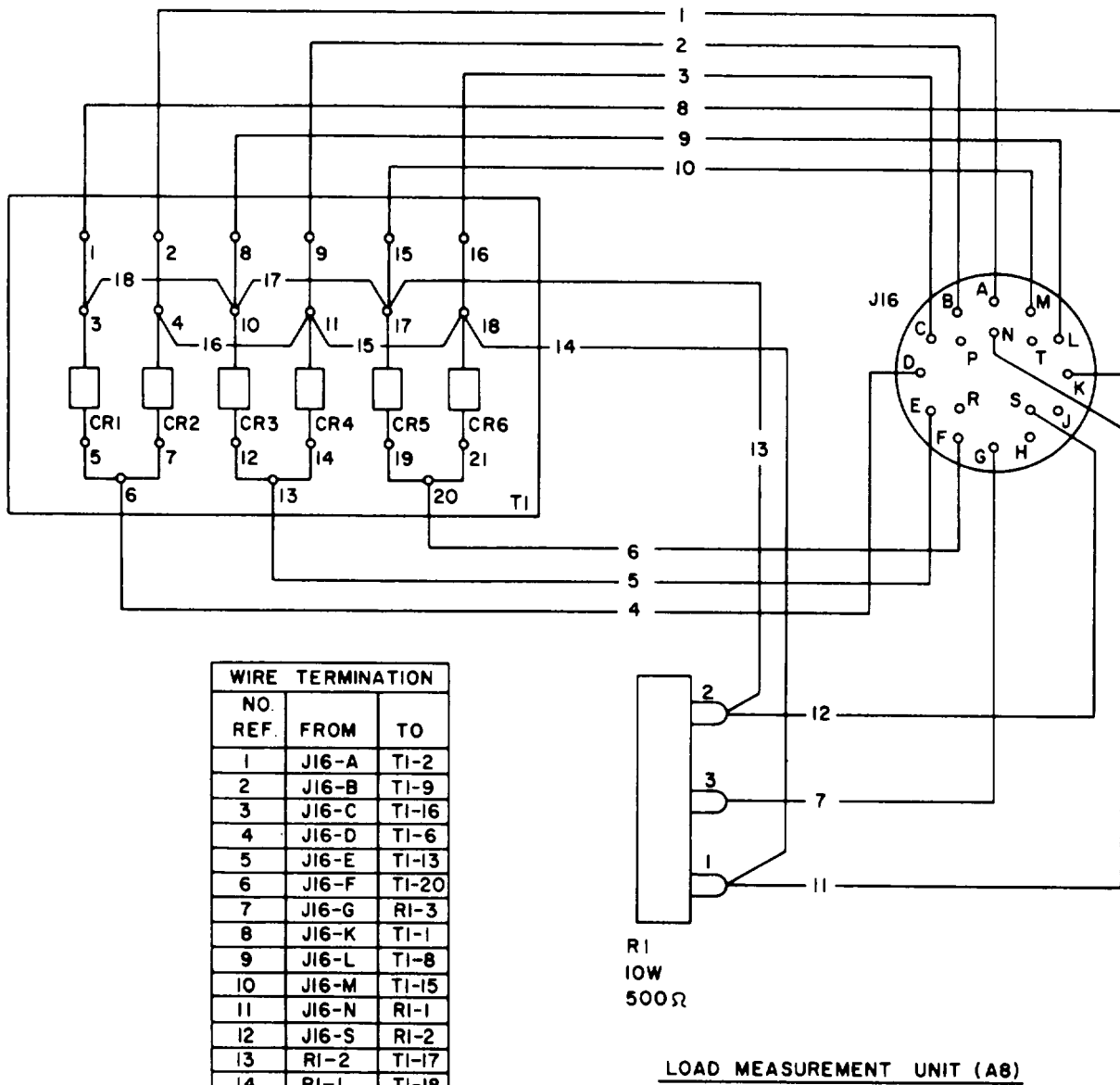


Figure 1-27. Load measuring unit (A8) wiring diagram

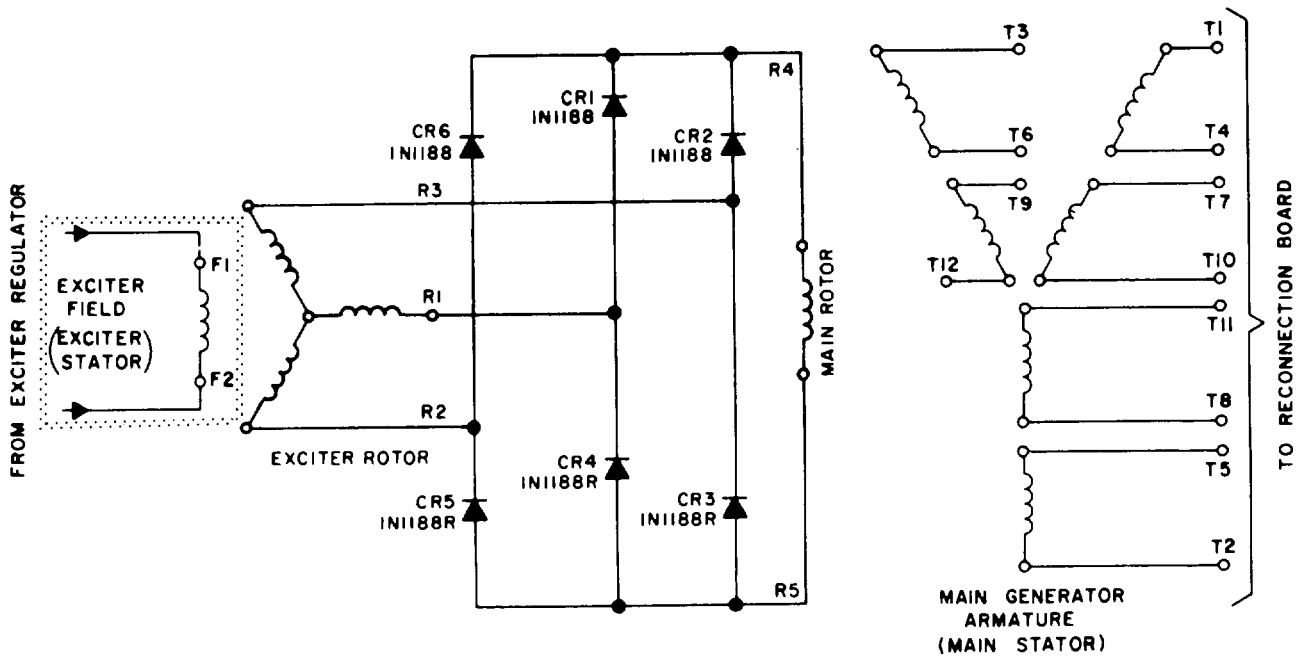


Figure 1-28. Generator assembly simplified schematic diagram

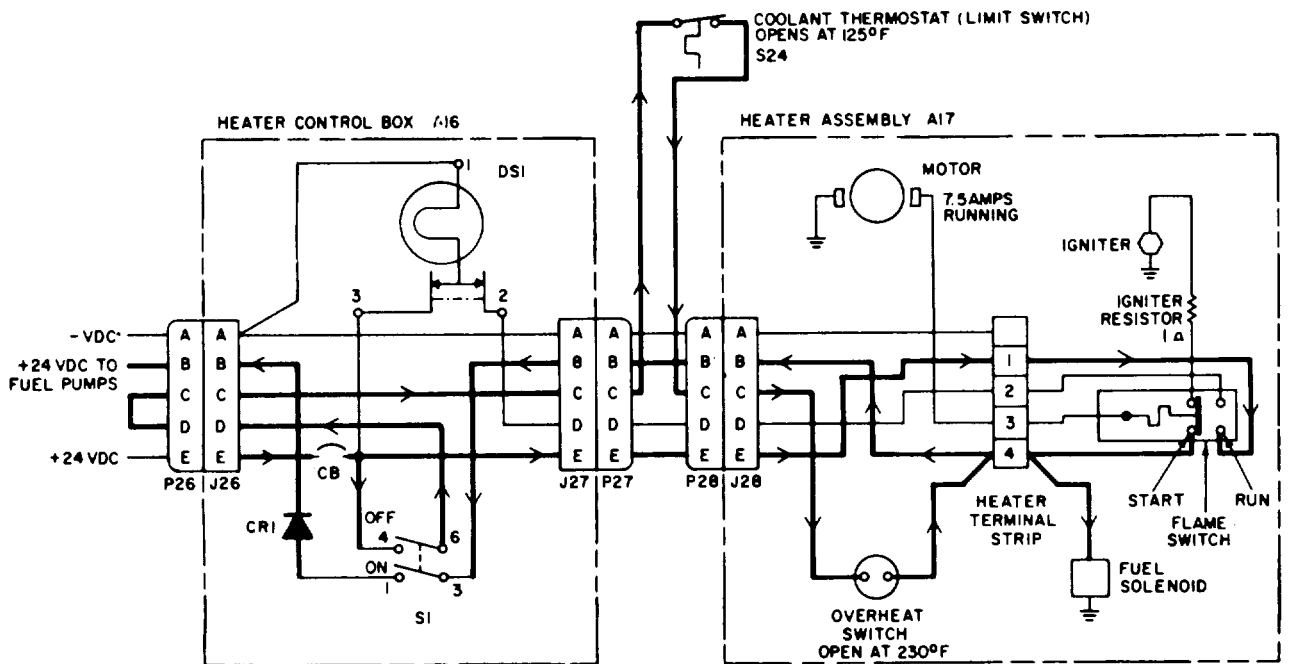


Figure 1-29. Fuel burning winterization kit (A17) schematic

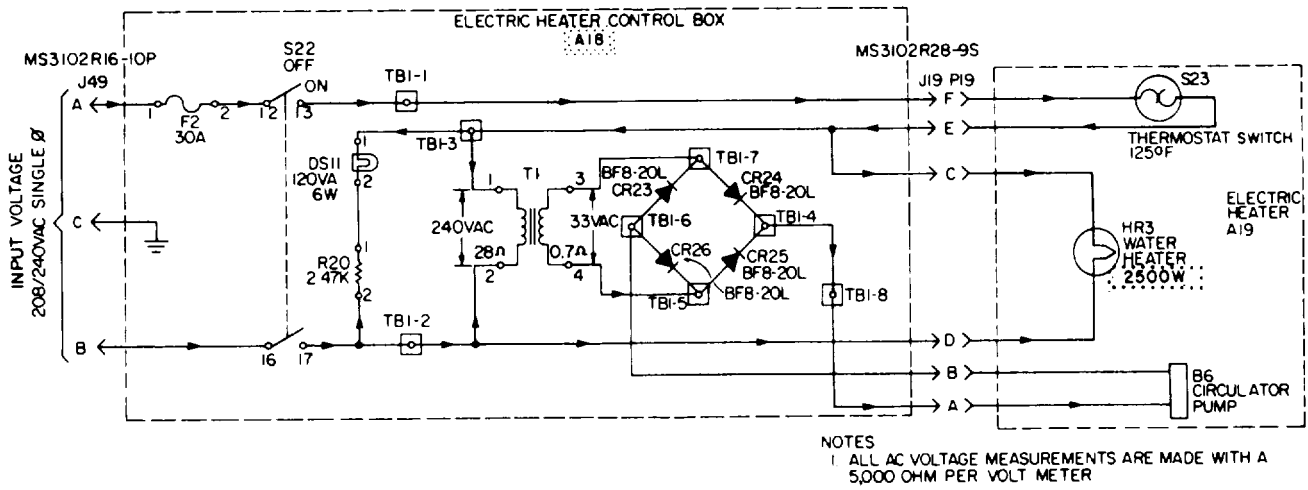


Figure 1-30. Electric winterization kit schematic.

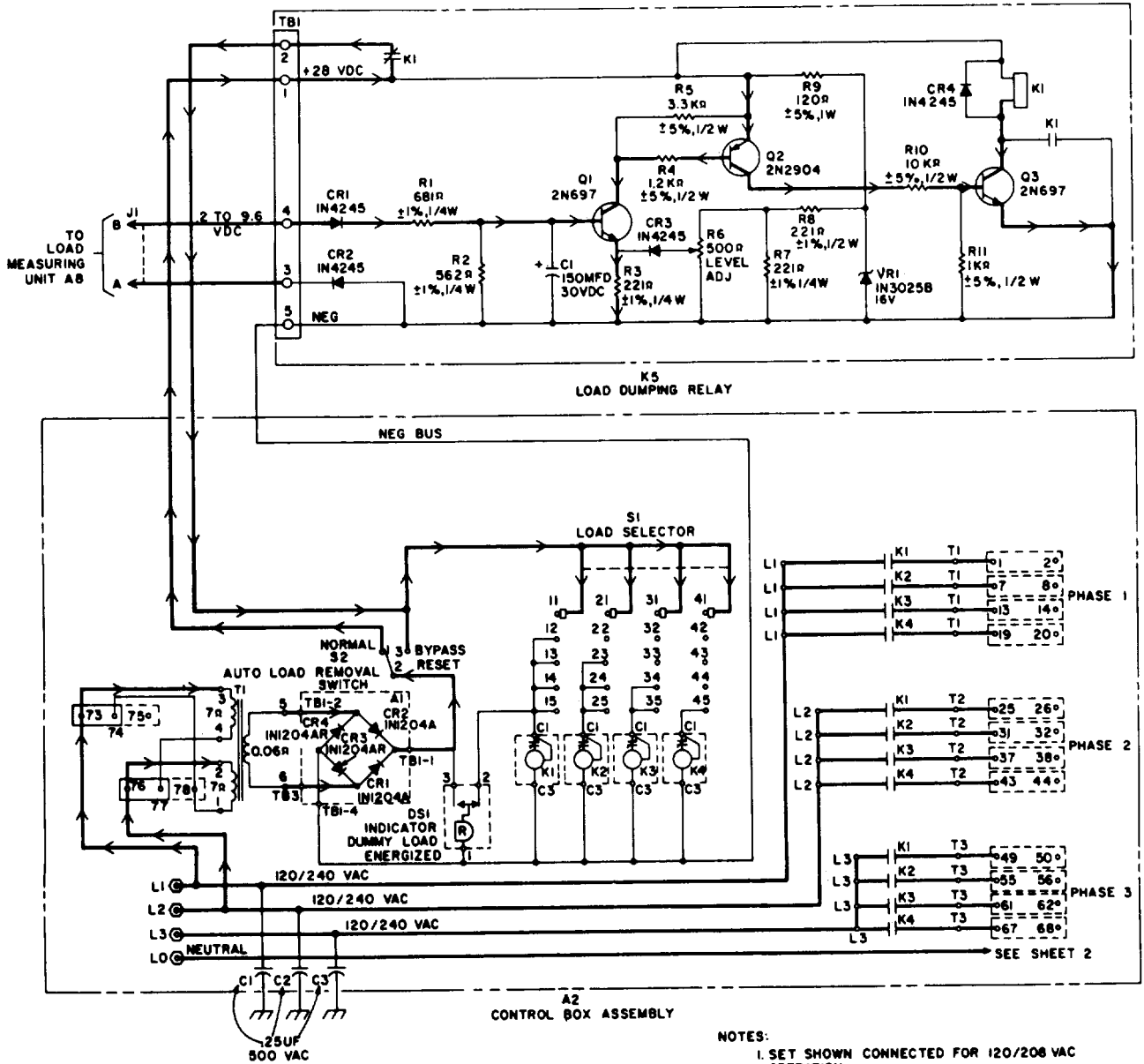


Figure 1-31. Dummy load kit (A28) schematic (sheet 1 of 2)

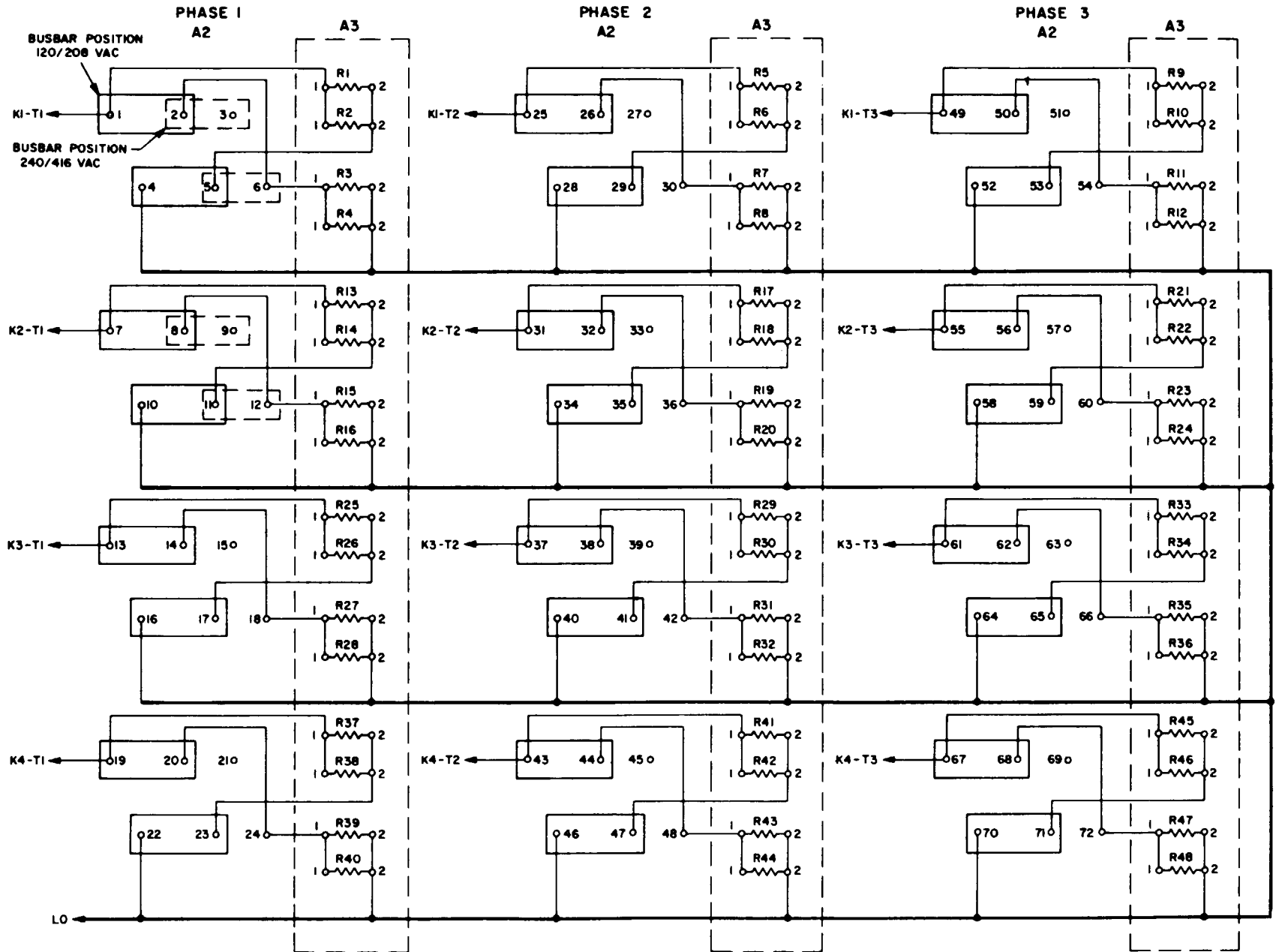


Figure 1-31. Dummy load kit (A28) schematic (sheet 2 of 2)

CHAPTER 2  
 GENERAL MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-1. SPECIAL TOOLS AND EQUIPMENT.

There are no special tools and equipment required to perform intermediate (field) (direct and general support) and depot maintenance on generator sets Models MEP007A, MEP106A, and MEP116A. Recommended tools are listed in table 2-1.

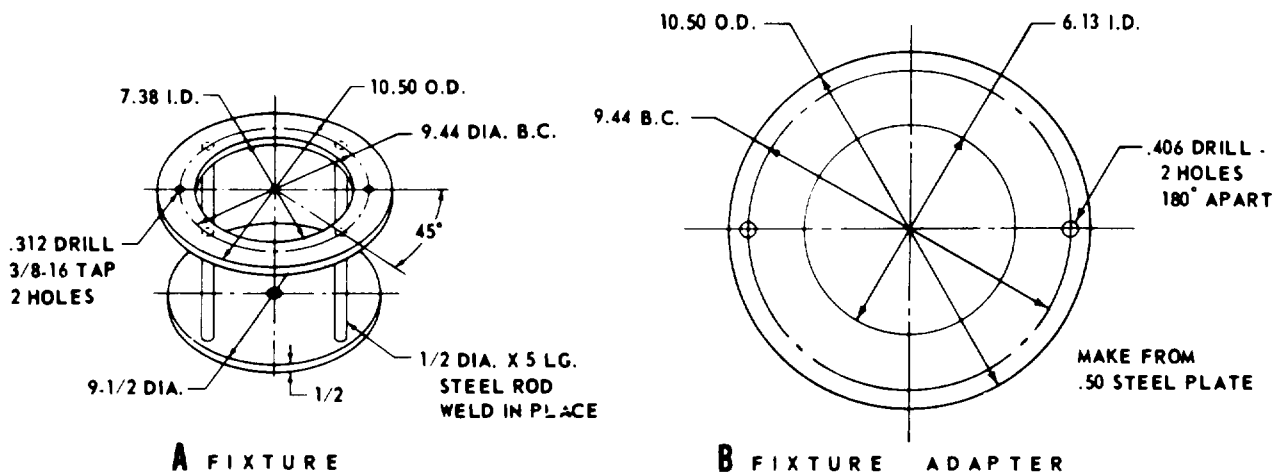
2-2. ORGANIZATIONAL. INTERMEDIATE (FIELD) (DIRECT SUPPORT AND GENERAL SUPPORT) AND DEPOT MAINTENANCE REPAIR PARTS.

Refer to Organizational, Intermediate (Field) (Direct Support and General

Support) and Depot Maintenance Repair Parts and Special Tools List.

2-3. SPECIALLY DESIGNED (FABRICATED) TOOLS AND EQUIPMENT.

The specially designed tools and equipment illustrated in figure 2-1 and listed in table 2-2 are for intermediate (field) (direct and general support) and depot maintenance personnel performing maintenance on the generator set. The tools and equipment listed in table 2-2 are not available for issue, but must be fabricated by qualified maintenance personnel.



**NOTE:** All dimensions are in inches.

Figure 2-1. Specially designed tools (fabricated)  
 (sheet 1 of 3)

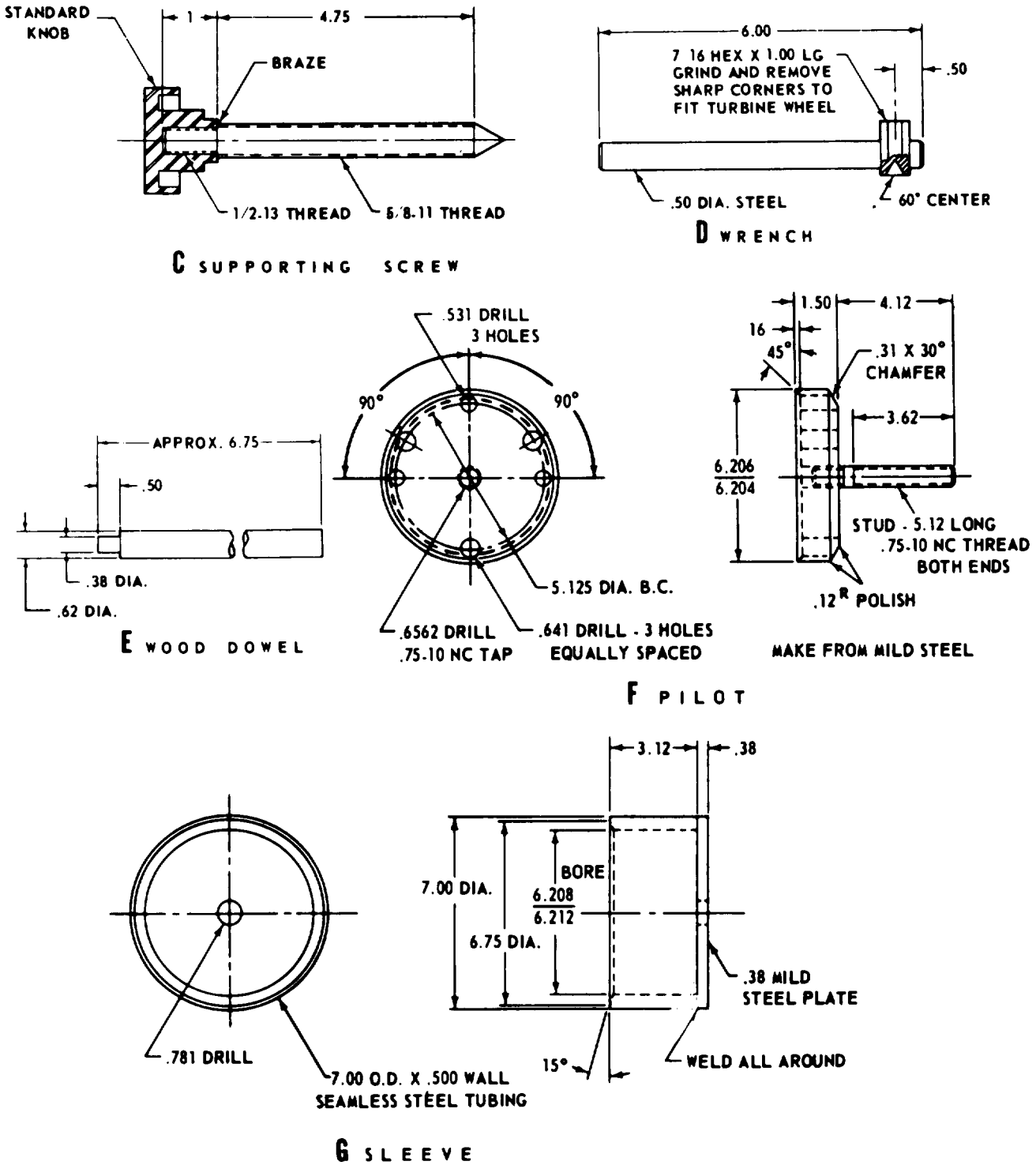


Figure 2-1. Specially designed tools (fabricated)  
 (sheet 2 of 3)



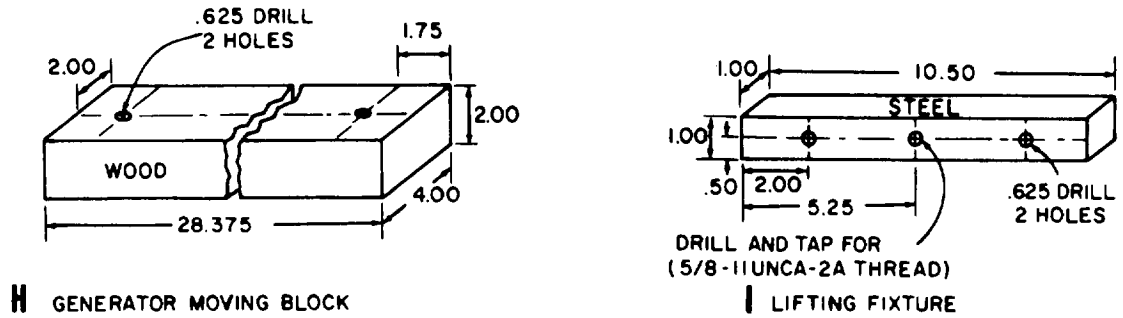


Figure 2-1. Specially designed tools (fabricated)  
 (sheet 3 of 3)

## Section II. TROUBLESHOOTING

### 2-4. GENERAL.

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the engine generator sets and their components.

Malfunctions which may occur are listed in table 2-3. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

## Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

### 2-5. GENERAL.

This section contains instructions for the removal and installation of major components of the generator set to facilitate repair and overhaul. Detailed maintenance procedures for these components are contained in subsequent sections of this technical manual.

1. Disconnect harness from control cubicle.

2. Disconnect control cubicle from rear housing by removing screws and washers. Remove control cubicle.

b. Installation. Refer to figure 2-2 and install control cubicle as follows:

1. Install control cubicle in rear housing and secure with screws and washers.

2. Connect electrical harness to control cubicle connector.

### 2-6. CONTROL CUBICLE.

a. Removal. Refer to figure 2-2 and remove control cubicle as follows:

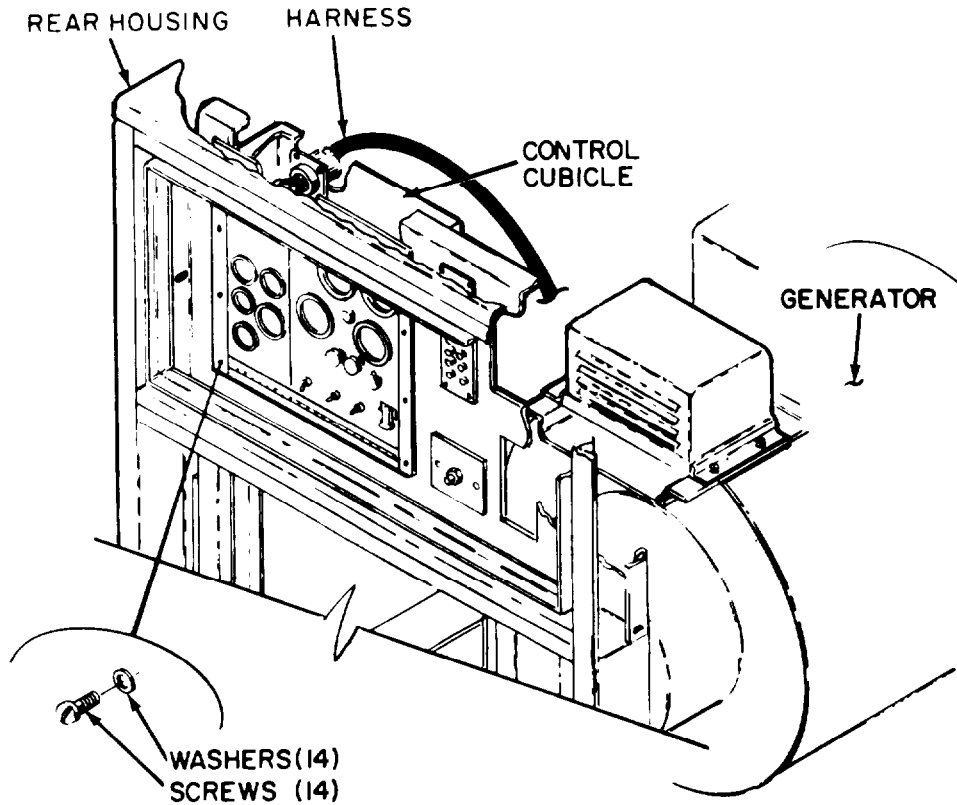


Figure 2-2. Control cubicle, removal and installation

## 2-7. GENERATOR.

a. Removal. Remove generator as follows:

1. Refer to Operator and Organizational Maintenance Manual and perform the following:

- (a) Disconnect negative battery cable.
- (b) Remove rear housing cover and generator compartment access doors.
- (c) Remove air cleaner.
- (d) Tag and disconnect wiring harnesses from fault locator, DC control

circuit breaker, control cubicle, convenience receptacle, exciter regulator, mode I or mode II relay box, load measurement unit, tactical relay box, precise relay box (on 50/60 hertz precise generator sets), and kit control boxes, if installed.

(e) Disconnect receptacles of parallel receptacle wiring harness from rear housing.

(f) Remove manual speed control.

2. Refer to figure 2-3 and remove upper side housings (5) and assembled rear housing (14) in the-order of index numbers assigned.

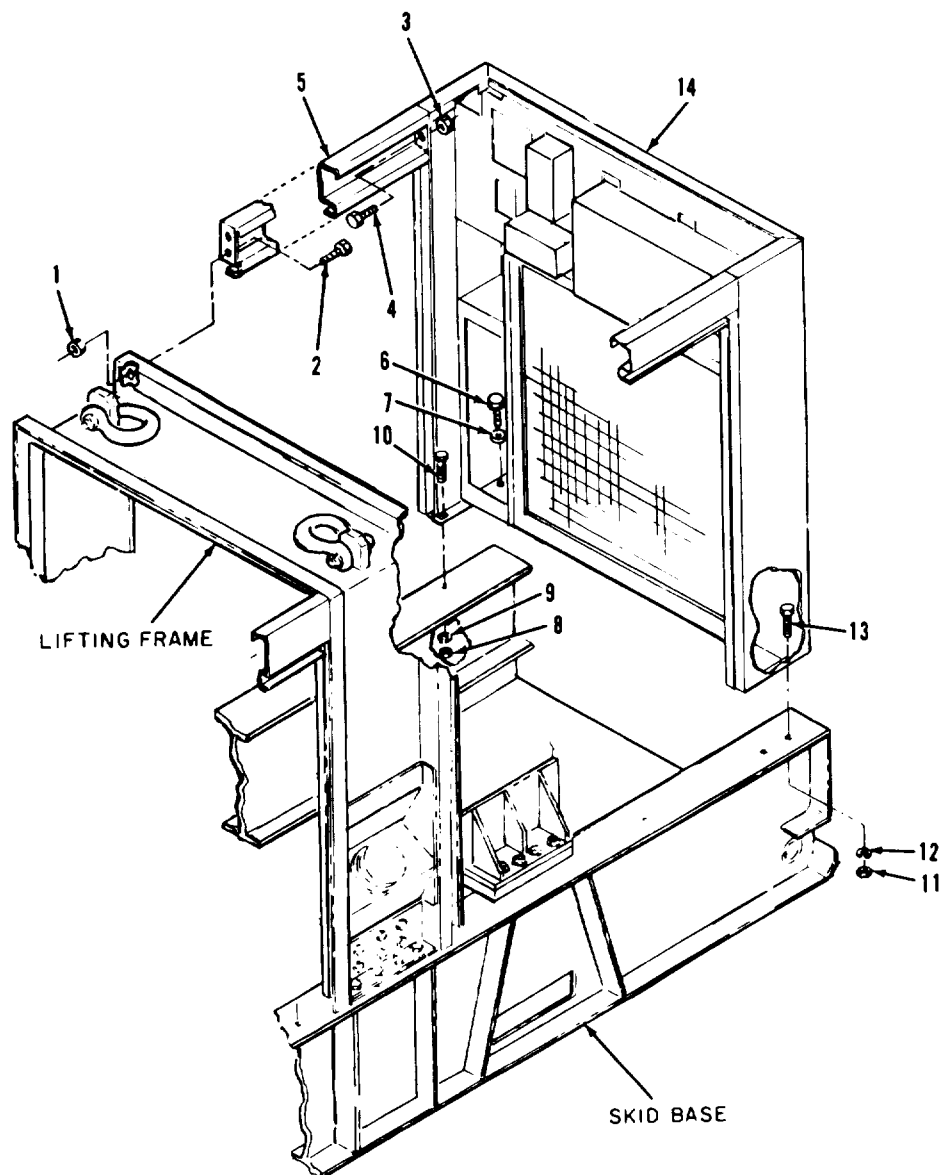


Figure 2-3. Rear housing and upper sides housing, removal and installation

Legend to figure 2-3:

- |                           |                |                  |
|---------------------------|----------------|------------------|
| 1. Nut (4)                | 6. Screw (4)   | 11. Nut (2)      |
| 2. Screw (4)              | 7. Washer (4)  | 12. Washer (2)   |
| 3. Nut (4)                | 8. Nut (10)    | 13. Screw (2)    |
| 4. Screw (4)              | 9. Washer (10) | 14. Rear housing |
| 5. Upper side housing (2) | 10. Screw (10) |                  |

3. Remove auxiliary fuel hose and kit mount from skid base on left rear side of generator by removing two screws and nuts.

4. Refer to figure 2-4 and remove exciter regulator and stowage box (3), mode I or mode II relay box (6), transformer assembly cover (10), bracket (16), reconnection board assembly (20), transformer assembly (25), relay box and bracket assembly (28), and circuit breaker assembly (33) in the sequence of index numbers assigned. Pay particular attention to the following:

(a) Remove nut (17), screw (18), and washer (19). Move connection board assembly (20) out to permit access to wiring.

(b) Tag and disconnect generator leads and relay box to reconnection board wiring harness from reconnection board and connector J41 of load contactor. Tag and disconnect ground cable from frame. Remove board assembly.

(c) Tag and disconnect relay box

to reconnection board wiring harness from connector J61 of the generator and terminals of TB2 located on transformer assembly (25).

(d) Remove generator leads from transformer assembly.

5. Refer to figure 2-5 and disconnect screen (4) by removing nuts (1), lock washers (2), and screws (3).

### CAUTION

Rotate engine crank shaft as required to gain access to screws. Do not attempt to rotate generator by prying on generator fan or flywheel ring gear.

6. Straighten corners of locking plates (6) and remove screws (5) and locking plates. Rotate engine using a suitable barring tool on crankshaft pulley bolt. Turn engine clockwise (standing in front of engine looking toward generator) as required for access to screws (5).

Legend to figure 2-4:

1. Nut (4)	13. Screw (4)	25. Transformer assembly
2. Screw (4)	14. Screw (6)	26. Screw
3. Exciter regulator and stowage box	15. Washer (6)	27. Washer
4. Nut (4)	16. Bracket	**28. Relay box and bracket
5. Screw (4)	17. Nut (4)	+29. Bracket
*6. Relay Box	18. Screw (4)	+30. Screw (4)
7. Screw (4)	19. Washer (4)	+31. Lock washer (4)
8. Lock washers (4)	20. Reconnection board assembly	+32. Washer (4)
9. Washer (4)	21. Screw (3)	+33. Circuit breaker assembly
10. Cover	22. Washer (3)	+33A. Screw (2)
11. Nut (4)	23. Stepped spacer (2)	+33B. Clamp (2)
12. Washer (4)	24. Washer (2)	

\*Mode I relay box on 50/60 hertz generator set, Mode II relay box on 400 hertz generator sets.

\*\*Precise relay box is utilized on 50/60 hertz precise generator sets only.

+Used on 400 hertz generator sets only.

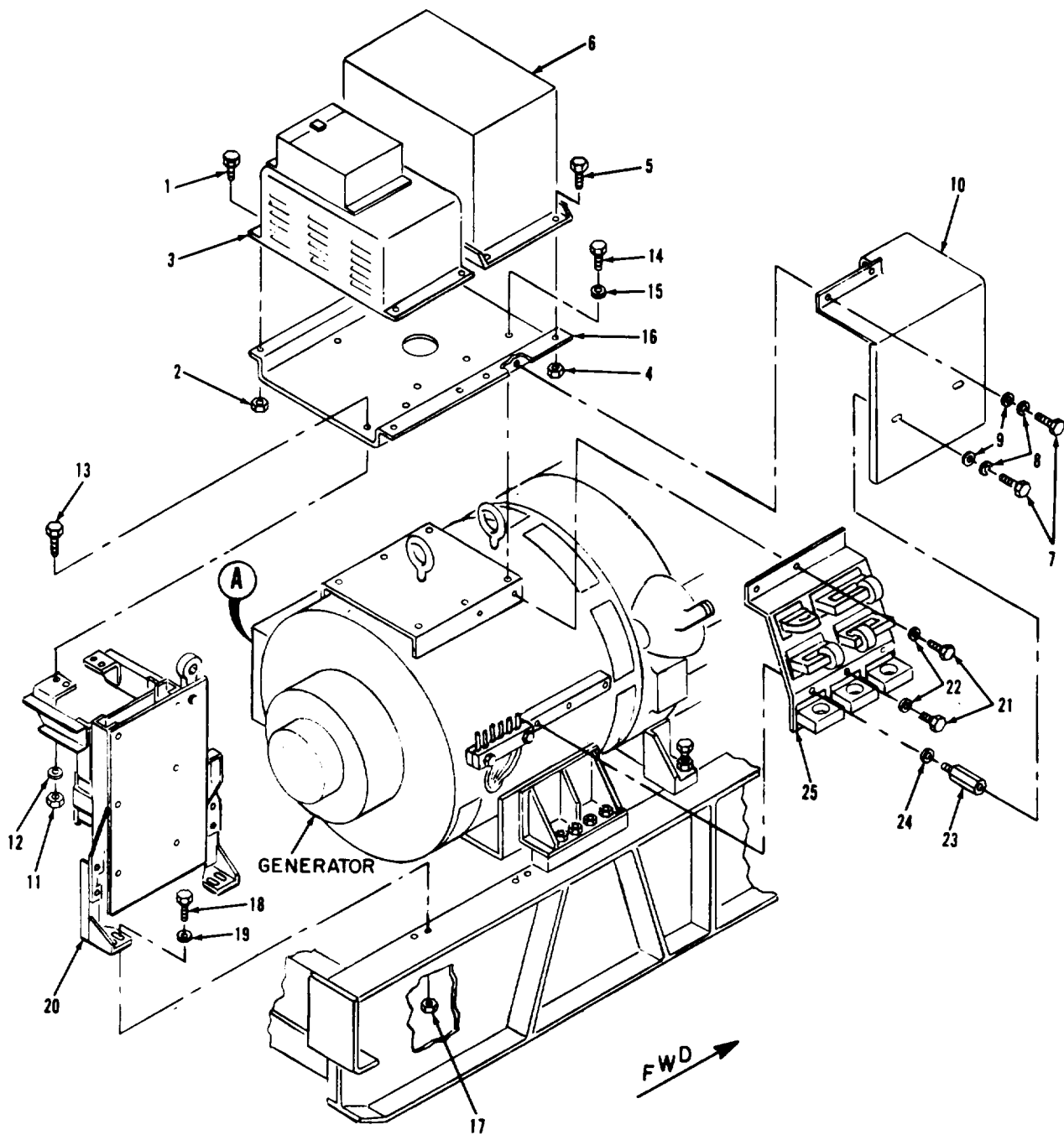


Figure 2-4. Generator controls, removal and installation  
(sheet 1 of 2)

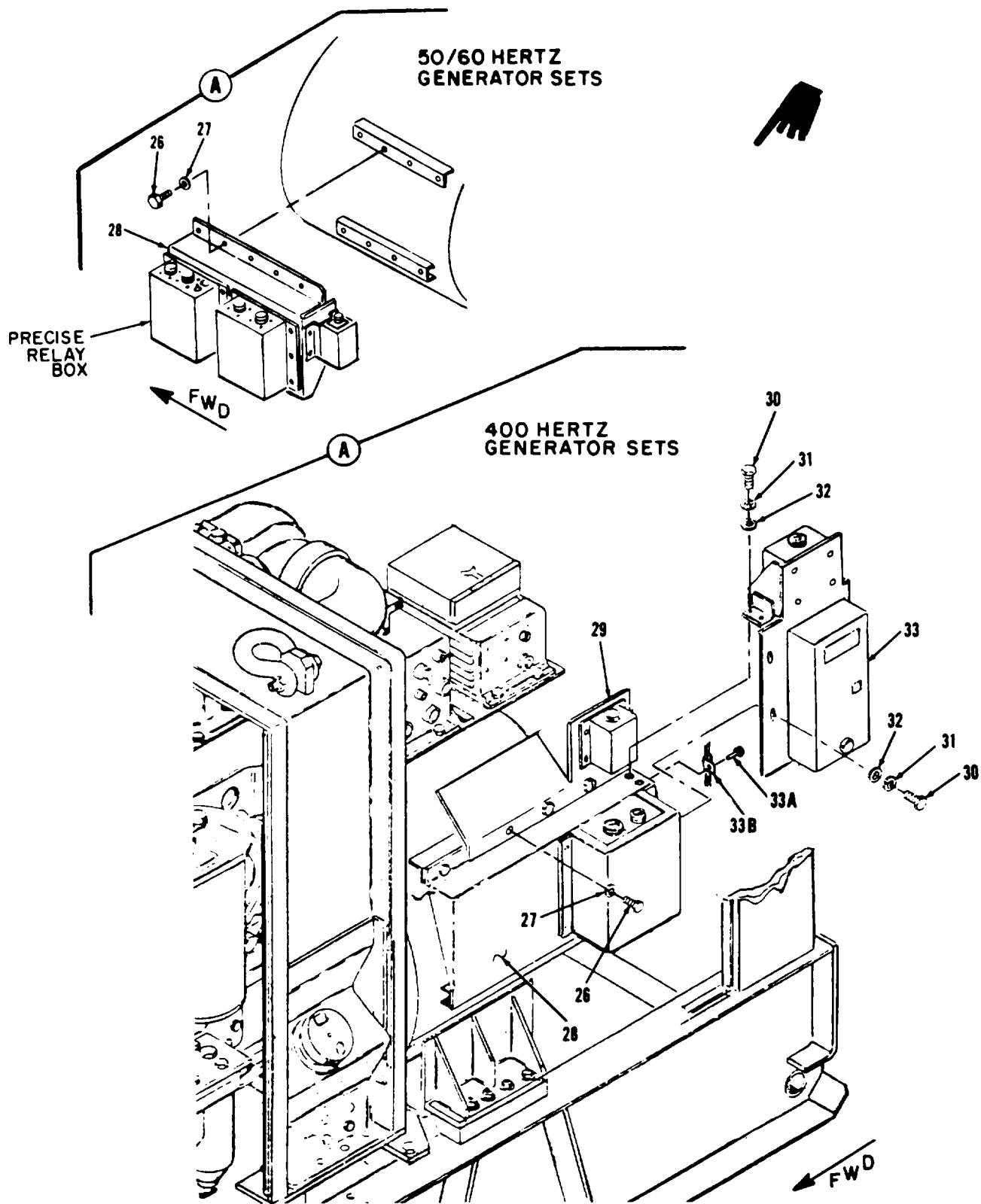


Figure 2-4. Generator controls, removal and installation (sheet 2 of 2)

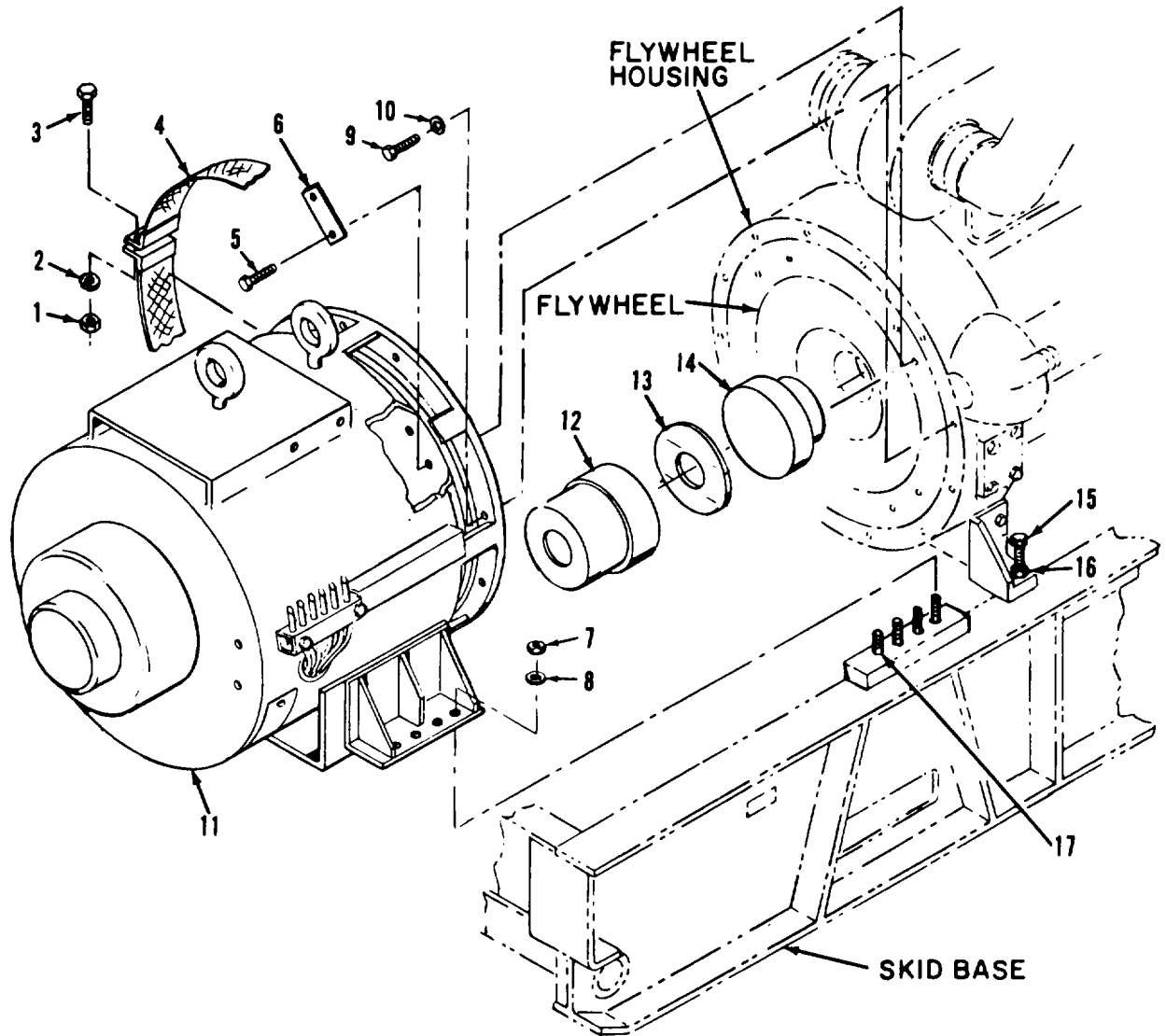


Figure 2-5. Generator, removal and installation

Legend to figure 2-5:

- |                      |                      |                             |
|----------------------|----------------------|-----------------------------|
| 1. Nut (2)           | 7. Nut (8)           | 13. Spring washer           |
| 2. Lockwasher (2)    | 8. Washer (8)        | 14. Spacer                  |
| 3. Screw (2)         | 9. Screw (12)        | 15. Engine support bolt (2) |
| 4. Screen            | 10. Lock washer (12) | 16. Lock nut (2)            |
| 5. Screw (8)         | 11. Generator        | 17. Mounting bolt (8)       |
| 6. Locking plate (4) | 12. Spacer           |                             |





7. Connect a suitable overhead lifting device to both generator lifting eye-bolts and remove slack from lifting device.

**NOTE**

To remove generator mounting bolts, the fuel tank must be removed.

8. Remove nuts (7) and washer (8) and permit mounting bolts to rest on fuel tank.

9. Loosen engine support bolts lock nuts. Turn engine support bolts clockwise to contact skid base. Simultaneously turn engine support bolts and lift generator with overhead lifting device until generator clears generator mounting bolt. Tighten engine support bolt lock nuts.

10. Install two suitable wooden block, 180 degrees apart, between generator frame and generator fan to prevent main rotor assembly from sliding out of frame during lifting. Remove screws (9) and lockwashers (10).

**WARNING**

Stay clear of generator during lifting operations.

**CAUTION**

Do not lower generator on mounting bolts, weight of generator on bolts may damage fuel tank.

11. Remove generator from generator set.

12. Lower generator to floor and block generator to prevent tipping, removing lifting device from generator.

13. Remove wooden blocks installed between generator frame and fan. Secure fan to shaft couplings with two nuts and screws 180 degrees apart.

14. Install screen (4) on generator with screws (3), lock washers (2), and nuts (7).

15. Install a suitable moving block (refer figure 2-1 view H) across engine mounting end of generator frame to support main rotor assembly and prevent it from sliding out of frame during movement.

16. Place tag on generator stating; fan mounted to shaft coupling with two screws and nuts for moving purposes only.

17. If necessary, remove spacers (12 and 14) and spring washer (13) from engine flywheel.

b. Installation. Install generator as follows:

1. Move generator as close to generator set as possible. Remove shipping blocks .

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

2. Make sure spacers (12 and 14) and spring washer (13) are installed in flywheel. Clean flywheel with an approved cleaning solvent and dry thoroughly. Inspect flywheel for nicks and burrs. Remove nicks and burrs using a suitable file or stone.

3. Remove screen (4) from generator. If fan is bolted to shaft couplings, remove shipping screws and nuts.

4. Inspect generator shaft couplings for ragged edges and burrs. Touch up ragged edges and burrs with a suitable file, exercising care to remove burrs and ragged

edges only. Clean shaft couplings with an approved cleaning solvent and dry thoroughly.

5. Install two suitable wooden blocks, 180 degrees apart, between generator frame and fan to prevent main rotor assembly from sliding out of frame during installation.

6. Connect a suitable overhead lifting device to both generator lifting eyebolts.

### WARNING

Stay clear of generator during lifting.

7. Position generator against flywheel housing and secure generator with two screws (9) and washers (10), 180 degrees apart.

8. Remove wooden blocks from generator frame. Rotate engine crankshaft using a suitable barring tool on engine crankshaft pulley bolt to align flywheel generator shaft coupling holes with holes in shaft couplings. Turn engine clockwise (standing in front of engine looking toward generator). After holes are aligned, push generator shaft couplings against engine flywheel, making sure couplings are inside of flywheel recess.

### NOTE

Rotate engine crankshaft as required to gain access to screws.

9. Position generator fan on rear of shaft couplings and install locking plates (6) and screws (5). Tighten screws evenly in a criss-cross pattern. Torque screws to 150 foot-pounds. Bend corners of locking plates (6) against screws (5) to prevent screws from turning.

10. Install remaining screws (9, and washers (10). Tighten screws evenly. Torque screws to 75 foot-pounds.

### CAUTION

Do not lower generator on mounting bolts; weight of generator on bolts may damage fuel tank.

11. Simultaneously lower engine and generator using overhead lifting device engine support bolts until generator mounts are just above generator mounting bolts.

12. Push generator toward radiator until generator mount holes are in alignment with mounting bolts. Push mounting bolts up through generator mounting holes and install washer (8) and nuts (7). Lower engine and generator onto skid base. Remove overhead lifting device and tighten engine support bolt lock nuts. Hold generator mounting bolts stationary and tighten nuts (7) to 600 foot-pounds torque.

### NOTE

Generator air gap should be 0.125 inch for 50/60 hertz generators and 0.049 inch for 400 hertz generators. ■

13. Check generator air gap using three plastic gauges approximately one foot long. Equally space gauges and insert gauges through opening between generator frame and fan. Position gauges between main stator and main rotor, making sure gauges are positioned on high points of stator pole splices. Hold gauges stationary and rotate engine and generator approximately three revolutions by turning engine crankshaft. Remove and inspect gauges. Gauges should not show any signs of interference. If

interference is indicated, generator is defective or engine flywheel is not concentric.

14. Install screen (4) and secure with screws (3), washer (2), and nuts (1).

15. Refer to figure 2-4 and install relay box and bracket assembly (28), transformer assembly (25), reconnection board assembly (20), bracket (16), cover (10), mode I or mode II relay box (6), and exciter regulator and stowage box (3) in the reverse order of index numbers assigned. Pay particular attention to the following:

NOTE

For wire routing and termination, refer to Operator and Organizational Maintenance Manual.

(a) Install transformer assembly (25) and route generator leads through transformers.

(b) Connect relay box to reconnection board wiring harness and generator leads to reconnection board assembly. Secure reconnection board assembly to skid base. Assure that generator leads are routed and secured in a manner that no chaffing occurs.

(c) Connect relay box to reconnect on board harness to connector J41 of the load contactor, J61 of the generator, and terminal board TB2 located on transformer assembly.

16. Position auxiliary fuel hose and mount on skid base at left side of generator and secure with two screws and nuts.

17. Refer to figure 2-3 and install upper side housings (5) and assembled rear housing (14) in the reverse order of index numbers assigned.

18. Refer to Operator and Organizational Maintenance Manual and perform the following:

(a) Install and adjust manual speed control.

(b) Connect receptacles of parallel receptacle wiring harness to rear housing.

(c) Connect wiring harnesses to fault locator, DC control circuit breaker, control cubicle, convenience receptacle, exciter regulator, mode I or mode II relay box, load measurement unit, tactical relay box, precise relay box (on 50/60 hertz precise generator sets), and kit control boxes, if installed.

(d) Install air cleaner.

(e) Install rear basing cover and generator compartment access doors.

(f) Connect negative battery cable.

2-8. ENGINE, D333C(T)

a. Removal. Remove the engine as follows:

1. Refer to Operator and Organizational Maintenance Manual and perform the following:

(a) Drain fuel filter and strainer, secondary fuel filter, day tank, radiator, engine lubricating oil, and hydraulic tank on precise generator sets,

(b) Disconnect negative battery cable. Tag and disconnect cables from slave receptacle SR2, starter and starter solenoid. Remove starter ground cable from skid base.

(c) Disconnect muffler clamps from front housing cover. Remove front and rear housing covers, engine, generator, and battery compartment access doors.

(d) Remove muffler, exhaust pipe, and crankcase breather tube. Remove engine breather assembly.

(e) Remove radiator and shutter.

(f) Disconnect manual speed control from utility governor input shaft and lifting frame bracket.

(g) Remove air cleaner.

(h) If installed, remove winterization kit heaters and coolant lines from oil pan heat exchanger tubes and engine block. Disconnect kit harnesses from control boxes and coil harness on engine.

(i) Tag and disconnect engine harness from connector J5 of mode I or mode II relay box, connector J39 of DC control circuit breaker, connector J33 of the day tank float switch, connector J38 of the ether primer and fuel tank fuel level transmitter. Cut tiedown strap securing engine harness to other harnesses. Coil engine harness wires and secure wires to engine.

(j) Disconnect ether starting aid tube from atomizer at rear of cylinder head inlet elbow.

(k) Tag and disconnect electrical leads from radio suppression diode assembly mounted to day tank.

2. Disconnect four upper side housing members from lifting frame by removing eight screws and nuts securing members to lifting frame.

(a) Remove two members from rear housing by removing four screws and washers.

3. Disconnect engine oil drain hose from engine oil drain valve at left side of engine. Plug hose and valve opening.

4. Remove engine block coolant drain hose from right side skid base fitting.

5. Loosen clamp and remove fuel filler hose from fuel tank. Cover fuel tank opening. Disconnect fuel tank vent hoses from fuel filler neck. Tag and disconnect fuel hoses from fuel transfer valve, auxiliary fuel inlet fitting, fuel supply outlet fitting and day tank. Remove supply hose from electric fuel transfer pump. Plug hoses. Disconnect two clamps securing hoses to lifting frame; one clamp is located on each inside wall of lifting frame.

#### NOTE

Governor control unit is mounted to lifting frame on the right side.

6. On precise generator sets, tag and disconnect connectors from governor control unit. Remove harness from connector P8 of the precise relay box, cut tiedown strap and coil harness on engine. Disconnect governor control unit and mount from lifting frame by removing four screws, washers, and nuts.

7. Remove sixteen screws, washers, and nuts securing lifting frame to skid base. Using a suitable lifting device, remove lifting frame from generator set.

8. Tag and disconnect electrical connectors from exciter regulator. Disconnect exciter regulator and stowage box (3, figure 2-4) by removing nuts (1) and

screws (2). Remove nuts (11 and 17), screws (13 and 18), and washers (12 and 19). Move reconnection board assembly (20) away from bracket (16).

9. Disconnect screen (4, figure 2-5) by removing nuts (1), washers (2), and screws (3).

10. Disconnect auxiliary fuel hose and mount from skid base at left rear of generator by removing screws and nuts.

CAUTION

Rotate engine crankshaft as required to gain access to screws. Do not attempt to rotate generator by prying on generator fan or flywheel ring gear.

11. Straighten corners of locking plates (6) and remove screws (5) and locking plates. Rotate engine using a suitable barring tool on crankshaft pulley bolt. Turn engine clockwise (standing in front of engine looking toward generator) as required for access to screws (5). Hold barring tool stationary to permit loosening screws.

12. Remove nuts (7) and washers (8) and permit generator mounting bolts to rest on fuel tank.

13. Connect a suitable overhead lifting device to both engine lifting eyebolts (figure 2-6). Remove slack from lifting device.

14. Disconnect engine trunion mount from engine support by removing bolts and washers.

WARNING

Stay clear of engine during lifting.

CAUTION

During lifting operations, check that generator mounting bolts are not binding on generator mount.

15. Slowly raise lifting device, pivoting front of engine up until there is sufficient clearance for engine oil pan to clear engine support.

16. Support front of engine to prevent it from swinging forward when generator to flywheel housing bolts are removed.

CAUTION

Generator must be blocked so that generator weight is on skid base.

17. Block generator in raised position with suitable blocks that contact each side of the skid base.

18. Remove screws (9, figure 2-5) and washers (10) securing generator to flywheel housing.

WARNING

Stay clear of engine during lifting.

19. Remove support from front of engine and move engine free of generator. Remove engine from generator set. Place engine on stand, cradle, or crib and block.

20. If necessary, remove spacers (12 and 14) and spring washer (13) from flywheel.

WARNING

Steam cleaning creates hazardous noise levels and severe burn and injury potential. Eye, skin and ear protection required.

21. Plug all engine openings and steam clean engine.

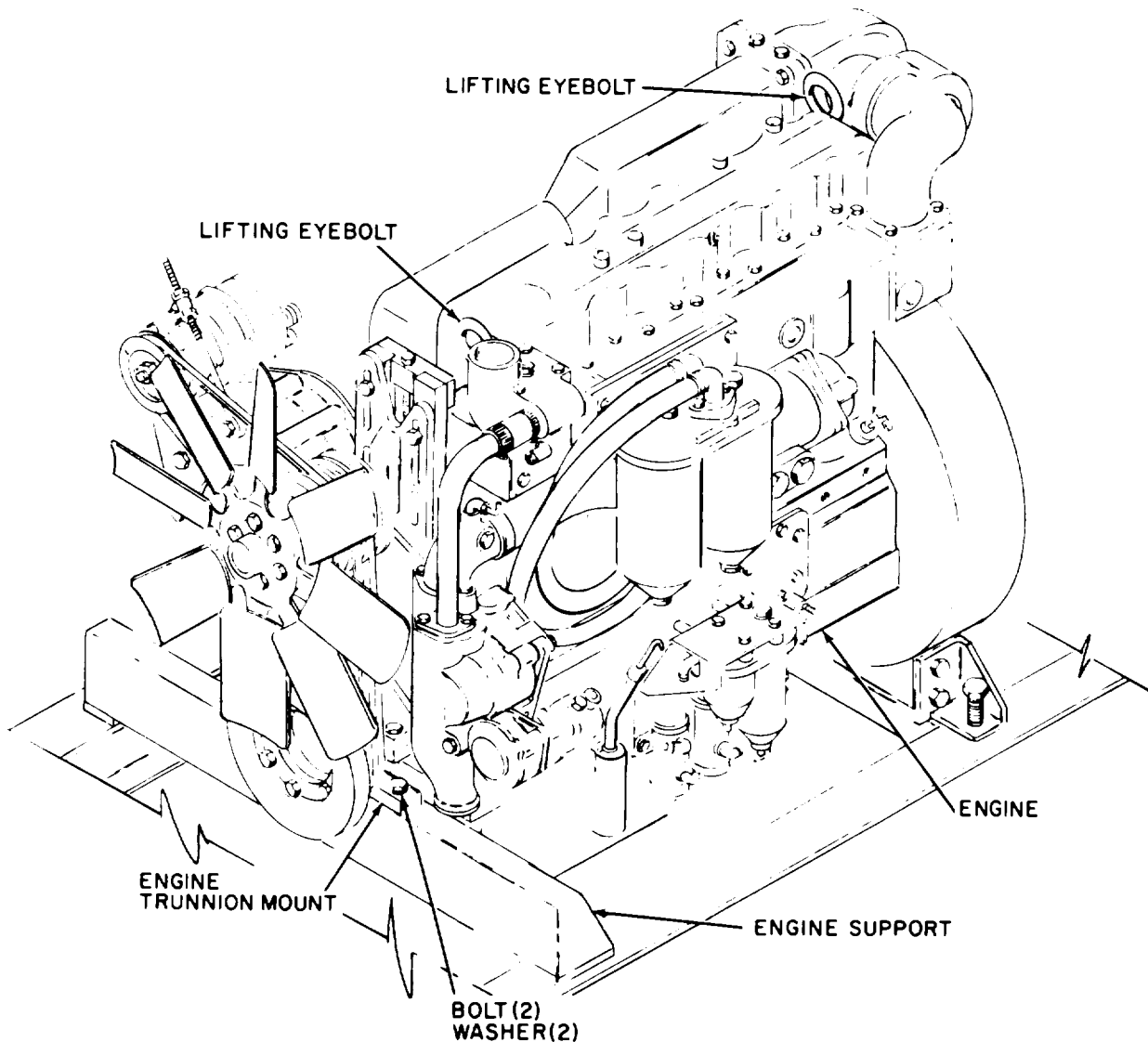


Figure 2-6. Engine, removal and installation

b. Installation. Install the engine as follows:

1. Move engine as close to generator set as possible.
2. Connect a suitable lifting device to both engine lifting eyebolts (figure 2-6).

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate. Remove nicks and burrs using a suitable

3. Inspect flywheel for nicks and burrs on generator contact surfaces. Remove nicks and burrs using a suitable file or stone. Clean flywheel with an approved cleaning solvent and dry thoroughly.

4. Insert spacers (12 and 14, figure 2-5) and spring washer (13) in flywheel.

5. Inspect generator shaft couplings for ragged edges and burrs. Touch up ragged edges and burrs with a suitable file, exercising care to remove burrs and ragged edges only. Clean shaft couplings

with an approved cleaning solvent and dry thoroughly.

**WARNING**

Stay clear of engine during lifting operations.

6. Position engine in generator set, aligning engine flywheel housing screw holes with generator frame holes. Install four screws (9, figure 2-5) and washers (10), 90 degrees apart.

7. Raise lifting device so that block can be removed from under generator. Remove block and slowly lower engine in place so that engine support bolt holes (figure 2-6) and trunion mount holes are in alignment. Secure trunion mount to engine support with bolts and washers. Make sure generator mounting bolts are in alignment with generator mount holes and tighten engine mount bolts to 200 foot-pounds torque.

8. Remove four screws securing generator to engine to permit engine to move forward.

9. Rotate engine crankshaft using suitable engine barring tool on crankshaft pulley bolt to align flywheel generator shaft coupling holes with holes in generator shaft couplings. Turn engine crankshaft clockwise (standing in front of engine looking toward generator). After holes are aligned, push generator shaft couplings against engine flywheel, making sure couplings are inside of flywheel recess.

**NOTE**

Rotate engine crankshaft as required to gain access to screws.

10. Position generator fan on rear of shaft couplings and install locking plates (6, figure 2-5) and screws (5). Tighten screws evenly in a criss-cross pattern. Torque screws to 150 foot-pounds. Bend corners of locking plates (6) against screws (5) to prevent screws from turning.

11. Install screws (9) and washers (10). Tighten screws evenly and to 75 foot-pounds torque.

12. Push mounting bolts up through generator mounting holes and install washer (8) and nuts (7). Hold generator mounting bits stationary and tighten nuts (7) to 500-550 foot-pounds torque.

**NOTE**

Generator air gap should be 0.125 inch for 50/60 hertz generators and 0.049 inch for 400 hertz generators.

13. Check generator air gap using three plastic gauges approximately one foot long. Equally space gauges and insert gauges through opening between generator frame and fan. Position gauges between main stator and main rotor, making sure gauges are positioned on high points of stator pole pieces. Hold gauges stationary and rotate engine and generator approximately three revolutions by turning engine crankshaft. Remove and inspect gauges. Gauges should not show any signs of interference. If interference is indicated, generator is defective or engine flywheel is not concentric.

14. Install screen (4) and secure with screws (3), washer (2), and nuts (1).

15. Secure reconnection board assembly (20) to skid base and bracket (16)

with screws (13 and 18), washers (12 and 19), and nuts (11 and 17). Install exciter regulator and stowage box and secure with screws (2) and nuts (1). Connect electrical connectors to exciter regulator.

16. Using a suitable lifting device, position lifting frame on generator set skid base. Secure lifting frame to skid base with sixteen screws, washers, and nuts.

17. On precise generator sets, position governor control unit on lifting frame and secure with four screws, washers, and nuts. Connect electrical connectors to governor control unit and governor actuator. Connect harness to connector P8 on precise relay box. Secure harness to other harnesses with tie down strap.

18. Connect fuel filler hose to fuel tank and secure with clamp. Connect fuel tank vent hoses to fuel filler neck. Connect fuel hoses to fuel transfer valve, auxiliary fuel inlet fitting, fuel supply outlet fitting, day tank, and electric fuel transfer pump. Clamp hose to lifting frame.

19. Connect engine block coolant drain hose to skid base fitting and secure with clamp.

20. Connect engine oil drain hose to engine oil drain valve.

21. Connect four upper side housing members to lifting frame and secure eight screws and washers. Connect two members to rear housing and secure with four screws and washers.

22. Refer to Operator and Organizational Maintenance Manual and perform the following:

(a) Connect three electrical leads to radio suppression diode assembly.

(b) Connect ether starting tube to atomizer at rear of cylinder head inlet elbow.

(c) Connect engine harness to connector J5 of mode I or mode II relay box, connector J33 of day tank float valve, connector J38 of ether primer, connector J39 of DC control circuit breaker, and fuel tank fuel level send unit. Fasten harness to other harness with tiedown straps.

(d) If required, install winterization kit heaters and coolant lines. Connect kit harnesses to control boxes.

(e) Install air cleaner.

(f) Connect and adjust manual speed control.

(g) Install radiator and shutter.

(h) Install engine crankcase breather, crankcase breather tube, muffler, and exhaust pipe.

(i) Install front and rear housing covers; battery, engine, and generator compartment access doors. Connect muffler clamps to front housing cover.

(j) Connect starter ground cable to skid base. Connect cables to slave receptacle SR2. Install negative battery cable.

(k) Service radiator, engine and on precise generator sets hydraulic tank.

(l) Start engine and bleed fuel system and hydraulic system on precise generator sets.



2-9. WHEEL MOUNTING KIT.

a. Removal. Refer to figure 2-7 and remove wheel mounting kit in the order of index numbers assigned. Pay particular attention to the following:

1. Using a suitable lifting device, lift generator set off ground. Place suitable block under skid base and lower generator set on blocks.

2. Place suitable hydraulic jack under front axle assembly and raise jack so it will support axle assembly weight.

3. Disconnect brake cables.

4. Remove axle assembly attaching hardware and lower hydraulic jack, lowering wheels to ground. Remove axle assembly from under generator set.

5. Repeat steps 2. through 4. for rear axle.

b. Installation. Refer to figure 2-7 and install wheel mounting kit in the reverse order of index numbers assigned. Pay particular attention to the following:

1. On initial installation, assemble kit components prior to performing steps 2. through 6. as follows:

(a) Install two nuts (16) and two yokes (15) on each stud (17), and attach yokes on one end to hand brake and shaft assembly (26).

(b) Attach brackets (20 and 25) to hand brake and shaft assembly.

2. Using a suitable lifting device, lift generator set off ground. Place suitable block under skid base and lower generator set on blocks.

3. Place front axle assembly under generator set. Place suitable hydraulic jack under axle assembly and jack axle into position. Secure axle assembly to generator set and remove hydraulic jack.

4. Repeat step 3. for rear axle.

5. Connect brake cables to each wheel.

6. Lift generator set, remove blocks, and lower generator set.

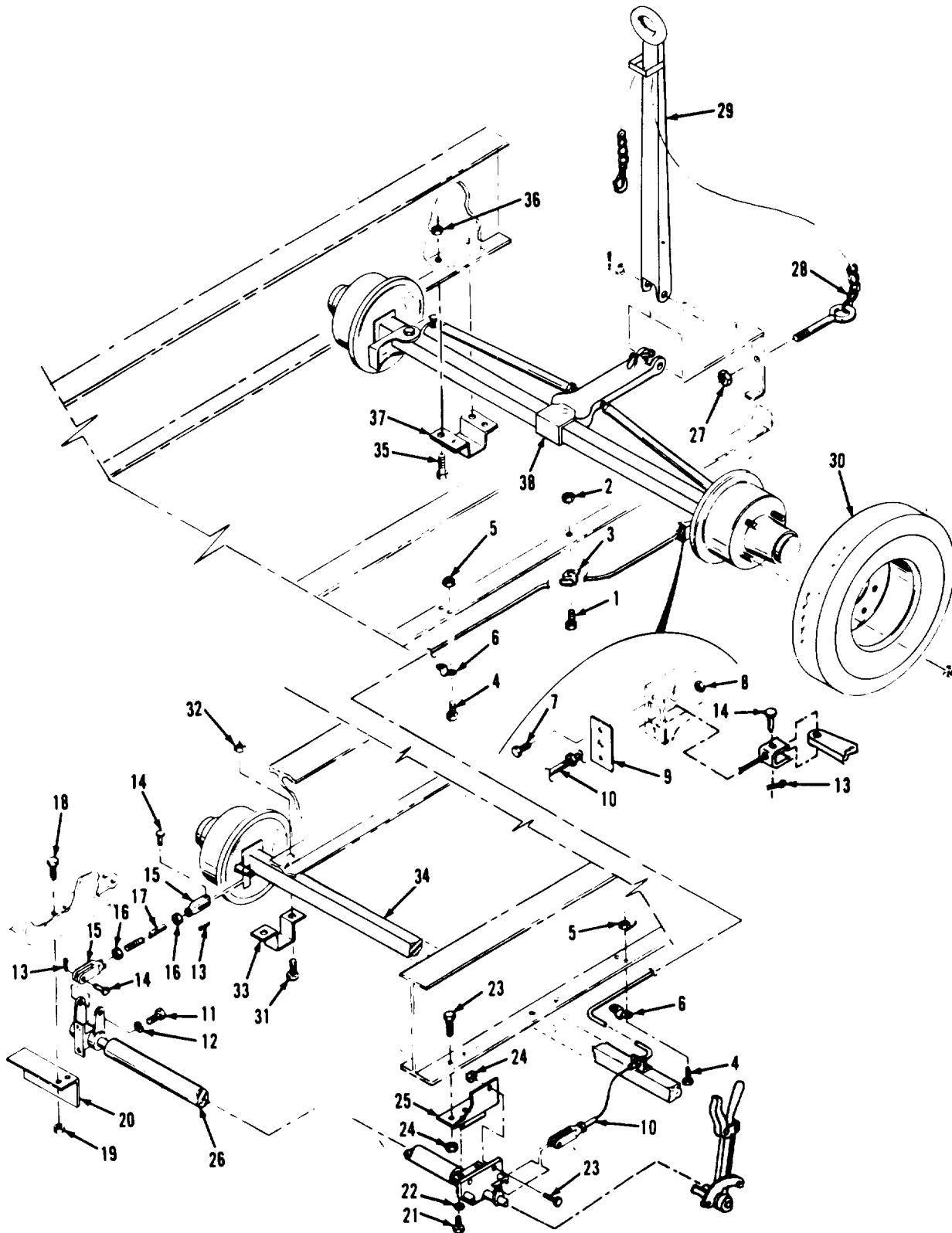


Figure 2-7. Wheel mounting kit, removal and installation

Legend to figure 2-7:

- |  |                                   |                               |
|--|-----------------------------------|-------------------------------|
| 1. Screw (2)                             | 14. Pin (8)                       | 27. Nut (2)                   |
| 2. Nut (2)                               | 15. Yoke (6)                      | 28. Safety chain assembly (2) |
| 3. Guide (2)                             | 16. Nut (6)                       | 29. Drawbar assembly          |
| 4. Screw (8)                             | 17. Stud (2)                      | 30. Wheel assembly (4)        |
| 5. Nut (8)                               | 18. Screw (2)                     | 31. Screw (4)                 |
| 6. Clamp (4)                             | 19. Nut (2)                       | 32. Nut (4)                   |
| 7. Screw (4)                             | 20. Bracket                       | 33. clamp (2)                 |
| 8. Nut (4)                               | 21. Screw (2)                     | 34. Rear axle assembly        |
| 9. Plate (2)                             | 22. Lock washer (2)               | 35. Screw (4)                 |
| 10. Brake cable and conduit assembly (2) | 23. Screw (5)                     | 36. Nut (4)                   |
| 11. Screw (2)                            | 24. Nut (5)                       | 37. clamp (2)                 |
| 12. Lock washer (2)                      | 25. Bracket                       | 38. Front axle assembly       |
| 13. Cotter pin (8)                       | 26. Hand brake and shaft assembly |                               |

Table 2-1. Recommended Tools and Equipment

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Ohmmeter	6625-581-2466	As applicable		Check continuity and resistance of electrical components.
Inside micrometer		As applicable		To measure inside diameter of engine components.
Outside micrometer		As applicable		To measure outside diameter of engine components.
Wheatstone bridge		As applicable		To measure resistance of electrical components.
Kelvin bridge		As applicable		To measure resistance of electrical components.
Multimeter		As applicable		To test electrical components.
Pressure gauge 0-20 PSI		4-10		To check radiator pressure.
Radiator cap tester		4-13		To check radiator cap.
Vacuum tube DC voltmeter 0-50 MV			6-1	To test thermal watt converter.
Power source 120/208 ± 2 VAC 3 phase, 4 wire, 60 hertz			6-1	To test thermal watt converter.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Ammeter 0-1.5 AMPERES			6-1	To test thermal watt converter.
Auto transformer 75 VOLT- AMPERES			6-1	To test thermal watt converter.
Variable frequency supply, 120V 45-415 Hz			6-2	To test frequency meter and frequency transducer.
Test frequency meter			6-2	To test frequency meter and frequency transducer.
Power source 120 ± 2 VAC 50, 60 or 400 Hz			6-3	To test control box relay assembly.
Voltmeter 120 ± 2 VAC			6-3	To test control box relay assembly.
Power supply 24 ± 2 VDC 0.5 AMP			6-5	To test relay.
Power supply 210 ± 2 VAC, 60 Hz			6-6	To test AC current meter.
Auto transformer 75 VA, 60 and/or 400 Hz (Quantity of 3)			6-6	To test AC current meter.
Ammeter 0-1.5 AMPERES (Quantity of 3)			6-6	To test AC current meter.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Power supply 24 ± 2 VDC 0.5 AMP			6-10	To test indicator box.
Power source 24 ± 2 VDC 3 AMP			6-16	To test exciter- regulator.
Power source 0-130 ± 2 VAC 60 or 400 Hz			6-16	To test exciter- regulator.
Ammeter 0-3 AMPS DC			6-16	To test exciter- regulator.
Ammeter 0-10 AMPS DC			6-16	To test exciter- regulator.
Ammeter 0-130 VAC 10 AMP			6-16	To test exciter- regulator.
Power supply 24 ± 2 VDC 0.5 AMP			6-23	To test DC relay assembly.
Power supply 0-400 Hz 120 ± 2 VAC			6-23	To test DC relay assembly.
Power supply 24 ± 2 VDC 3 AMP			6-25	To test Mode I relay box assembly.
Prover supply 120 ± 2 VAC 60 ± 0.5 HZ 5 AMP			6-25	To test Mode I relay box assembly.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Voltmeter 0-15 VAC SCALE	5895-01-021-7156		6-25	To test Mode I relay box assembly.
Ohmmeter R x 1000 SCALE			6-25	To test Mode I relay box assembly.
Ohmmeter 0-3 AMP SCALE			6-25	To test Mode I relay box assembly.
Power supply 24 ± 2 VDC 0.5 AMP			6-28	To test 400 Hertz underfrequency relay.
Variable frequency power supply 0-400 hertz 120 VAC			6-28	To test 400 Hertz underfrequency relay.
Frequency meter 0-400 HZ			6-28	To test 400 Hertz un- derfrequency relay.
Power supply 24 ± 2 VDC 0.5 AMP			6-31	To test under volt- age relay
Variable voltage power supply 0-130 ± 5 VAC, 400 HZ 1 AMP			6-31	To test under volt- age frequency.
Power supply 24 ± 2 VDC 0.5 AMP			6-34	To test permissive paralleling relay.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Variable voltage power supply 0-20 ± 1 VAC 400 hertz 1 AMP			6-34	To test permissive paralleling relay.
Power supply 24 ± 2 VDC 3 AMP			6-39	To test Mode H relay box assembly.
Fewer supply 0-130 VAC 360-420 HZ 5 AMP			6-39	To test Mode II relay box assembly.
Voltmeter 0-15 VAC			6-39	To test Mode II relay box assembly.
Voltmeter 0-20 VAC SCALE			6-39	To test Mode II relay box assembly,
Voltmeter 0-150 VAC SCALE			6-39	To test Mode II relay box assembly.
Ammeter 0-3 AMP SCALE			6-39	To test Mode II relay box assembly.
Frequency meter 360-420 HZ SCALE			6-39	To test Mode II relay box assembly.
Power supply 24 ± 2 VDC 5 AMP		6-161		To test load contactor.
Resistor 5 OHM ± 1%, 1 watt		6-161		To test load contactor.
Resistor 250 OHM ± 10%, 25 watt			6-48	To test over voltage relay (K2).
Power supply 24 ± 2 VDC 0.5 AMP			6-48	To test over voltage relay.



Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Variable voltage power supply 0-160 VAC 60 HERTZ	6625-00-414-6626		6-48	To test over voltage relay,
Variable voltage power supply 0-160 VAC 400 HERTZ			6-48	To test over voltage relay.
Power supply 24 ± 2 VDC 0.5 AMP			6-51	To test reverse power relay.
Oscillator			6-51	To test reverse power relay.
Variable voltage power supply 0-10 ± 1 VDC 1 AMP			6-51	To test reverse power relay.
Power supply 24 ± 2 VDC 0.5 AMP			6-54	To test short circuit relay.
Power source 0-50 ± 5 VAC 60 hertz single phase 1 AMP			6-54	To test short circuit relay.
Indicator, Digital			6-211 6-211A	SCU alignment
Power supply 24 ± 2 VDC 0.5 AMP			6-57	To test overload relay.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Power source 120/208 ± 2 VAC 3 phase, 4 wire 60 Hertz 3 AMP			6-57	To test overload relay.
Resistor 35 OHM ± 1% 50 WATT (Quantity of 3)			6-57	To test overload relay.
Transformer 2 AMP (Quantity of 3)			6-57	To test overload relay.
Ammeter 0-3 AMPS (Quantity of 3)			6-57	To test overload relay.
Power supply 24 ± 2 VDC 2 AMP			6-58	To test tactical relay box.
Power supply 0-10 ± 1 VDC 0.5 AMP			6-58.	To test tactical relay box.
Power supply 0-1604 VAC 50/60-400 Hz 1 AMP			6-58.	To test tactical relay box.
Power supply 0-50 VOLT 3/phase 50/60 or 400 HZ 4 wire 5 AMP			6-58.	To test tactical relay box.
Ammeter 0 to 2 AMP AC			6-58.	To test tactical relay box.
Voltmeter 0-12 VDC			6-58.	To test tactical relay box.
Volt meter 0-180 VAC			6-58.	To test tactical relay box.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Resistor (100 OHM ± 10% 5 watt)			6-65	To test under fre- quency relay (K12).
Power supply 120/208 ± 2 VAC 3 phase, 4 wire 47-420 HZ 10 AMP			6-74	To test load measur- ing unit.
Ammeter 1 AMP (Quantity of 3)			6-74	To test load measur- ing unit.
Voltmeter 0-5.6 ± 0.5 VAC			6-74	To test load measur- ing unit.
Voltmeter 0-10 VDC			6-74	To test load measur- ing unit.
Power supply 0-10 ± 2 VDC 15 AMP		7-2 7-5		To check generator component.
Megger 500 VOLT		7-2 7-5		To check generator component.
Variable speed drive (2000 to 3000 RPM)		8-19		To check alternator speed.
Resistor (1/2 OHM 500 WATT)		8-19		Used in alternator voltage regulator setting test.
DC voltmeter 0 to 50 volt scale		8-19 8-28		Used in alternator and starter motor test.
Carbon pile (0 to 600 ampere load capacity)		8-19 8-28		Used in alternator and starter motor test.
Ammeter 0 to 50 ampere scale		8-19 8-28		Used in alternator and starter motor test.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Armature test set	6625-238-1459	8-25		To test starter motor armature for ground.
Spring scale (0 to 100 pound scale)		8-25		To check starter motor brush spring for proper tension.
Growler		8-25		To check starter motor armature for shorts.
Mica undercutter	4940-204-0319	8-26		To undercut mica and starter motor commutator.
Spring scale (0 to 50 pound scale)		8-28		Used in starter motor stall torque test.
Torque arm (12 inch long)		8-28		Used in starter motor stall torque test.
Hand held tachometer (0 to 10,000 RPM)		8-28		Used in starter motor stall torque test.
Variable speed drive (0 to 3000 RPM)		8-51		Used to check trip settings on over-speed switch.
Hydraulic test stand		8-98		To test hydraulic pump.
Variable speed drive (0 to 2500 RPM)		8-98		To test hydraulic pump.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Pressure gauge 0 to 400 PSI		8-98		To test hydraulic pump.
Universal puller kit	3180-701-8046	8-99 8-151 8-222		To remove timing gears and crankshaft pulley.
Rack setting tool		8-140		Used to adjust governor drive housing.
Dial indicator (0 to 1 inch)		8-140		Used to adjust governor drive housing.
Diesel injector tool test set	4910-317-8265	8-149		To test fuel injection pump.
Diesel injector pump test stand	4910-443-0976	8-149		To test fuel injection pump.
Fuel rack setting gauge		8-149		Used to set fuel injection pump timing dimension.
Fuel injection timing plate		8-149		Used to set fuel injection pump timing dimension with pump off engine.
Fuel injection pump depth bore gauge		8-149		Used to time fuel injection pump on engine.
Precombustion chamber wrench	5120-157-0718	8-190		To remove precombustion chamber
Valve face grinding machine	4910-540-4679	8-185 8-193		To reface rocker arm contact surface and intake and exhaust valves.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Thickness gauge	5210-221-1999	8-187		To adjust valve lash.
Valve spring test stand		8-192		To test intake and exhaust valve springs.
Valve seat grinding kit	4910-473-6437	8-193		To reface intake and exhaust valve seats.
Depth micrometer (0 to 1 inch)		8-235		Used to measure cylinder liner height projection.
Spring tester		11-13		To check heater spring.
Power supply 24 ± 2 VDC 12 AMP		11-13		To check heater component.
Dial indicator		11-13		To check heater component.
Ammeter 0-10 AMP			11-4	To test coolant pump.
Voltmeter 0-30 VOLT			11-4	To test coolant pump.
Pressure gauge 0-50 PSI			11-4	To test coolant pump.
Power supply 24 ± 2 VDC 0.5 AMP			11-4	To test coolant pump.
Strobe light		11-16 11-22		To check coolant pump.

Table 2-1. Recommended Tools and Equipment (Continued)

ITEM	FSN OR PART NUMBER	REFERENCE		USE
		PARA	FIG.	
Power supply 120 ± 2 VAC 50, 60, 400 hertz	AVTRON 100 KW/100 KVAR		13-5	To test load dumping relay.
Ammeter 0-10 AMP AC			13-5	To test load dumping relay.
Power supply 24 VDC 0.5 AMP			13-5	To test load dumping relay.
Ammeter 0-5 AMP DC			13-5	To test load dumping relay.
Ammeter 0-3 AMP AC			13-5	To test load dumping relay.
Voltmeter 0-50 VAC			13-5	To test load dumping relay.
Voltmeter 0-10 VDC			13-6	To test load dumping relay.
Power supply 0-10 VDC 0.5 AMP			13-6	To test load dumping relay.
Power supply 24 ± 2 VDC 0.5 AMP			13-6	To test load dumping relay.
Load Bank			13-6	To test load dumping relay.

Table 2-2. Specially Designed (Fabricated) Tools and Equipment

ITEM	REFERENCE		USE
	FIGURE	PARAGRAPH	
Holding fixture	2-1A	8-71	Repair of turbocharger
Holding fixture adapter	2-1B	8-71	Repair of turbocharger
Supporting screw	2-1C	8-71	Repair of turbocharger
Wrench	2-1D	8-71	Repair of turbocharger
Wooden dowel	2-1E	8-71	Repair of turbocharger
Pilot	2-1 F	8-202	Installation of crank- shaft seal
Sleeve	2-1G	8-202	Installation of crank- shaft seal
Generator moving block	2-1H	7-3	Used when moving generator
Lifting fixture	2-1I	7-3	Used during disassem- bly of generator



Table 2-3. Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET		
<p>1. Start-stop run switch positioned to START but engine does not turn over.</p> <p>2. Start-stop-run switch positioned to START; engine turns over but does not start.</p>	<p>a. Defective dc voltage assembly, mode I or mode 11 relay box.</p> <p>b. Defective or improperly adjusted overspeed switch (S9-1).</p> <p>c. Defective starter.</p> <p>d. Defective flywheel ring gear.</p> <p>a. Defective governor linkage.</p> <p>b. Defective or improperly adjusted utility governor.</p> <p>c. Defective fuel pump.</p> <p>d. Defective governor actuator.</p> <p>e. Defective or improperly adjusted over speed switch (S9-1).</p> <p>f. Engine not properly timed.</p> <p>g. Defective DC solenoid or loose electrical connections of the solenoid plugs.</p>	<p>a. Test relay (paragraph 6-96 or 6-128). Test relay box (paragraph 6-96 or 6-128).</p> <p>b. Repair or adjust switch (paragraph 8-46 or 8-51).</p> <p>c. Repair STARTER (paragraph 8-23).</p> <p>d. Replace gear (paragraph 8-196 thru 8-203).</p> <p>a. Repair linkage (paragraph 8-135 or 8-140)</p> <p>b. Adjust or repair governor (paragraph 8-135 or 8-140).</p> <p>c. Repair pump (paragraph 8-63).</p> <p>d. Test and repair if defective (paragraph 8-110 thru 8-115).</p> <p>e. Repair or adjust switch (paragraph 8-46 thru 8-51).</p> <p>f. Reset accessory drive shaft timing (paragraph 8-156).</p> <p>g. Repair or adjust (paragraph 8-137.a.10).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
<p>3. Engine shuts down after positioning start-stop-run switch to RUN.</p> <p>4. Precise governor fails to take over after starting. Engine speed increases and remains at 2250 rpm (precise generator sets).</p> <p>5. During operation, engine fuel throttle goes to minimum fuel position (precise generator sets).</p>	<p>a. Defective control box relay assembly.</p> <p>b. Defective over voltage relay K2.</p> <p>c. Defective mode I or mode II relay box.</p> <p>a. Defective or improperly adjusted speed switch (S9-2).</p> <p>b. 120 vac not supplied to control unit receptacle P1 pins A and B.</p> <p>c. Defective governor linkage.</p> <p>d. Defective governor actuator.</p> <p>e. Defective governor control unit.</p> <p>f. Defective hydraulic pump.</p> <p>a. Defective governor actuator.</p> <p>b. Defective governor control unit.</p>	<p>a. Test and repair if defective (paragraph 6-14 thru 6-22).</p> <p>b. Test relay (paragraph 6-163).</p> <p>c. Test relay box (paragraph 6-86 or 6-105).</p> <p>a. Repair or adjust switch (paragraph 8-46 or 8-5 1),</p> <p>b. Repair or replace wiring (paragraph 6-243).</p> <p>c. Repair linkage (paragraph 8-135 or 8-140).</p> <p>d. Test and repair if defective (paragraph 8-110 thru 8-115).</p> <p>e. Test and repair if defective (paragraph 6-202).</p> <p>f. Test and replace if defective (paragraph 8-94 thru 8-98).</p> <p>a. Test and repair if defective (paragraph 8-110 thru 8-115).</p> <p>b. Test and repair if defective (paragraph 6-202).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
<p>6. Generator voltage fails to build up.</p>	<p>a. Defective dc relay assembly, A5 field flash relay K5, in mode I or mode II relay box.</p> <p>b. Defective or improperly adjusted speed switch (S51).</p> <p>c. Defective exciter-regulator A10 and All.</p> <p>d. Defective (shorted) current transformer C T4, CT5, or CT6.</p> <p>e. Defective generator.</p>	<p>a. Test relay (paragraph 6-87 or 6-107).</p> <p>b. Repair or adjust switch (paragraph 8-46 or 8-51).</p> <p>c. Test and replace exciter-regulator if defective (paragraph 6-75).</p> <p>d. Test and replace if defective (paragraph 6-154).</p> <p>e. Test and repair if defective (paragraph 7-2).</p>
<p>7. Generator voltage does not respond to adjustment of voltage adjusting rheostat R2 .</p>	<p>a. Defective control box relay assembly A4.</p> <p>b. Defective exciter-regulator A10 and A11.</p>	<p>a. Test and repair if defective (paragraph 6-15).</p> <p>b. Test and repair if defective (paragraph 6-75).</p>
<p>8. Generator output voltage erratic; frequency is stable.</p>	<p>a. Defective exciter-regulator A10 and A11.</p> <p>b. Defective current transformers CT4, CT5, or CT6.</p> <p>c. Defective generator.</p>	<p>a. Test and replace if defective (paragraph 6-75).</p> <p>b. Test and replace if defective (paragraph 6-154).</p> <p>c. Test and repair if defective (paragraph 7-2).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
9. Generator frequency fails to attain rated value after start-up (precise generator sets).	a. Precise governor system not properly aligned. b. Defective precise or mode II relay box. c. Defective or improperly adjusted hydraulic pump. d. Defective governor actuator. e. Defective precise governor control unit. f. Improperly adjusted engine fuel rack.	a. Align system (paragraph 6-211). b. Test and repair relay box (paragraph 6-189 or 6-107). c. Test and replace if defective (paragraph 8-98). d. Test (paragraph 8-115). e. Test and repair if defective (paragraph 6-202). f. Adjust fuel rack (paragraph 8-147).
10. Generator frequency fails to attain rated value (utility generator sets).	a. Defective or improperly adjusted utility governor. b. Improperly adjusted fuel rack. c. Defective governor linkage.	a. Adjust or repair if defective (paragraph 8-135). b. Adjust fuel rack (paragraph 8-148). c. Repair linkage (paragraph 8-135).
11. Generator frequency erratic (NO LOAD).	a. Defective current transformers CT1, CT2, or CT3. b. Defective or improperly adjusted utility governor.	a. Test and replace if defective (paragraph 6-154). b. Adjust or repair if defective (paragraph 8-135).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
11. Generator frequency erratic (NO LOAD). (continued)	c. Precise governor system not properly aligned.  d. Defective hydraulic pump (precise generator sets).  e. Defective precise generator actuator.  f. Defective precise governor control unit.  g. Defective precise or mode H relay box (precise generator sets).  h. Defective exciter regulator.	c. Align system (paragraph 6-211).  d. Test and replace if defective (paragraph 8-94 or 8-98).  e. Test and repair if defective (paragraph 8-110 thru 8-115).  f. Test and repair if defective (paragraph 6-202).  g. Test relay box (paragraph 6-189 or 6-107).  h. Test exciter regulator (paragraph 6-75).
12. Frequency drifts under steady load (precise generator sets).	a. Defective governor control unit.  b. Defective precise governor actuator.  c. Defective hydraulic pump.	a. Test and repair if defective (paragraph 6-202).  b. Test and repair if defective (paragraph 8-110 thru 8-115).  c. Test and replace if defective (paragraph 8-94 or 8-98).
13. Generator set frequency regulation is not isochronous (precise generator sets).	a. Defective mode II or precise relay box.	a. Test relay box (paragraph 6-107 or 6-189).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
ENGINE SHUTS DOWN AND/OR LOAD CONTACTOR OR MOTOR OPERATED CIRCUIT BREAKER OPENS DUE TO PROTECTIVE FUNCTION AND FAULT LOCATOR ILLUMINATES AS FOLLOWS:		
14. Low oil pressure indicator DS1.	a. Broken oil line or fitting. b. Defective oil pump. c. Clogged or defective oil cooler.	a. Repair or replace. b. Repair pump (paragraph 8-174). c. Clean, inspect and repair cooler (paragraph 8-77 thru 8-84).
15. Overspeed indicator DS2.	a. Defective or improperly adjusted utility governor. b. Defective governor linkage. c. Improperly adjusted fuel rack. d. Defective precise governor actuator (precise generator sets). e. Defective governor control unit (precise generator sets). f. Defective or improperly adjusted speed switch (SS1).	a. Test and repair if defective (paragraph 8-135 thru 8-140). b. Repair linkage (paragraph 8-135). c. Adjust rack (paragraph 8-148). d. Test and repair if defective (paragraph 8-110 thru 8-115). e. Test and repair if defective (paragraph 6-202). f. Repair or adjust switch (paragraph 8-46 or 8-51).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
16. Short circuit indicator DS3.	a. Defective short circuit relay (K13).	a. Remove and test relay (paragraph 6-171 and 6-172)
17. Under voltage indicator DS4 (precise generator sets).	a. Defective current transformers CT4, CT5, or CT6.  b. Defective exciter regulator.  c. Defective generator.	a. Test and replace if defective (paragraph 6-154).  b. Test exciter regulator (paragraph 6-75).  c. Test generator (paragraph 7-2).
18. Reverse power indicator DS5 (in parallel operation).	a. Defective or improperly adjusted utility governor.  b. Defective governor linkage.  c. Defective precise governor actuator (precise generator sets).  d. Defective governor control unit (precise generator sets).	a. Adjust or repair if defective (paragraph 8-135 thru 8-140).  b. Repair linkage (paragraph 8-135).  c. Test and repair if defective (paragraph 8-110 thru 8-115).  d. Test and repair if defective (paragraph 6-202).
19. Over voltage indicator DS6.	a. Defective exciter regulator.	a. Test exciter regulator (paragraph 6-75).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
20. Coolant temperature high indicator DS7.	a. Clogged or defective radiator. b. Defective water pump. c. Incorrect fuel injection timing. d. Clogged engine coolant passages. e. Defective shutter.	a. Clean or repair radiator (paragraph 4-10). b. Repair pump (paragraph 8-119). c. Reset timing (paragraph 8-148). d. Clean passages (paragraph 8-230 and 8-231). e. Inspect and repair shutter (paragraph 4-26 thru 4-33).
21. Overload indicator DS9.	a. Defective relay (K14).	a. Test relay (paragraph 6-175).
22. Under frequency indicator DS10 (precise generator sets).	a. Defective precise governor actuator (precise generator sets). b. Defective governor control unit (precise generator sets).	a. Test and repair if defective (paragraph 8-110 thru 8-115). b. Test and repair if defective (paragraph 6-202).
23. Generator set operates properly but fault locator indicators illuminate.	a. Defective fault locator.	a. Test and repair if defective (paragraph 6-49).
24. Generator set shuts down, low fuel indicator illuminates but sufficient fuel is available for operation.	a. Defective dc relay assembly, A5 relay K8, in mode I or mode II relay box.	a. Test relay (paragraph 6-96 or 6-128).



Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
25. Generator set shuts down, overspeed indicator illuminates but engine was operating at normal speed.	a. Defective or improperly adjusted over speed switch.	a. Repair or adjust switch (paragraph 8-46 or 8-51).
26. Load contactor or motor operated circuit breaker opens and overload indicator illuminates with no overload fault.	a. Defective overload relay K14. b. Defective current transformer CT1, CT2, or CT3.	a. Test relay (paragraph 6-175). b. Test and replace if defective (paragraph 6-154).
27. Overload fault condition exists but load contactor does not open.	a. Defective overload relay K14. b. Defective thermal watt converter. c. Defective current transformer CT1, CT2, or CT3.	a. Test relay (paragraph 6-175). b. Test and replace if defective (paragraph 6-3). c. Test and replace if defective (paragraph 6-154).
28. Short circuit fault condition exists but load contactor does not open.	a. Defective short circuit relay K13. b. Defective current transformers CT1, CT2, or CT3. c. Defective thermal watt converter. d. Defective current transformers CT4, CT5, or CT6. e. Defective exciter regulator.	a. Test relay (paragraph 6-171). b. Test and replace if defective (paragraph 6-154). c. Test and replace if defective (paragraph 6-3). d. Test and replace if defective (paragraph 6-154). e. Test exciter regulator (paragraph 6-75).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
29. Over voltage fault condition exists but load contactor or motor operated circuit breaker does not open.	s. Defective over voltage relay K2.	a. Test relay (paragraph 6-163).
30. Under voltage fault condition exists but load contactor or motor operated circuit breaker does not open (precise generator sets).	a. Defective under voltage relay K11.	a. Test and remove relay (paragraph 6-111 and 6-112).
31. Under frequency fault exists but load contactor or motor operated circuit breaker does not open (precise generator sets).	a. Defective under frequency relay (K12).	a. Test relay (paragraph 6-189 and 6-190).
32. Load contactor or motor operated circuit breaker opens and reverse power indicator illuminate with no reverse power fault.	a. Defective load measurement unit. b. Defective reverse power relay.	a. Test unit (paragraph 6-213). b. Test and replace relay (paragraph 6-167).
33. Generator sets do not parallel properly (precise generator sets).	a. Precise governor system not properly aligned. b. Defective governor control unit. c. Defective load measurement unit. d. Defective permissive paralleling relay.	a. Align system (paragraph 6-211). b. Test and repair if defective (paragraph 6-202). c. Test unit (paragraph 6-213). d. Remove and test relay (paragraph 6-193 and 6-194).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
34. Attempting to parallel, without output connected for 120/208 VAC, synchronizing lights are very dim.	a. Defective mode I or mode II relay box.	a. Test relay box (paragraph 6-96 or 6-128).
35. During parallel operation, load contactor or motor operated circuit breaker of set number 2 will not close.	a. Defective load contactor or motor operated circuit breaker. b. Defective permissive paralleling relay K16 (precise generator sets). c. Defective dc relay assembly, A5 in mode I or mode II relay box.	a. Test and replace if defective (paragraph 6-145). b. Test relay (paragraph 6-115). c. Test relay (paragraph 6-96 or 6-128).
36. During parallel operation, generator sets do not share total KVA equally.	a. Defective or improperly adjusted KVA rheostat R29. b. Defective parallel receptacles. c. Defective mode I or mode II relay box. d. Defective exciter regulator e. Defective current transformers CT4, CT5, or CT6. f. Defective generator.	a. Adjust or replace rheostat (paragraph 6-104). b. Rebuild receptacles (paragraph 5-5). c. Test relay box (paragraph 6-96 or 6-128). d. Test exciter regulator (paragraph 6-76). e. Test and replace if defective (paragraph 6-154). f. Test and repair if defective (paragraph 7-2).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
<p>37. During parallel operation, generator sets do not share real load (KW) equally (precise generator sets).</p>	<ul style="list-style-type: none"> <li>a. Defective or improperly adjusted real load sharing rheostat R28.</li> <li>b. Precise governor system not properly aligned.</li> <li>c. Defective current transformers CT1, CT2, or CT3.</li> <li>d. Defective tactical relay box.</li> <li>e. Defective exciter regulator.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust or replace rheostat (paragraph 6-128 and 6-193).</li> <li>b. Align system (paragraph 6-211).</li> <li>c. Test and replace if defective (paragraph 6-154).</li> <li>d. Test relay box (paragraph 6-161).</li> <li>e. Test exciter regulator (paragraph 6-76).</li> </ul>
<p>38. During parallel operation, generator sets do not share real load (KW) equally (utility generator sets).</p>	<ul style="list-style-type: none"> <li>a. Defective or improperly adjusted utility governor.</li> <li>b. Defective governor linkage.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust or repair governor (paragraph 8-140).</li> <li>b. Repair linkage (paragraph 8-140).</li> </ul>
<p>39. Engine misses or runs erratically.</p>	<ul style="list-style-type: none"> <li>a. Incorrect fuel injection timing.</li> <li>b. Sticking valves.</li> <li>c. Broken rocker arm assembly.</li> <li>d. Cracked cylinder liner.</li> </ul>	<ul style="list-style-type: none"> <li>a. Reset timing (paragraph 8-148).</li> <li>b. Free valves (paragraph 8-192).</li> <li>c. Replace rocker arm (paragraph 8-182).</li> <li>d. Replace liner (paragraph 8-230).</li> </ul>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
<p>39. Engine misses or runs erratically. (continued)</p>	<p>e. Blown head gasket.</p> <p>f. Broken valve spring.</p> <p>g. Defective fuel injection nozzle.</p> <p>h. Defective fuel injection pump.</p> <p>i. Bend or broken push rod.</p> <p>j. Defective piston or rings.</p>	<p>e. Replace gasket (paragraph 8-189).</p> <p>f. Replace spring (paragraph 8-182).</p> <p>g. Replace nozzle (paragraph 8-143).</p> <p>h. Repair pump (paragraph 8-143).</p> <p>i. Replace push rod (paragraph 8-182).</p> <p>j. Replace piston or rings (paragraph 8-214).</p>
<p>40. Engine hunts (pre - sise generator sets).</p>	<p>a. Defective exciter regulator</p> <p>b. Defective or imp operly adjusted governor actuator feedback transducer.</p> <p>c. Defective electronic component assembly, A26 in precise or mode II relay box.</p> <p>d. Defective governor actuator.</p> <p>e. Defective control unit.</p>	<p>a. Remove, test and replace if defective (paragraph 6-75 and 6-76).</p> <p>b. Test and adjust transducer (paragraph 6-202).</p> <p>c. Replace assembly (paragraph 6-194 or 6-128).</p> <p>d. Test and repair if defective (paragraph 8-109).</p> <p>e. Test and repair if defective (paragraph 6-202).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
<p>40. Engine hunts (precise generator sets). (continued)</p> <p>41. Sluggish governor actuator operation (precise generator sets).</p> <p>12. Engine lacks power.</p>	<p>f. Defective hydraulic pump.</p> <p>a. Low hydraulic pressure to actuator.</p> <p>b. Defective governor linkage.</p> <p>c. Defective precise governor actuator.</p> <p>d. Defective governor control unit.</p> <p>e. Defective hydraulic pump.</p> <p>a. Defective fuel nozzle.</p> <p>b. Incorrect fuel injection timing.</p> <p>c. Blown head gasket.</p> <p>d. Defective valves or valve springs.</p> <p>e. Defective piston, rings, or connecting rods.</p>	<p>f. Test and replace if defective (paragraph 8-94 and 8-98).</p> <p>a. Test pump (paragraph 8-98).</p> <p>b. Repair linkage (paragraph 8-109).</p> <p>c. Test and repair if defective (paragraph 8-94 or 8-98).</p> <p>d. Test and repair if defective (paragraph 6-202).</p> <p>e. Test and replace if defective (paragraph 8-94 or 8-98).</p> <p>a. Replace fuel nozzle (paragraph 8-143).</p> <p>b. Reset timing (paragraph 8-148).</p> <p>c. Replace gasket (paragraph 8-190).</p> <p>d. Repair or replace valves or springs (paragraph 8-182).</p> <p>e. Replace piston, rings, or connecting rods (paragraph 8-214).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
42. Engine lacks power. (continued)	f. Defective cylinder liner,  g. Turbocharger carboned or dragging.  h. Defective governor linkage.	f. Replace liner (paragraph 8-230).  g. Repair turbocharger (paragraph 8-71).  h. Repair linkage (paragraph 8-135).
43. Engine knocks, develops excessive noise, or vibration.	a. Loose or defective crankshaft pulley or vibration damper.  b. Defective or loose fan.  c. Loose or defective engine mounts.  d. Defective crankshaft or bearings.  e. Defective connecting rod or bearings.  f. Defective piston or pin.  g. Damaged timing gear train components.	a. Tighten or replace pulley or damper (paragraph 8-127).  b. Tighten or replace fan (paragraph 8-31).  c. Tighten or replace mount (paragraph 8-127).  d. Replace crankshaft or bearings (paragraph 8-222).  e. Replace rod or bearings (paragraph 8-214).  f. Replace piston or pin (paragraph 8-214).  g. Replace defective components (paragraph 8-127).
44. Engine exhaust excessively black or gray.	a. Defective fuel nozzle.  b. Incorrect fuel injection timing.	a. Replace nozzle (paragraph 8-143).  b. Reset timing (paragraph 8-148).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
45. Engine exhaust excessively white or blue.	a. Defective valve guides. b. Defective piston rings. c. Incorrect fuel injection timing.	a. Repair cylinder head (paragraph 8-143). b. Replace rings (paragraph 8-214). c. Reset timing (paragraph 8-148).
46. Excessive engine oil consumption.	a. Excessive valve guide wear. b. High oil temperature due to defective oil cooler. c. Worn piston rings and/or cylinder liners.	a. Repair cylinder head (paragraph 8-190). b. Repair cooler (paragraph 8-79). c. Replace piston rings (paragraph 8-214) and/or cylinder liners (paragraph 8-236).
47. Heavy engine combustion knock.	a. Defective fuel injection pump plunger and barrel assembly. b. Defective or leaking fuel injection valve.	a. Replace plunger and barrel assembly (paragraph 8-143). b. Replace fuel injection valve (paragraph 8-143).
48. Engine valve train clicking noise.	a. Defective valve spring. b. Insufficient lubrication in valve compartment.	a. Replace spring (paragraph 8-143). b. Clean oil passages leading to the cylinder head (paragraph 8-191).



Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
49. Engine lubricating oil in coolant.	<ul style="list-style-type: none"> <li>a. Defective cylinder head gasket.</li> <li>b. Defective oil cooler core.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace gasket (paragraph 8-190).</li> <li>b. Repair or replace cooler (paragraph 8-82).</li> </ul>
50. Engine stalls at low speed.	<ul style="list-style-type: none"> <li>a. Idle speed too low.</li> <li>b. Defective fuel injection valve.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust governor low idle setting (paragraph 8-237).</li> <li>b. Repair valve (paragraph 8-143).</li> </ul>
51. Loud valve train noise in engine.	<ul style="list-style-type: none"> <li>a. Defective camshaft.</li> <li>b. Defective valve lifters.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace camshaft (paragraph 8-206).</li> <li>b. Replace valve lifters (paragraph 8-182).</li> </ul>
52. Little rocker arm movement and excessive valve lash.	<ul style="list-style-type: none"> <li>a. Defective camshaft and/or followers.</li> <li>b. Defective valve lifters.</li> <li>c. Defective push rod.</li> <li>d. Insufficient lubrication in valve compartment.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace camshaft and/or followers (paragraph 8-206).</li> <li>b. Replace lifters (paragraph 8-182).</li> <li>c. Replace rod (paragraph 8-182).</li> <li>d. Clean oil passages (paragraph 8-185).</li> </ul>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
53. Engine valve roto-coil or spring retainer free.	a. Broken valve keepers. b. Broken valve spring. c. Defective valve.	a. Replace keepers (paragraph 8-182). b. Replace valve spring (paragraph 8-182). c. Replace valve (paragraph 8-182).
54. Excessive engine blow-by.	a. Excessive valve guide wear. b. Excessive lubricating oil in valve compartment. c. Worn piston rings and/or liners.	a. Repair cylinder head (paragraph 8-190). b. Check rocker arm shaft end plugs for proper installation (paragraph 8-186). c. Replace piston rings (paragraph 8-214) and/or liners (paragraph 8-230).
55. Coolant in engine lubricating oil.	a. Defective cylinder head gasket. b. Defective cylinder head. c. Defective combustion chamber. d. Defective cylinder block. e. Defective oil cooler.	a. Replace gasket (paragraph 8-190). b. Replace head (paragraph 8-190). c. Replace chamber (paragraph 8-190). d. Replace block (paragraph 8-230). e. Repair or replace oil cooler (paragraph 8-79).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
56. Alternator charging rate low or unsteady.	a. Intermittent or high resistance in charging or ground return circuits or battery connections.  b. Defective regulator.  c. Alternator rectifier diodes shorted or open.  d. Alternator rotor (field coil) turns grounded or shorted.  e. Loose connections on alternator and/or regulator.  f. Defective brushes.	a. Clean, retighten, or replace defective parts.  b. Replace if defective (paragraph 8-16).  c. Replace diodes (paragraph 8-16).  d. Replace rotor (paragraph 8-16).  e. Tighten connections.  f. Replace brushes (paragraph 8-16).
57. Noisy alternator.	a. Misaligned belt or pulley.  b. Loose pulley.  c. Worn bearings.  d. Shorted rectifier diodes.	a. Align drive pulley and alternator pulley and belts.  b. Tighten pulley nut, if keyway is worn, replace pulley (paragraph 8-16).  c. Replace bearings (paragraph 8-18).  d. Replace diode assembly (paragraph 8-18).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
GENERATOR SET (Continued)		
58. Noisy turbocharger.	a. Worn bearings.  b. Insufficient lubrication.  c. Excessive end play.  d. Defective shaft and wheel assembly.	a. Replace bearings (paragraph 8-71).  b. Clean oil passages (paragraph 8-71).  c. Repair turbocharger (paragraph 8-71).  d. Repair turbocharger (paragraph 8-71).
FUEL BURNING WINTERIZATION KIT		
59. Heater switch ON, nothing happens, press to test indicator energizes when depressed.  60. Switch on, heater will not ignite. Blower operates.	a. Limit switch detective.  b. Heater switch defective.  a. Heater orifice clogged.  b. Fuel regulator valve solenoid closed.	a. Test and replace defective limit switch (paragraph 11-11).  b. Check continuity of switch. Replace if defective (paragraph 11-5).  a. Clean orifice. Replace if defective (paragraph 11-13).  b. Test and adjust fuel regulator valve (paragraph 11-13).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
FUEL BURNING WINTERIZATION KIT (Continued)		
61. Fan runs continuously with switch off.	a. Broken quartz rod. b. Flame switch out of adjustment. c. Wiring defective.	a. Replace quartz rod (paragraph 11-11). b. Readjust (paragraph 11-16). c. Check continuity of wiring. Replace if defective (figure 1-29).
62. Heater starts, then shuts off .	a. Defective micro switch. b. Heater overheats, causing limit switch to trip.	a. Test and replace micro switch if defective (paragraph 11-16). b. Check and adjust fuel flow rate by adjusting and testing regulator valve (paragraph 11-13).
63. Circuit breaker trips open.	a. Short circuit.	a. Disconnect basic components one at a time, to isolate short, then check wiring (figure 1-29).
64. Heater will not shut off .	a. Fuel regulator valve stuck open. b. Flame switch stuck in RUN position.	a. Test fuel regulator valve and replace if defective (paragraph 11-13). b. Adjust flame switch and replace if defective (paragraph 11-16).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
FUEL BURNING WINTERIZATION KIT (Continued)		
65. Heater has surging combustion.	a. Fuel regulator operating erratically.	a. Test fuel regulator valve (paragraph 11-13).
	b. Defective sintered filter.	b. Clean filter.
66. Coolant pump fails to recirculate liquid.	a. Defective coolant pump.	a. Test coolant pump (paragraph 11-16).
67. Coolant pump turns over but fails to deliver liquid.	a. Pump passages or blade slots plugged with foreign matter.	a. Remove pump and disassemble and clean (paragraph 11-11).
68. Heater has erratic operation or reduced output.	a. Air leaks in tubing.	a. Check tubing connections for leaks and repair as necessary (paragraph 11-11).
	b. Reduced voltage.	b. Check voltage input to motor. It should be above 24 vdc (figure 1-29).
	c. Motor lags, low rpm.	c. Inspect motor brushes for wear (paragraph 11-11).
	d. Scored cam ring bore.	d. Replace cam ring (paragraph 11-11).
	e. Foreign matter in pump blade slot.	e. Remove pump, disassemble and clean (paragraph 11-11).
69. Heater leaks.	a. Face of seal cage scored or seal is damaged.	a. Disassemble pump and re-finish or replace seal cage (paragraph 11-11).

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
ELECTRIC WINTERIZATION KIT		
<p>70. Switch on control box positioned to ON; heater ON indicator energized, coolant pump operating but coolant temperature not rising.</p>	<p>a. Defective electric heater.</p>	<p>a. Test electric heater and replace if defective (paragraph 12-14).</p>
<p>71. Switch on control box positioned to ON; indicator energized but coolant not being circulated and coolant temperature not rising.</p>	<p>a. Defective thermo switch S2.</p> <p>b. Defective control box.</p> <p>c. Defective heater.</p> <p>d. Defective coolant pump.</p>	<p>a. Check continuity of switch at room temperature. It should have continuity. Immerse its temperature sensing element in a water bath at a temperature of 120 + °F. There should be no continuity now. Allow water to cool below 100°F. There should be continuity again.</p> <p>b. Test control box (paragraph 12-3).</p> <p>c. Repair heater (paragraph 12-14).</p> <p>d. Test pump (paragraph 12-19).</p>
<p>72. Switch on control box positioned to ON and indicator does not energize.</p>	<p>a. No power to input receptacle J49, terminals A and B, figure 1-30.</p> <p>b. Defective control box.</p>	<p>a. Remove cable and measure voltage to these two terminals. It should be between 205 to 240 VAC, 50/60 or 400 hertz.</p> <p>b. Test control box (paragraph 12-3).</p>

Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
DUMMY LOAD KIT		
73. Dummy load kit will not apply load when automatic load switch is in the ON position, but does apply load when switch is in BYPASS RESET position.	a. Defective load measuring unit. b. Defective load dumping relay (K5). c. Defective wiring harness.	a. Test and repair if defective (paragraph 6-248). b. Test and repair if defective (paragraph 13-11). c. Rebuild harness (paragraph 13-7 or 13-26).
74. Dummy load kit trips off the line below automatic removal point.	a. Defective load dumping relay (K5). b. Defective load measuring unit.	a. Test and repair if defective (paragraph 13-11). b. Test and repair if defective (paragraph 6-248).
75. Dummy load kit does not disconnect at automatic removal point.	a. Defective load dumping relay (K5). b. Defective load measuring unit.	a. Test and repair if defective (paragraph 13-11). b. Test and repair if defective (paragraph 6-248).
76. Dummy load set does not apply load when automatic load switch is in either position.	a. Defective transformer (T1). b. Defective bridge rectifier assembly CR1, CR2, CR3, or CR4. c. Defective wiring harness.	a. Test and replace if defective (paragraph 13-24). b. Test and replace if defective (paragraph 13-24). c. Rebuild harness (paragraph 13-7 or 13-26).



Table 2-3. Troubleshooting (Continued)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
DUMMY LOAD KIT (Continued)		
77. Dummy load kit Load does not change when load selector switch is rotated.  78. Dummy load is unbalanced.	a. Defective contactor K1, K2, K3, or K4.  a. Defective contactor K1, K2, K3, or K4.  b. Defective heater elements.  c. Defective wiring harness.	a. Test and replace if defec- tive (paragraph 13-24)  a. Test and replace if defec- tive (paragraph 13-24).  b. Test and replace if defec- tive (paragraph 13-5).  c. Test and repair if defec- tive (paragraph 13-7 or 13-26).

## Section IV. ENGINE CHANGE INSTRUCTIONS, D3306(T) ENGINE

2-10. GENERAL.

This section contains instructions for the replacement of the existing D333C(T) engine, which is no longer manufactured, with the new D3306(T) engine.

2-11. ENGINE REMOVAL, D333C(T) ENGINE.

Refer to paragraph 2-8 and remove the existing D333C(T) engine.

2-12. REMOVAL OF SALVAGABLE COMPONENTS FROM THE D333C(T) ENGINE.

The following components are to be removed from the D333T engine and salvaged for installation on the D3306(T) engine.

a. Refer to Operation and Organizational Maintenance Manual and remove the oil pressure transmitter, low oil pressure switch, coolant temperature transmitter, high coolant temperature switch, alternator, air cleaner, fuel filter and pump assembly, coolant drain valve, hydraulic tank and hydraulic filter assembly (MEP 116A only), starter motor, oil sump shut-off valve with hose assembly, elbow and nipple, and the turbocharger exhaust elbow.

b. Refer to paragraph 8-86 and remove the hydraulic tank. Refer to figure 8-10 and remove the fan (3) in the sequence of index number assigned. Refer to figure 8-64 and remove the lube oil filler neck (30) in the sequence of index numbers assigned.

2-13. INSTALLATION OF COMPONENTS, D3306(T) ENGINE.

a. Installation of Salvaged and New Components.

The following salvaged components from the D333C(T) engine are to be installed on the D3306(T) engine. Before installation of these components, completely remove all engine preservative packaging and proceed as follows:

(1) Over speed Switch Magnetic Pickup. Before installing the D3306(T) engine into the generator set, refer to figure 2-8 and install the magnetic pickup (85B) into the engine flywheel housing. Pay particular attention to the following:

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

(a) Inspect flywheel for nicks and burrs on generator contact surfaces. Remove nicks and burrs using a suitable file or stone. Clean flywheel with an approved cleaning solvent and dry thoroughly.

(b) Run the locknut on the pickup (85B) to the electrical connector end of the pickup and thread the magnetic pickup into the flywheel housing.

(c) Center one flywheel tooth directly below the pickup head. Using a suitable feeler gage, adjust the pickup to tooth clearance to 0.015 to 0.020 inch gap. Pickup can also be positioned by bottoming lightly on gear tooth and backing off 95° to 130° to obtain correct gap.

(d) Secure pickup and tighten locknut. Recheck clearance.

(2) Engine. Refer to paragraph 2-8 and install the D3306(T) engine into the generator set.

(3) Turbocharger Exhaust Elbow. Refer to figure 2-8 and install the salvaged turbocharger exhaust elbow (85E). Pay particular attention to the following:

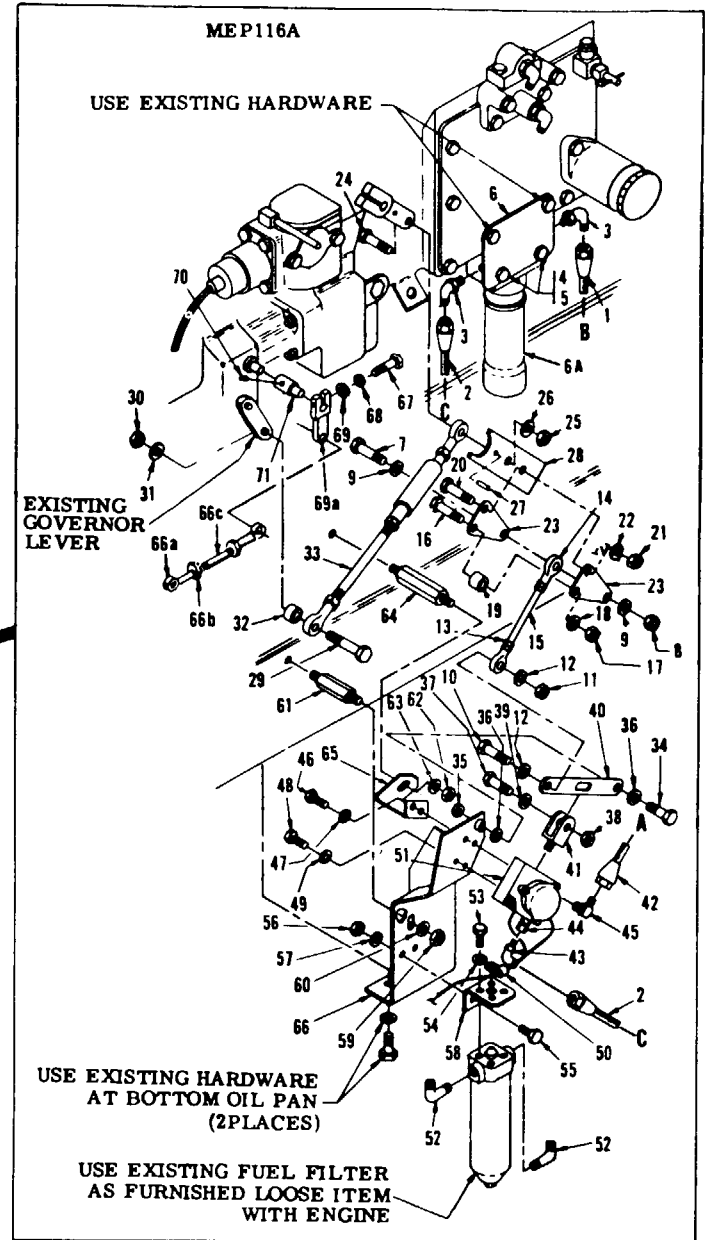
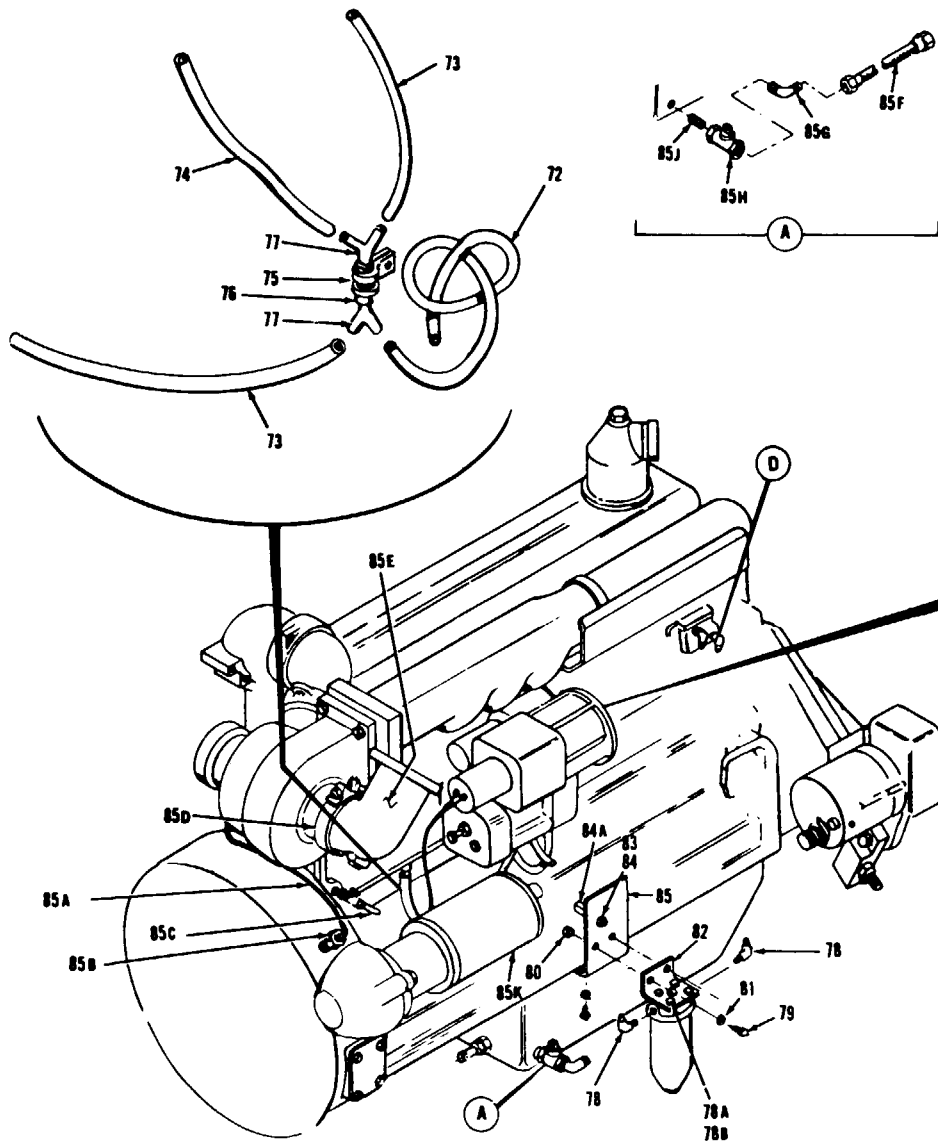


Figure 2-8. Engine assembly, D3306(T) (sheet 1 of 2)

Change 4  
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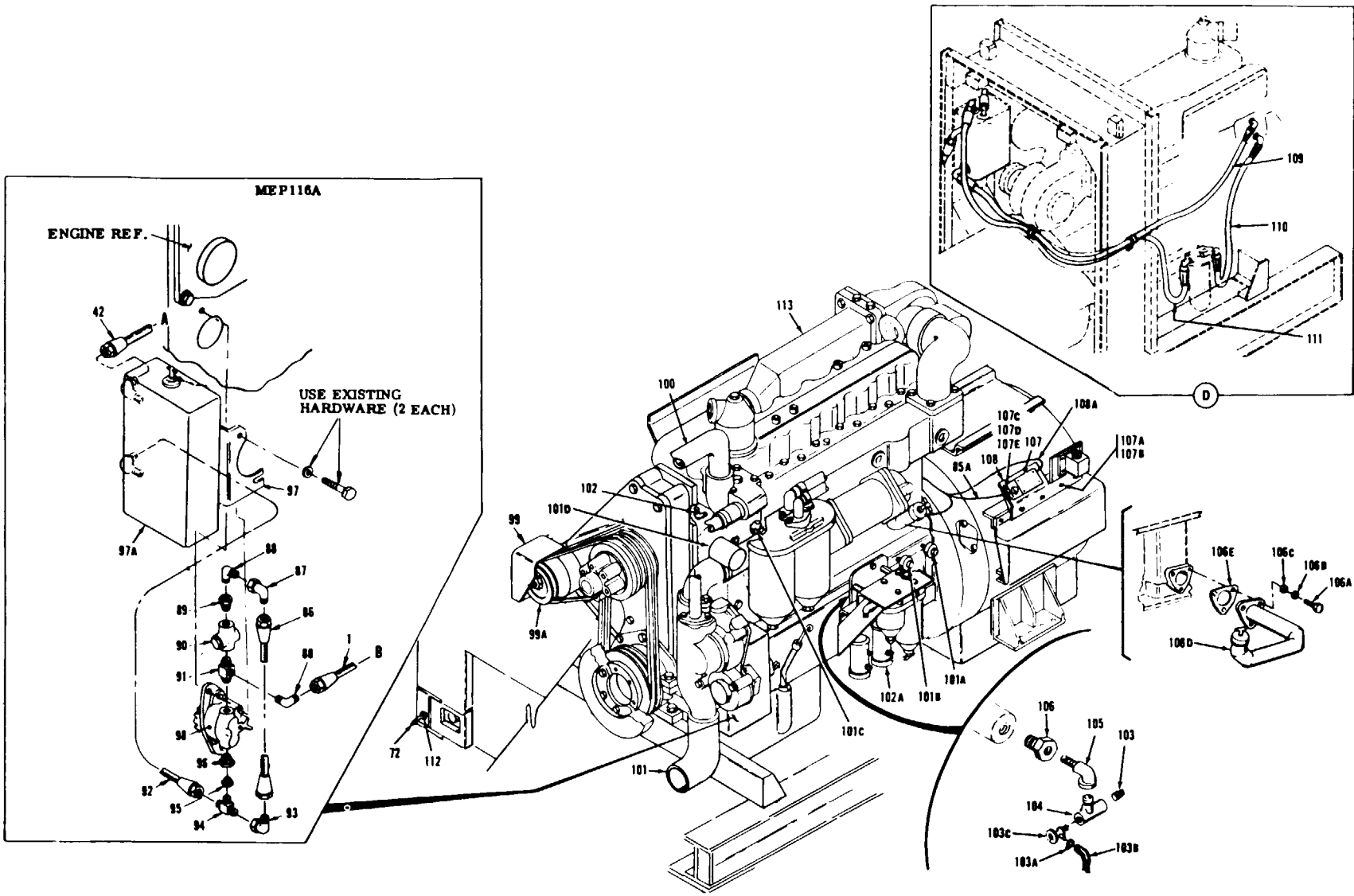


Figure 2-8. Engine assembly, D3306(T) (sheet 2 of 2)

Legend to figure 2-8:

- |     |                                   |      |                              |
|-----|-----------------------------------|------|------------------------------|
| 1.  | Hose assembly                     | 44.  | Reducer                      |
| 2.  | Hose assembly                     | 45.  | Elbow                        |
| 3.  | Elbow                             | 46.  | Screw                        |
| 4.  | Screw (2)                         | 47.  | Washer                       |
| 5.  | Nut (2)                           | 48.  | Screw                        |
| 6.  | Bracket, hydraulic filter         | 49.  | Washer                       |
| 6A. | Hydraulic filter assy. (salvaged) | 50.  | Clamp                        |
| 7.  | Screw                             | 51.  | Governor actuator            |
| 8.  | Nut                               | 52.  | Elbow (2)                    |
| 9.  | Washer                            | 53.  | Screw (4)                    |
| 10. | Screw                             | 54.  | Washer (4)                   |
| 11. | Nut                               | 55.  | Screw (2)                    |
| 12. | Washer                            | 56.  | Nut (2)                      |
| 13. | Nut                               | 57.  | Washer (2)                   |
| 14. | Rod end                           | 58.  | Fuel filter mounting bracket |
| 15. | Threaded rod                      | 59.  | Nut                          |
| 16. | Screw                             | 60.  | Washer                       |
| 17. | Nut                               | 61.  | Stud                         |
| 18. | Washer                            | 62.  | Nut                          |
| 19. | Roller stop                       | 63.  | Washer                       |
| 20. | Screw                             | 64.  | Stud                         |
| 21. | Nut                               | 65.  | Actuator mounting brace      |
| 22. | Washer                            | 66.  | Governor support bracket     |
| 23. | Throttle override plate           | 66A. | Rod end bearing              |
| 24. | Screw                             | 66B. | Nut                          |
| 25. | Nut                               | 66C. | Threaded rod                 |
| 26. | Washer                            | 67.  | Screw                        |
| 27. | Spring pin                        | 68.  | Washer                       |
| 28. | Throttle extension arm            | 69.  | Washer                       |
| 29. | Screw                             | 69A. | Speed control lever          |
| 30. | Nut                               | 70.  | Setscrew                     |
| 31. | Washer                            | 71.  | Shaft extender               |
| 32. | Link spacer                       | 72.  | Plastic tubing               |
| 33. | Throttle link assembly            | 73.  | Plastic tubing               |
| 34. | Screw                             | 74•  | Plastic tubing               |
| 35. | Nut                               | 75.  | Clamp                        |
| 36. | Washer                            | 76.  | Plastic tubing               |
| 37. | Screw                             | 77.  | Plastic fitting              |
| 38. | Nut                               | 78.  | Elbow (2)                    |
| 39. | Washer                            | 78A. | Screw                        |
| 40. | Governor throw extender link      | 78B. | Washer                       |
| 41. | Hydraulic actuator clevis         | 79.  | Screw (2)                    |
| 42. | Hose assembly                     | 80.  | Nut (2)                      |
| 43. | Elbow                             | 81.  | Washer (2)                   |

Legend to figure 2-8 (continued):

- |      |                                       |        |  |
|------|---------------------------------------|--------|--|
| 82.  | Fuel filter mounting bracket          | 10 IA. | Oil pressure transmitter (salvaged)        |
| 83.  | Nut                                   | 101B.  | Low oil pressure switch (salvaged)         |
| 84.  | Washer                                | 101C.  | Coolant temperature transmitter (salvaged) |
| 84A. | Stud                                  | 101D.  | High coolant temperature switch (salvaged) |
| 85.  | Fuel filter support bracket           | 102.   | Elbow                                      |
| 85A. | Cable assembly                        | 102A.  | Fuel filter and pump assembly (salvaged)   |
| 85B. | Magnetic pickup                       | 103.   | Plug                                       |
| 85C. | Elbow                                 | 103A.  | Clamp (salvaged)                           |
| 85D. | Clamp                                 | 103B.  | Hose (salvaged)                            |
| 85E. | Turbocharger exhaust elbow (salvaged) | 103C.  | Drain valve (salvaged)                     |
| 85F. | Hose assembly (salvaged)              | 104.   | Tee  |
| 85G. | Elbow (salvaged)                      | 105.   | Elbow                                      |
| 85H. | Oil sump shut-off valve (salvaged)    | 106.   | Reducer bushing                            |
| 85J. | Long nipple (salvaged)                | 106A.  | Bolt (3)                                   |
| 85K. | Starter motor (salvaged)              | 106B.  | Lock washer (3)                            |
| 86.  | Hose assembly                         | 106C.  | Washer (3)                                 |
| 87.  | Elbow                                 | 106D.  | Lube oil filler neck (salvaged)            |
| 88.  | Elbow                                 | 106E.  | Gasket                                     |
| 89.  | Reducer bushing                       | 107.   | Speed switch assembly                      |
| 90.  | Regulating valve                      | 107A.  | Screw (4)                                  |
| 91.  | Pipe tee                              | 107B.  | Washer (4)                                 |
| 92.  | Hose assembly                         | 107C.  | Screw (4)                                  |
| 93.  | Elbow                                 | 107D.  | Washer (4)                                 |
| 94.  | Tee                                   | 107E.  | Nut (4)                                    |
| 95.  | Reducer bushing                       | 108.   | Bracket                                    |
| 96.  | Reducer bushing                       | 108A.  | Engine wiring harness                      |
| 97.  | Hydraulic tank mounting bracket       | 109.   | Hose assembly                              |
| 97A. | Hydraulic tank (salvaged)             | 110.   | Hose assembly                              |
| 98.  | Hydraulic pump assembly               | 111.   | Hose assembly                              |
| 99.  | Alternator fan guard                  | 112.   | Grommet                                    |
| 99A. | Alternator                            | 113.   | Engine, D3306(T)                           |
| 100. | Upper radiator hose                   |        |  |
| 101. | Lower radiator hose                   |        |  |

(a) Remove the existing D3306(T) turbocharger exhaust elbow from the engine by removing the existing retaining clamp (85D).

(b) Install the salvaged turbocharger exhaust elbow (85E) onto the engine and secure with existing retaining clamp (85D). Make certain that water drain plug points directly downward.

(4) Oil Sump Shut-Off Valve. Refer to figure 2-8 and install the salvaged oil sump shut-off valve (85H), long nipple (85J), elbow (85G) and hose assembly (85F).

(5) Starter Motor. Refer to figure 2-8 and install the salvaged starter motor (85K) and attaching hardware in the engine. Pay particular attention to the following:

(a) Reconnect tagged electrical leads to the starter motor and solenoid.

(6) Hydraulic Filter Assembly (MEP116A only). Refer to figure 2-8 and install the salvaged hydraulic filter assembly (6A) as shown. Pay particular attention to the following:

(a) Assemble the hydraulic filter bracket (6) to the salvaged filter assembly (6A) using screws (4) and self-locking nuts (5).

(b) Remove existing hardware as shown and mount the hydraulic filter assembly to the engine.

(c) Connect elbows and hose assemblies as shown.

(7) Lube Oil Filler Neck Assembly. Refer to figure 2-8 and install the salvaged lube oil filler neck assembly (106D). Pay particular attention to the following:

(a) Remove the existing D3306(T) lube oil filler neck assembly from the engine by removing three bolts (106A), three lockwashers (106B) and three washers (106C). Make certain not to damage existing gasket (106E).

(b) Install the salvaged lube oil filler neck assembly (106D) to the engine using the existing three bolts (106A), three lockwashers (106B), three washers (106C) and gasket (106E).

(8) Coolant Drain Valve. Refer to figure 2-8 and install the salvaged coolant drain valve (103C) as shown. Pay particular attention to the following:

(a) Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III to pipe threads prior to installation.

(b) Thread new reducer bushing (106) into engine block.

(c) Assemble tee (104), plug (103) and elbow (105). Thread assembly into reducer bushing (106). Thread salvaged coolant drain valve (103C) into tee (105) as shown.

(9) Fuel Filter and Pump Assembly. Refer to figure 2-8 and install the salvaged fuel filter and pump assembly (102A) as shown. Pay particular attention to the following:

(a) Connect tagged electrical leads and hoses.

(10) Alternator. Refer to figure 2-8 and install the salvaged alternator (99A) as shown. Pay particular attention to the following:

(a) Install new alternator fan guard (99) using salvaged hardware.

(11) Fan. Refer to figure 8-10 and install the salvaged fan in the reverse sequence of index numbers assigned.

(12) Hydraulic Tank and Hydraulic Pump (ME P116A only).

(a) Refer to figure 2-8 and remove the hydraulic tank mounting bracket from the salvaged hydraulic tank (97A).

(b) Install new mounting bracket (97) onto the hydraulic tank (97A).

(c) Refer to figure 2-8 and assemble the modified hydraulic tank (97A) and the new hydraulic pump (98) onto the engine as follows:

NOTE

Be sure hydraulic pump gears mesh properly and there is no binding.

1. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III to pipe threads prior to installation.

2. Place hydraulic pump (98) into pump receptacle, making certain that gear teeth mesh properly and do not bind.

3. Place hydraulic tank (97A) onto pump and secure both assemblies with existing hardware.

4. Attach fittings and hoses.

(13) Alternator Belt and Fan Belts. Refer to Operator and Organizational Maintenance Manual and install and adjust the alternator belt and fan belts.

(14) High Coolant Temperature Switch. Refer to figure 2-8 and install the salvaged high coolant temperature switch (101D) as shown. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III to pipe threads prior to installation.

(15) Coolant Temperature Transmitter. Refer to figure 2-8 and install the salvaged coolant temperature transmitter (101C) as shown. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III, to pipe threads prior to installation.

(16) Low Oil Pressure Switch. Refer to figure 2-8 and install the salvaged low oil pressure switch (101B) as shown. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III to pipe threads prior to installation.

(17) Oil Pressure Transmitter. Refer to figure 2-8 and install the salvaged oil pressure transmitter (101A) ) as shown. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III to pipe threads prior to installation.

(18) Over speed Switch. Refer to figure 2-8 and install the overspeed switch (107). Pay particular attention to the following:

(a) Remove existing screws (107A) and washers (107B).

(b) Assemble the over speed switch (107) to the over speed switch bracket (108) using screws (107C), washers (107D) and nuts (107E).

(c) Install the overspeed shutdown switch onto the generator as shown.



(d) Overspend switch cable assembly. Install connector P62 on the cable assembly (85A) to J62 on the overspeed switch (107). Connect loose end of cable assembly (85A) to magnetic pickup (85B).

(19) Governor Actuator and Linkage (ME P116A only). Refer to figure 2-8, sheet 1 and install the governor actuator (51) and the associated linkage as shown. Pay particular attention to the following:

(a) Install the final fuel filter supplied with the 3306(T) engine to fuel filter bracket (58) using screws (53) and washers (54).

(20) Lifting Frame Assembly. Refer to paragraph 3-14 and install the lifting frame assembly onto the generator skid base.

(21) Day Tank. Refer to Operator and Organizational Maintenance Manual and install the day tank in the reverse sequence of index numbers assigned.

(22) Engine Wiring Harness. Refer to figure 2-8 and Operator and Organizational Maintenance Manual and install the engine wiring harness (108A). Pay particular attention to the following:

(a) Install connector P37 to J37 on overspeed switch (107).

(b) Connect harness connectors and wires.

(c) Secure harnesses with clamps.

(d) Join harnesses in common run from one side of engine to opposite side at six inch intervals with tiedown straps.

(23) Air Cleaner. Refer to Operator and Organizational Maintenance Manual and install the air cleaner as shown.

(24) Manual Speed Control. Refer to figure 2-8 and Operator and Organizational Maintenance Manual and connect the manual speed control in the reverse sequence of index numbers assigned.

(25) Radiator and Housing Frame Assembly. Refer to Operator and Organizational Maintenance Manual and install the radiator and housing frame assembly in the reverse sequence of index numbers assigned. Pay particular attention to the following:

(a) Install new radiator hoses; upper hose (figure 2-8, 100) and lower hose (101).

(26) Doors and Covers. Refer to Operator and Organizational Maintenance Manual and install the doors and covers in the reverse sequence of index numbers assigned.

(27) Crankcase Breather Tube and Hose. Refer to Operator and Organizational Maintenance Manual and install crankcase breather tube and hose in reverse sequence illustrated.

(28) Muffler and Exhaust Pipe. Refer to Operator and Organizational Maintenance Manual and install muffler and exhaust pipe.

(29) Engine Fuel Bleed Line Installation. Refer to figures 2-8 and 2-9 and install the engine fuel bleed line (72) as follows:

WARNING

Drilling operations create metal chips which may enter the eye. Eye protection is required.

(a) Refer to figure 2-9 and drill a 0.438 inch hole as illustrated.

(b) Refer to figure 2-8 and install grommet (112). Install the engine fuel bleed line (72) as illustrated.

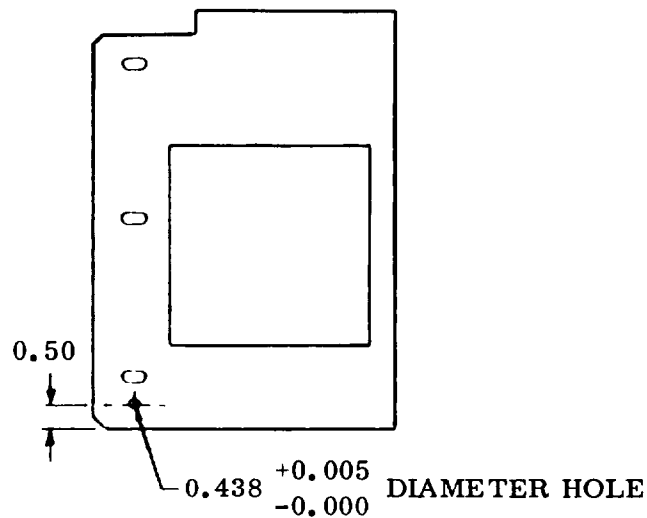


Figure 2-9. Front lower right panel drilling dimensions for fuel bleed line tubing

(30) Battery Cables. Refer to Operator and Organizational Maintenance Manual and connect the battery cables as illustrated.

(31). Winterization Kits. If the generator set contains a winterization kit,

refer to the Operator and Organizational Maintenance Manual for modification instructions.

(32) Generator Set Test After Engine Change. Refer to Chapter 10 and perform generator set test after engine change.

## CHAPTER 3

### HOUSING AND LIFTING FRAME ASSEMBLY REPAIR INSTRUCTIONS

#### Section I. HOUSING FRAME

##### 3-1. GENERAL.

a. **HOUSING FRAME.** The housing frame reinforces the housing panels and doors. It provides interconnection between the lifting frame and front and rear housings.

b. **FRONT HOUSING.** The front housing is the mounting frame for the generator set radiator and shutter assembly. It also provides a connection point for the engine crankcase breather tube and slave receptacle SR2.

c. **REAR HOUSING.** The rear housing provides a mount for the control cubicle, fault locator panel, DC control cubicle, convenience receptacle, sleeve and plate assembly, parallel harness receptacles, manual speed control, and mounting openings for the controls of the generator set optional kits which are covered by plates if the kits are not installed. It also contains the air intake panel.

##### 3-2. REMOVAL AND DISASSEMBLY.

Refer to figure 3-1 and remove and disassemble the housing frame in the order of index numbers assigned. Pay particular attention to the following:

a. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Disconnect negative battery cable.
  2. Remove housing panels and doors.
  3. Remove DC control circuit breaker.
  4. Disconnect parallel receptacle harness from rear housing.
  5. Remove manual speed control.
  6. Remove kit control panels from rear housing, if installed.
  7. Remove slave receptacles from front housing and receptacle mounting panel.
  8. Remove radiator and shutter assembly.
- b. Remove control cubicle, as specified in paragraph 2-6.
- c. Remove fault locator panel from rear housing by disconnecting harness from rear of locator panel and removing four screws attaching panel to rear housing.
- d. Remove convenience receptacle assembly from rear housing by disconnecting harness from rear of assembly and removing six screws and washer securing assembly to rear housing.

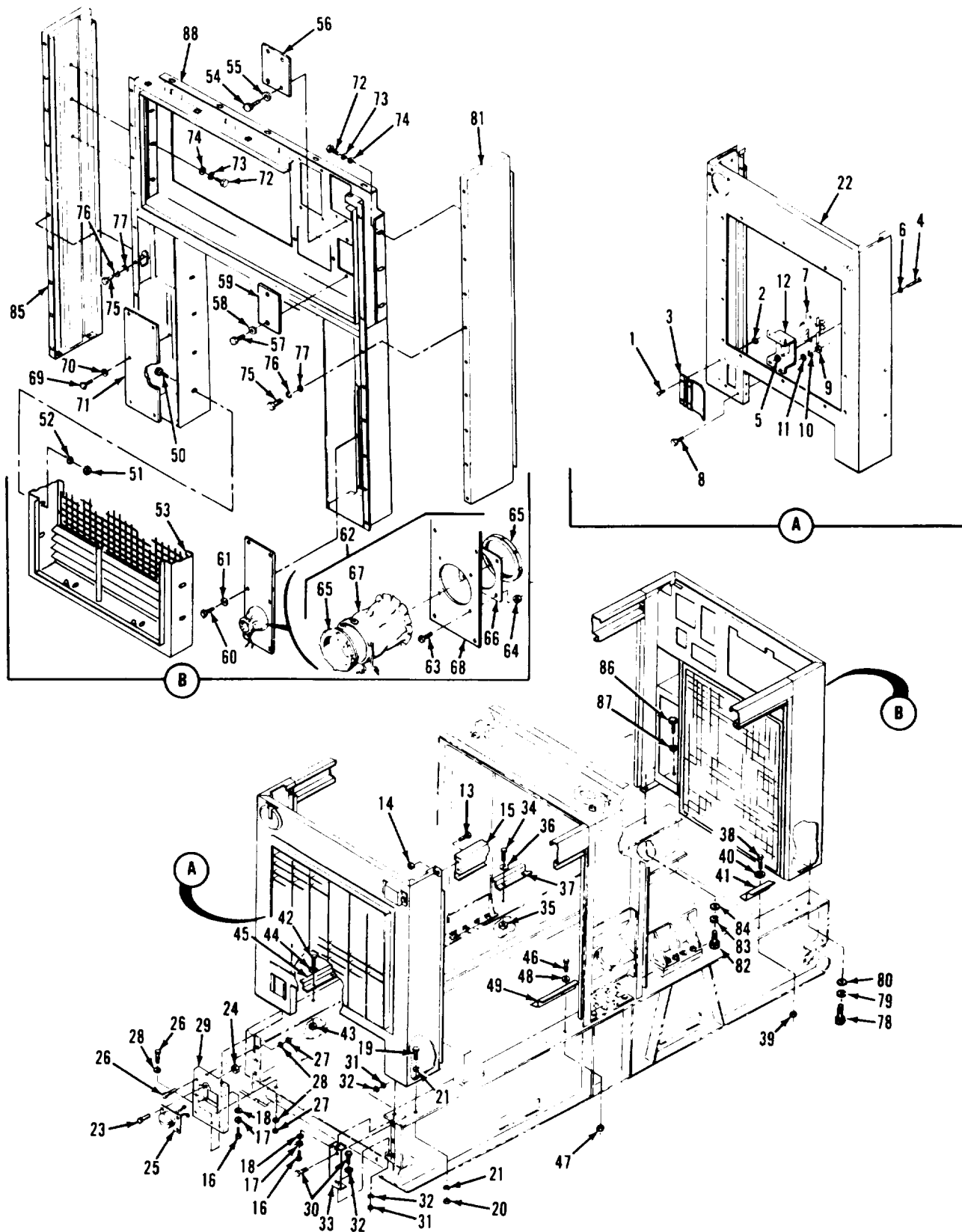


Figure 3-1. Housing frame, exploded view

Legend to figure 3-1:

- |                               |                      |                                 |
|-------------------------------|----------------------|---------------------------------|
| 1. Screw assembly (2)         | 30. Screw (4)        | 61. Lock washer (6)             |
| 2. Nut assembly (2)           | 31. Nut (4)          | 62. Plate and sleeve assembly   |
| 3. Connector cover            | 32. Washer (8)       | 63. Screw (4)                   |
| 4. Screw assembly (2)         | 33. Left side panel  | 64. Nut and washer assembly (4) |
| 5. Nut assembly (2)           | 34. Screw (5)        | 65. Bushing                     |
| 6. Washer (2)                 | 35. Nut (5)          | 66. Plate                       |
| 7. External power receptacle  | 36. Washer (5)       | 67. Sleeve                      |
| 8. Screw (4)                  | 37. Bracket          | 68. Plate                       |
| 9. Nut (4)                    | 38. Screw (5)        | 69. Screw (6)                   |
| 10. Lock washer (4)           | 39. Nut (5)          | 70. Lock washer (6)             |
| 11. Washer (4)                | 40. Washer (5)       | 71. Plate                       |
| 12. Bracket                   | 41. Bracket          | 72. Screw (6)                   |
| 13. Screw (16)                | 42. Screw (5)        | 73. Lock washer (6)             |
| 14. Nut (16)                  | 43. Nut (5)          | 74. Washer (6)                  |
| 15. Upper side panel (4)      | 44. Washer (5)       | 75. Screw (20)                  |
| 16. Screw (3)                 | 45. Bracket          | 76. Lock washer (20)            |
| 17. Lock washer (3)           | 46. Screw (5)        | 77. Washer (20)                 |
| 18. Washer (4)                | 47. Nut (5)          | 78. Screw (2)                   |
| 19. Screw (4)                 | 48. Washer (5)       | 79. Lock washer                 |
| 20. Nut (4)                   | 49. Bracket          | 80. Washer (2)                  |
| 21. Washer (8)                | 50. Screw (12)       | 81. Support                     |
| 22. Front housing             | 51. Lock washer (12) | 82. Screw (2)                   |
| 23. Screw (4)                 | 52. Washer (12)      | 83. Lock washer (2)             |
| 24. Nut (4)                   | 53. Air Intake panel | 84. Washer (2)                  |
| 25. Connector and lead        | 54. Screw (4)        | 85. Support                     |
| 26. Screw (4)                 | 55. Lock washer (4)  | 86. Screw (2)                   |
| 27. Nut (4)                   | 56. Plate            | 87. Lock washer (2)             |
| 28. Washer (8)                | 57. Screw (2)        | 88. Rear housing                |
| 29. Receptacle mounting panel | 58. Lock washer (2)  |                                 |
|                               | 59. Plate            |                                 |
|                               | 60. Screw (6)        |                                 |

3-3. CLEANING.

a. Clean electrical components with a cloth moistened with an approved cleaning solvent, and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean metal components with an approved cleaning solvent, and dry thoroughly.

3-4. INSPECTION.

a. Inspect slave receptacles and leads for continuity and for shorts to casing.

b. Inspect terminal lugs for security and condition.

c. Inspect air intake panel screen for holes and tears.

d. Inspect components for dents, cracks, distortion.

e. Inspect threads for damage.

f. Inspector damage paint.

3-5. REPAIR.

a. Straighten dented and distorted sheet metal parts using suitable tools.

b. Remove damaged paint. Blend in edges, prime, and paint damaged areas.

3-6. REASSEMBLY AND INSTALLATION.

Refer to figure 3-1 and reassemble and install housing frame in the reverse

order of index numbers assigned. Pay particular attention to the following:

NOTE

Wiring harness interconnecting diagram is contained in Operator and Organizational Maintenance Manual

a. Install convenience receptacle assembly in rear housing and secure with six screws and washers. Connect harness to assembly.

b. Install fault locator panel in rear housing and secure with four screws. Connect harness to locator panel.

c. Install control cubicle, as specified in paragraph 2-6.

d. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Install radiator and shutter assembly.

2. Install slave receptacles and in front housing and receptacle mounting panel.

3. If necessary, install kit control panels.

4. Install manual speed control.

5. Connect parallel receptacle harness in rear housing.

6. Install DC control circuit breaker.

7. Install housing panels and doors.

8. Connect negative battery cable.

## Section II. LIFTING FRAME ASSEMBLY

### 3-7. GENERAL.

The lifting frame assembly is bolted to the skid base and provides the means of lifting the generator set. Two clevis are located at the top of the lifting frame to permit attachment of a suitable lifting device. The lifting frame is the center support for the housing assembly. Bolted to the lifting frame are the day tank, fuel transfer valve, fuel tank filler neck and tube, and manual speed control bracket.

### 3-8. REMOVAL.

Refer to figure 3-2 and remove lifting frame as follows:

a. Remove housing frame as specified in paragraph 3-2.

b. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Remove fuel transfer valve, fuel inlet fitting, and fuel supply outlet fitting.

2. Remove day tank.

3. Disconnect manual speed control bracket from lifting frame.

4. Removal air cleaner.

c. Loosen clamp (1) securing hose (12) to fuel tank and remove hose from tank. Plug tank opening. Remove fuel lines connected to filler neck.

d. Disconnect electrical connectors from governor control unit (34) and lift governor control unit (34) from retainer (41). Remove guard (33) by removing screws (32).

e. Remove nuts (2 and 6), screws (4 and 8), and washers (3, 5, 7, and 9). Connect an overhead lifting device to clevis (31) and remove lifting frame (10) from skid base. Guide lifting frame during lifting operation to prevent damage to components.

### 3-9. DISASSEMBLY.

Refer to figure 3-2 and disassemble lifting frame as follows:

a. Loosen clamp (11) and remove hose (12).

b. Remove fuel filler cap (13), pull cap chain and remove filler tube (14) and cap from filler neck (17).

c. Remove nuts (15), screws, (16), filler neck (17) and gasket (18) from lifting frame.

d. Remove nuts (19, 22, and 25), screws (20, 23, and 26), and plates (21, 24, and 27).

e. Remove cotter pins (28), nuts (29), screws (30), and clevis (31).

f. Remove retainer (41) and bracket (44) from lifting frame by removing screws (38 and 42) nuts (39 and 43) and washers (40). Remove bracket (44) from retainer (41) by removing screws (35), nuts (36) and washer (37).

### 3-10. CLEANING.

a. Clean old gasket from lifting frame and filler neck using a suitable scraper.

b. Clean parts with an approved cleaning solvent, and dry thoroughly.

### 3-11. INSPECTION.

a. Inspect for damaged threads.

**WARNING**

- b. Inspect parts for cracks, breaks, and defective welds.
  - c. Inspect hose for cuts, tears, and deterioration.
  - d. Inspect filler tube screen for holes, cuts, and other damage.
  - e. Inspect lifting frame mounting screw holes for elongation.
  - f. Inspect plates for legibility.
  - g. Inspect paint for damage.
- 3-12. REPAIR.

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- a. Repair cracks by welding.
- b. Remove damaged paint. Blend in edges, prime, and paint damaged areas.

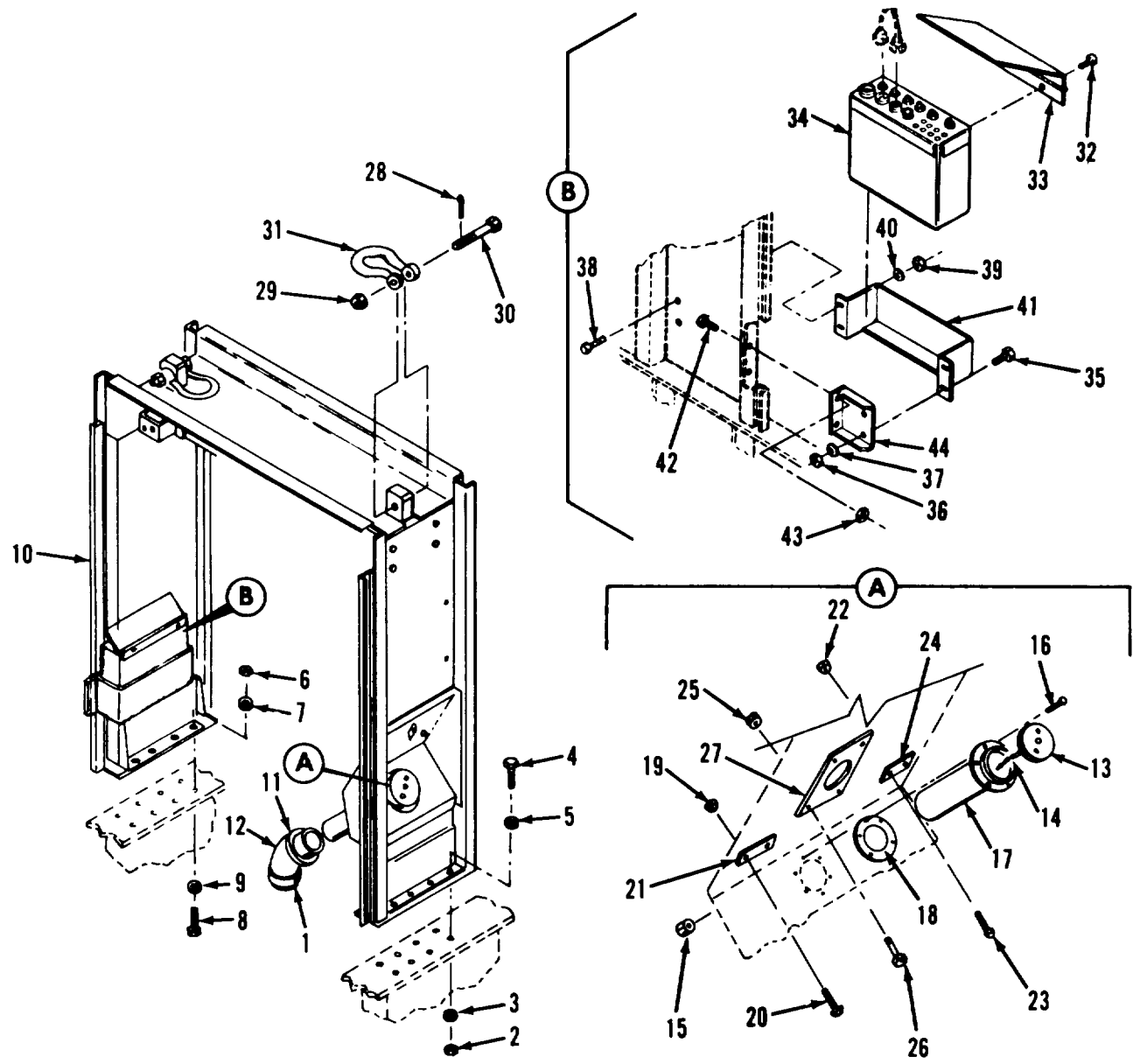


Figure 3-2. Lifting frame assembly, exploded view



Legend to figure 3-2:

1. Clamp	13. Fuel filler cap	23. Screw (2)	35. Screw (2)
2. Nut (8)	and chain	24. Fuel outlet plate	36. Nut (2)
3. Washer (8)	14. Filler tube and	25. Nut (2)	37. Washer (2)
4. Screw (8)	screen	26. Screw (2)	38. Screw (2)
5. Washer (8)	15. Nut (6)	27. Fuel selector plate	39. Nut (2)
6. Nut (8)	16. Screw (6)	28. Cotter pin (2)	40. Washer (2)
7. Washer (8)	17. Filler neck	29. Nut (2)	41. Ret airier
8. Screw (8)	18. Gasket	30. Screw (2)	42. Screw (2)
9. Washer (8)	19. Nut (2)	31. Clevis (2)	43. Nut (2)
10. Lifting frame	20. Screw (2)	32. Screw (2)	44. Bracket
11. Clamp	21. Fuel inlet plate	33. Guard	
12. Hose	22. Nut (2)	34. Governor control unit	

3-13. REASSEMBLY.

Refer figure 3-2 and reassemble lifting frame as follows:

a. Assemble bracket (44) to retainer (41) and secure with screws (35), nuts (36) and washers (37). Position retainer (41) and bracket (44) to lifting frame and secure with screws (28 and 42), nuts (39 and 43) and washers (40).

b. Install clevis (31), screws (30), and nuts (29). Tighten nuts (29) so that clevis are just free to move and cotter pin holes in nuts and screws are aligned. Install cotter pins (28).

c. Position plates (21, 24, and 27) on lifting frame (10) and secure with screws (20, 23, and 26) and nuts (19, 22, and 25).

d. Position gasket (18) and filler neck (17) in lifting frame (10) and secure with screws (16) and nuts (15). Install filler tube (14) and cap (13).

e. Position hose (12) on filler neck and secure with clamp (11).

3-14. INSTALLATION.

Refer to figure 3-2 and install lifting frame as follows:

a. Connect an overhead lifting device to clevis (31) and carefully position lifting frame (10) on skid base. Secure lifting frame to skid base with screws (4 and 8), washers (3, 5, 7, and 9), and nuts (2 and 6).

b. Position hose (12) on fuel tank and secure hose with clamp (1).

c. Secure guard (33) to governor control unit with screws (32). Place governor control unit into retainer (41) and connect electrical connector.

d. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Connect and adjust manual speed control bracket on lifting frame.

2. Install fuel transfer valve, fuel inlet fitting, and fuel supply outlet fitting.

3. Install day tank.

e. Secure fuel hoses to lifting frame with clamps, screws, and washers; one on each inside wall of lifting frame.

f. Install housing frame as specified in paragraph 3-6.

Legend to figure 3-3:

- |                          |                                  |                                |
|--------------------------|----------------------------------|--------------------------------|
| 1. Seal                  | 30. Slave receptacle access door | 61. Washer (8)                 |
| 2. Rod (8)               | * 31. Washer                     | 62. Nut (5)                    |
| 3. Rivet (32)            | * 32. Cotter pin                 | 63. Washer (5)                 |
| 4. Clip (8)              | * 33. Rain cap                   | 64. screw (5)                  |
| 5. Screw (28)            | * 34. Screw (2)                  | 65. Washer (5)                 |
| 6. Nut (28)              | * 35. Lock washer (2)            | 66. Screw (14)                 |
| 7. Access door (4)       | * 36. Washer (2)                 | 67. Lock washer (14)           |
| 8. Door holder (4)       | * 37. support                    | 68. Washer (14)                |
| 9. Screw (5)             | 38. <b>Pin</b>                   | 69. Nut (4)                    |
| 10. Nut (5)              | 39. Stud                         | 70. Screw (4)                  |
| 11. Access door          | 40. Deleted                      | 71. Washer (8)                 |
| 11A. Seal                | 41. Nut (3)                      | 72. Screw (4)                  |
| 12. Screw (5)            | 42. Screw (3)                    | 73. Lock washer (4)            |
| 13. Nut (5)              | 43. Radiator cap access door     | 74. Washer (4)                 |
| 13A. Seal                | 44. Rivet (2)                    | 75. Screw (5)                  |
| 14. Access door          | 45. Receptacle                   | 76. Lock washer (5)            |
| 15. Screw (8)            | 46. Screw (18)                   | 77. Washer (5)                 |
| 16. Nut (8)              | 47. Lock washer (18)             | 78. Rear cover                 |
| 16A. Seal                | 48. Washer (18)                  | 79. Nut (6)                    |
| 17. Access door          | 49. Nut (4)                      | 80. Screw (6)                  |
| 18. Screw (8)            | 50. Screw (4)                    | 81. Parallel cable stowage box |
| 19. Nut (8)              | 51. Washer (4)                   | 82. Parallel cable             |
| 19A. Seal                | 52. Nut (4)                      | 83. Nut (12)                   |
| 20. Access door          | 53. Screw (4)                    | 84. Washer (12)                |
| 21. Door holder          | 54. Washer (8)                   | 85. screw (12)                 |
| 22. Screw (21)           | 55. Screw (4)                    | 86. Air intake panel           |
| 23. Nut (21)             | 56. Lock washer (4)              | 87. Cotter pin (2)             |
| 24. Washer (21)          | 57. Washer (4)                   | 88. Nut (2)                    |
| 25. Access cover         | 58. Front cover                  | 89. Screw (2)                  |
| 26. Battery access frame | 59. Nut (4)                      | 90. Lifting clevis (2)         |
| 27. Washer (21)          | 60. Screw (4)                    |                                |
| 28. Nut (2)              |                                  |                                |
| 29. Screw (2)            |                                  |                                |

\*Used only on 50/60 Hertz Generator Sets.

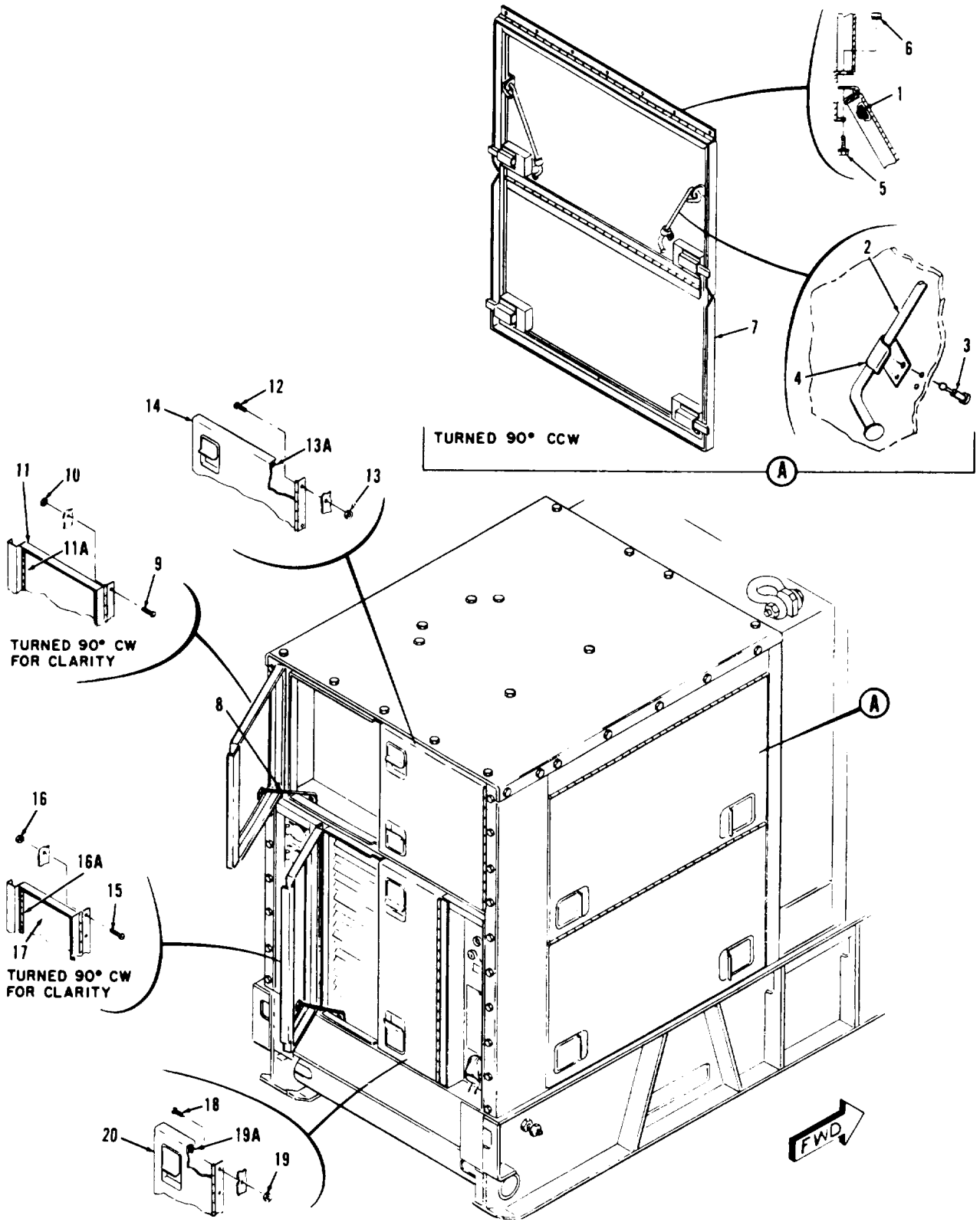


Figure 3-3. Housing, partially exploded view  
(sheet 1 of 2)

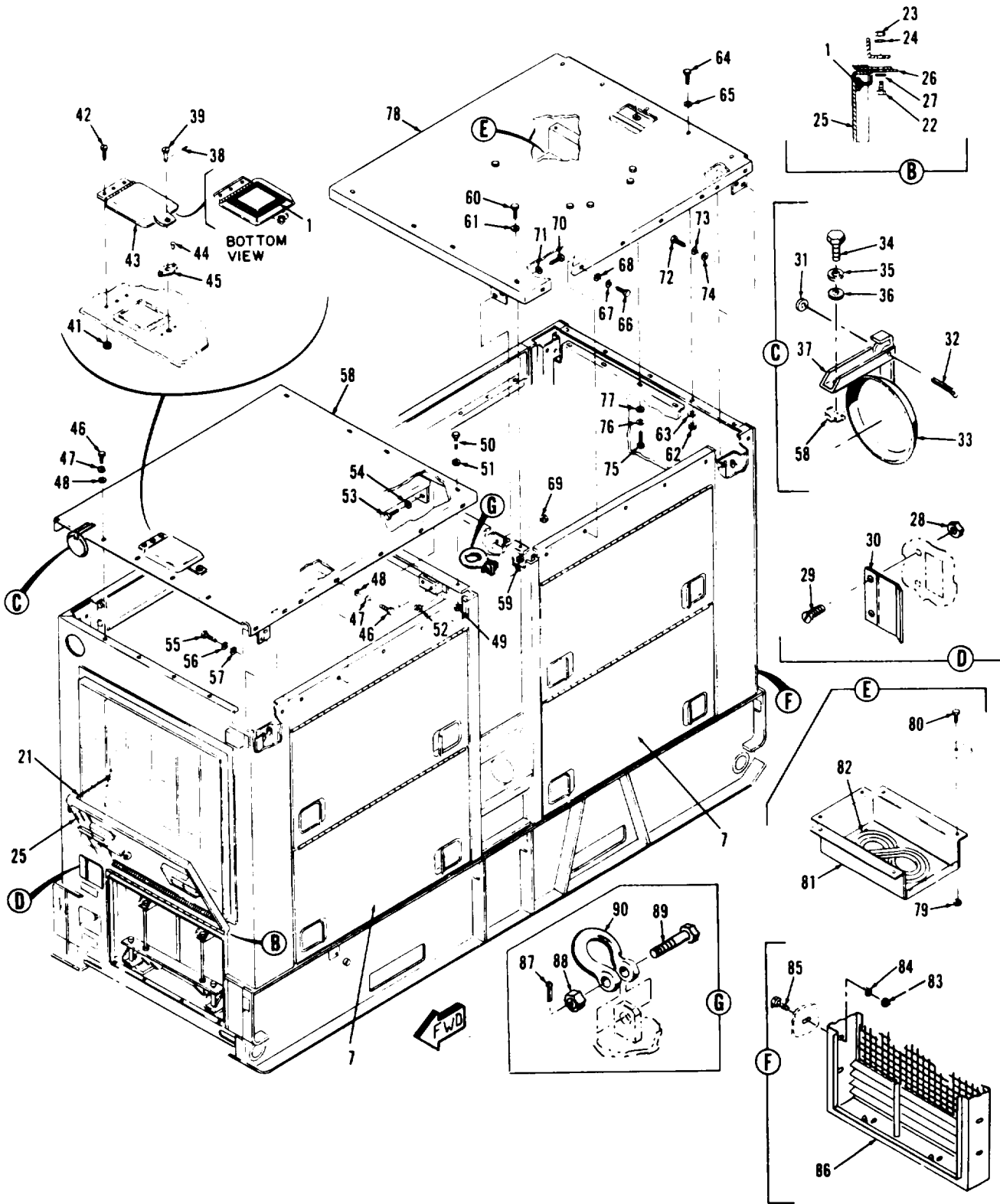


Figure 3-3. Housing, partially exploded view  
(sheet 2 of 2)

CHAPTER 4

RADIATOR AND SHUTTER ASSEMBLY REPAIR INSTRUCTIONS

Section I. RADIATOR ASSEMBLY

4-1. GENERAL.

The radiator assembly consists of top and bottom tanks, core assembly, vent tube, mounting brackets, upper and lower shrouds, and shroud plate. The shrouds and shroud plate are bolted to the radiator and insure that air drawn by the fan is forced through the radiator when exiting the generator set. The upper tanks and mounting brackets are soldered to the core assembly, the brackets provide a means of mounting the radiator and the tanks provide area for storage of coolant. The vent tube permits overflowing coolant to leave the radiator. Refer to Appendix A for applicable technical manual for additional information pertaining to radiator.

4-2. UPPER AND LOWER SHROUD AND SHROUD PLATE.

4-3. REMOVAL. Refer to Operator and Organizational Maintenance Manual and remove upper and lower shrouds and shroud plate.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

4-4. CLEANING. Clean parts with an approved cleaning solvent and dry thoroughly.

4-5. INSPECTION. Inspect upper and lower shrouds and shroud plate for cracks and distortion.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and air-borne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

4-6. REPAIR. Repair cracks by welding and straighten distorted parts using proper tools.

4-7. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install upper and lower shrouds and shroud plate.

4-8. RADIATOR.

4-9. REMOVAL. Refer to Operator and Organizational Maintenance Manual and remove the radiator.

4-10. TEST,

a. Differential Pressure Test.

1. Plug shutter power element port on bottom radiator tank. Check that vent tube is free of obstructions by forcing compressed air through tube. Install radiator cap.

2. Connect a suitable water supply to lower radiator hose cube and reverse flush radiator until water flowing from upper radiator hose tube is clear.

3. Connect water supply to upper radiator hose tube and flush radiator until water flowing from lower tube is clear.

NOTE

All test equipment must have a minimum inside diameter of 2.5 inches.

4. Connect 0 to 20 PSI pressure gauges to radiator hose tubes. Connect manual shut off valve and then an 80 GPM water supply to upper radiator hose tube. Connect return line from gauge at lower radiator hose tube to water supply reservoir. Close manual shut off valve.

**CAUTION**

Stop test immediately if pressure gauge at top hose port reaches 15 PSI.

5. Start water supply. Slowly open manual shutoff valve while observing gauge at top hose tube. Stop test if pressure reaches 15 PSI. Fully open shutoff valve and record pressure on both gauges. If pressure differential between upper and lower gauges exceeds 1.8 PSI, the radiator is restricted.

6. Shut down water supply, relieve pressure, and remove test equipment from radiator. If pressure differential exceeded 1.8 PSI, remove radiator cap and perform the following procedures.

**CAUTION**

Do not immerse cold radiator in boiling solution.

7. Mix a solution of one pound baking soda to each gallon. of water. Fill a suitable boiling tank with solution and place radiator in tank. Bring solution to a boil and boil radiator for a minimum of 30 minutes. Remove radiator and perform steps 2. through 6.

8. If pressure differential still exceeds 1.8 PSI, the radiator must be disassembled and cleaned.

b. Pressure Test.

1. Plug radiator filler neck, hose tubes, and shutter power element port. Connect a regulated pressure air supply manual shutoff valve, and 0-20 PSI pressure gauge, to radiator vent tube.

2. Place radiator in suitable tank filled with water.

3. Slowly apply 15 PSI to radiator and check for air bubbles that would indicate leaks. Mark leaks if any.

4. Remove radiator from tank. Relieve all air pressure and remove test equipment. Repair leaks.

4-11. DISASSEMBLY. Refer to figure 4-1 and disassemble radiator as follows:

**NOTE**

Prior to disassembly of radiator, its condition should be analyzed by performing test specified in paragraph 4-10.

a. Mark mounting brackets, top tank, and bottom tank in relation to core assembly to insure proper reassembly.

b. Remove oxide film on all soldered joints.

c. Using suitable soldering tools, unsolder vent tube, mounting brackets, top tank, and bottom tank.

**WARNING**

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

4-12. CLEANING.

a. Remove excessive solder using a suitable torch and rag.

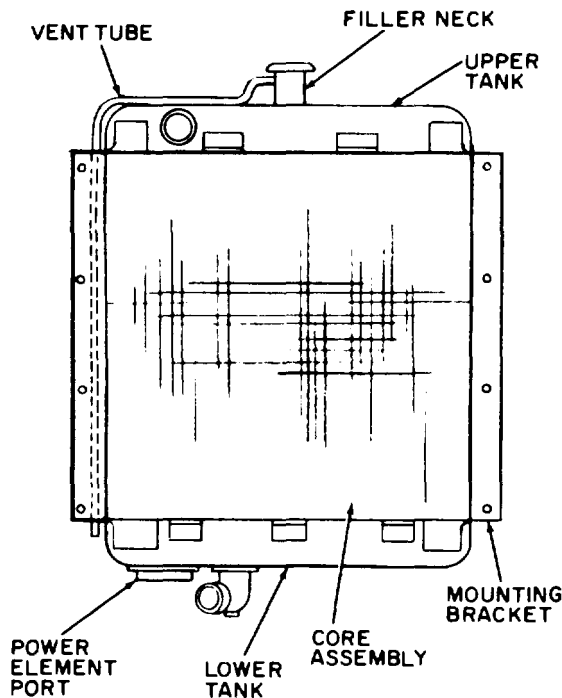


Figure 4-1. Radiator assembly

WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

- b. Remove obstruction from radiator core fins using compressed air.
- c. If core assembly tubes are clogged, boil core assembly in a solution of one pound of baking soda to each gallon of water for a minimum of 30 minutes or until clog is loosened.
- d. Clean core assembly tubes using a suitable bristle brush or cleaning rod. Remove loosened particles using compressed air.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

e. Clean parts with an approved cleaning solvent and dry thoroughly.

4-13. INSPECTION.

- a. Test radiator cap using suitable cap tester. Cap setting should be approximately 7 PSI. Check locking taps for condition.
- b. Inspect mounting brackets for cracks, distortion, missing captive nuts. Inspect captive nuts for damaged threads.
- c. Inspect tanks for cracks, holes, or dents. Check hose connection tubes for out-of-roundness, security, and damage. Check filler neck for damage and security. Check bottom tank flange for security, damaged threads, and damage to gasket contact surface.
- d. Inspect core assembly for loose tubes, bent or damaged cooling fins, and damage to tank contact surfaces.
- e. Inspect paint for damage.

4-14. REPAIR.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- a. Repair cracks in mounting brackets by welding. Straighten distorted parts using proper tools.
- b. Replace defective mounting bracket captive nuts.
- c. Solder cracks and holes in tanks. Large holes or cracks may be repaired by soldering as suitable patch over defect. Resolder loose hose connection tubes, filler neck, or bottom tank flange. Remove burrs from flange using suitable file or stone.

d. Solder loose core assembly tubes. To repair damaged tubes, remove cooling fins in area of leak and solder leak. Solder

cooling fin back into position. To replace a defective tube, unsolder tube from core assembly and remove tube. Insert a suitable replacement tube in core assembly and solder in position. Straighten bent cooling fins.

e. Remove damaged paint using a suitable scraper. Blend in edges, prime, and paint damaged areas.

4-15. REASSEMBLY. Refer to figure 4-1 and reassemble radiator as follows:

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

a. Using suitable soldering equipment,

fill core assembly tank contact surface grooves with solder.

b. Place upper tank on core assembly, making sure relationship marks are in alignment. Solder upper tank to core assembly. Repeat procedure for lower tank.

c. Solder mounting brackets and vent tube in position.

d. Test radiator as specified in paragraph 4-10. Perform necessary procedures if radiator does not meet required test results.

4-16. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install radiator.

## Section II. SHUTTER AND CONTROL ASSEMBLY

### 4-17. GENERAL.

The shutter consists of movable vanes mounted in nylon bearings which are actuated by a control rod connected to the control assembly. When engine coolant temperature reaches 158°F, the control assembly power element starts to extend which moves the control rod opening the shutter vanes. If coolant temperature decreases, the control assembly integral return spring moves the control rod closing the shutter vanes. This modulated control automatically opens and closes the shutter vanes the amount necessary to maintain the engine at normal operating temperature. Opening and closing of the shutter vanes regulates cooling air flow through the radiator. The shutter assembly is equipped with a manual control handle to permit manual opening of the shutter vanes. The handle should be in the full up position during normal operation.

### 4-18. CONTROL ASSEMBLY.

4-19. REMOVAL. Refer to Operator and Organizational Maintenance Manual and remove the control assembly.

4-20. DISASSEMBLY. Refer to figure 4-2 and disassemble the control assembly in the order of index numbers assigned. Pay particular attention to the following:

a. When removing retaining ring (14), press in on large seat (15) to relieve spring tension on ring. Remove retaining ring and slowly remove large seat until spring tension is relieved.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

4-21. CLEANING. Clean parts in an approved cleaning solvent and dry thoroughly.



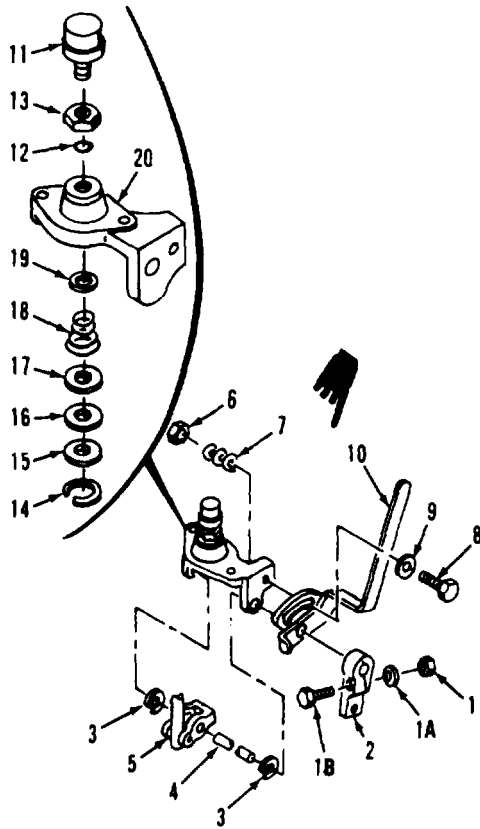


Figure 4-2. Shutter control exploded view

Legend to figure 4-2:

- |                           |                                   |
|---------------------------|-----------------------------------|
| 1. Nut                    | 11. Power element                 |
| 1A. Lock washer           | 12. Preformed packing             |
| 1B. Screw                 | 13. Nut                           |
| 2. Lever                  | 14. Retaining ring                |
| 3. Retainer               | 15. Large seat                    |
| 4. Shaft                  | 16. Felt washer                   |
| 5. Yoke assembly          | 17. Large seat                    |
| 6. Nut                    | 18. Spring                        |
| 7. Friction spring        | 19. Small seat                    |
| 8. Screw                  | 20. Shutter power element housing |
| 9. Washer                 |                                   |
| 10. Manual control handle |                                   |

#### 4-22. INSPECTION.

- a. Inspect threads for damage and parts for cracks.
- b. Inspect shaft for nicks, burrs, and scoring in flange bushing area.
- c. Inspect flange bushing for nicks, scores, and out of roundness.
- d. Inspect springs for distortion and broken ends.
- e. Test power element for proper operation, refer to Operator and Organizational Maintenance Manual.
- f. Inspect manual control handle for distortion.

#### 4-23. REPAIR.

- a. Remove nicks and burrs using a file or stone.
- b. Straighten distorted manual control handle using suitable tools.

4-24. REASSEMBLY. Refer to figure 4-2 and reassemble the control assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

- a. Apply a thin film of oil to packing (12), Position nut (13) and packing (12) on power element (11). Screw power element into housing (20) until top of power element is 2.75 inches above flat or flange. Hold power element stationary and tighten nut (13).
- b. Tighten nut (6) tight enough to apply spring tension on manual control handle (10) and still permit movement of handle.

4-25. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install control assembly.

4-26. SHUTTER.

4-27. REMOVAL. Refer to Operator and Organizational Maintenance Manual and remove shutter.

4-28. DISASSEMBLY. Refer to figure 4-3 and disassemble the shutter as follows:

a. Place shutter face down on a clean, dirt-free work bench. Secure spring (2)

and carefully remove cotter pin (1). Slide rod (3) free of block (4), Remove nut (5), lock washer (6) and screw (7) retaining block (4) to control bar (12).

b. Remove closing spring (8) and unscrew spring studs (9) free, from left angle (21).

c. Carefully remove retaining rings (10). Slide control rods (11) and (12) clear of vanes (23). Remove bushings (13) from control bars (11 and 12). Carefully remove retaining rings (14).

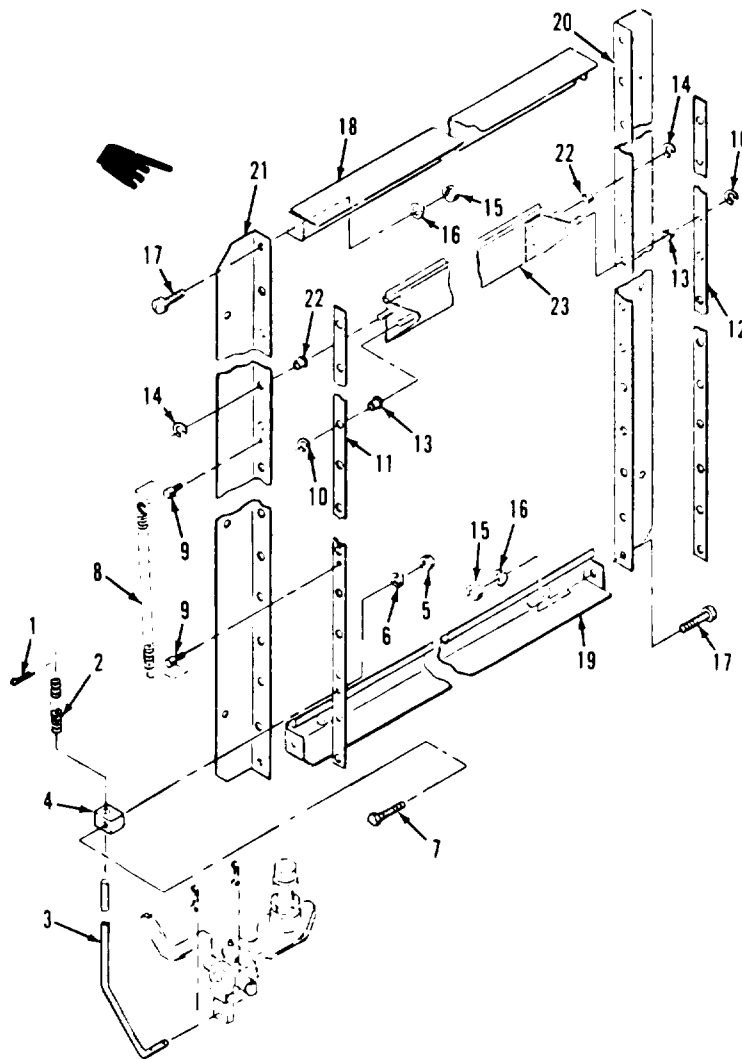


Figure 4-3. Shutter, exploded view

Legend to figure 4-3:

- |                        |                        |
|------------------------|------------------------|
| 1. Cotter pin          | 12. Control bar        |
| 2. Spring              | 13. Bushing            |
| 3. Rod                 | 14. Retaining ring (8) |
| 4. Block               | 15. Nut                |
| 5. Nut                 | 16. Lock washer        |
| 6. Lock washer         | 17. Screw              |
| 7. Screw               | 18. Top rail           |
| 8. Closing spring      | 19. Bottom rail        |
| 9. Spring stud         | 20. Right angle        |
| 10. Retaining ring (8) | 21. Left angle         |
| 11. Control bar        | 22. B u s h i n g      |
|                        | 23. Vane (16)          |

d. Remove nuts (15), lock washers (16) and screws (17). Remove the top rail (18) and the bottom rail (19) from the shutter. Carefully remove right angle (20) and left angle (21) from vanes (23) and remove bushings (22).

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

4-29. CLEANING. Clean all parts in an approved cleaning solvent and dry thoroughly using filtered, low pressure compressed air and clean, lint-free cloth. If shutter is not to be fully disassembled, utilize same procedure above.

4-30. INSPECTION.

- a. Inspect threads for damage.
- b. Inspect control rod assembly for distortion and missing components.
- c. Inspect spring for distortion and broken ends.

d. Inspect bushings for out-of-roundness, cuts, and cracks.

e. Inspect channel for distortion and for elongated holes.

f. Inspect vanes for cracks and nicks, burrs, and grooves on bushing contact surfaces.

4-31. REPAIR.

a. Straighten distorted parts using suitable tools.

b. Remove nicks or burrs from vane bushing contact surfaces using a file or stone.

4-32. REASSEMBLY. Refer to figure 4-3 and reassemble the shutter as follows:

a. On a clean, dirt-free work bench place left angle (21) with vane pivot holes perpendicular to the work bench,

b. Place bushings (22) into left angle (21), Insert vane pivot arm closest to vane into bushings (22). Secure with retaining ring (14); one on the top vane and every fifth vane the reafter.

c. Repeat procedure b. above for the right angle (20).

d. Place top rail (18) between right angle (20) and left angle (21) Secure with nut (15), lock washer (16) and screw (17).

e. Repeat procedure d. above for the bottom rail (19).

f. Place bushings (13) into control bar (12). Slide control bar (11) over vane pivot arm. Secure with retaining ring (10); one on the top vane and every fifth vane thereafter.

g. Repeat procedure f. above for control bar (11).

h. Fasten spring studs (9) into left angle 21. Secure closing spring (8) to spring studs (9).

i. Attach block (4) to control bar (11) utilizing nut (5) lock washer (6) and screw (7). Insert rod (3) through block (4); place spring (2) over rod (3) and secure with cotter pin (1).

4-33. INSTALLATION. Refer to Operator and Organizational maintenance manual and install shutter.

## CHAPTER 5

### ELECTRICAL CONTROLS WIRING HARNESSSES REPAIR INSTRUCTIONS

#### 5-1. GENERAL.

The electrical controls wiring harnesses interconnect the electrical components of the generator set.

#### NOTE

Mode I relay boxes are used on 50/60 hertz generator sets and mode H relay boxes on 400 hertz generator sets.

a. Relay Box To Control Cubicle Harness. The harness is connected to connector J1 of the control cubicle (A3 ) and connector J2 of the mode I or mode II relay box (A27).

b. Relay Box To Exciter Regulator Harness. The harness is connected to connector J9 of the exciter regulator (A10 and All) and connector J3 of the mode I or mode II relay box (A27).

c. Tactical Relay Box To Load Measurement Unit Harness. The harness is connected to connector J4 of the tactical relay box (A7) and connector J16 of the load measurement unit (A8).

d, Relay Box To Precise Relay Box Harness. The harness is connected to connector J32 of the precise relay box (A25) and connector J31 of the mode I relay box (A27). The harness is utilized on 50/60 hertz generator sets only.

e. Relay Box To Governor Control Unit Harness. The harness is connected to connectors J21 and J17 of the governor control

unit (A23) and connector J8 of the precise relay box (A25) on 50/60 hertz precise generator sets or connector J8 of the mode II relay box on 400 hertz generator sets. The harness is not used on utility generator sets.

f. Governor Control Unit To Governor Actuator Harness. The harness is connected to connectors J22 and J23 of the governor control unit (A23) and connectors J24 and J25 of the governor actuator (A24). The harness is not used on utility generator sets.

g. Relay Box To Reconnection Board Harness (50/60 Hertz Generator Sets). The harness is connected to connector J10 of the mode I relay box (A27), connector J13 of the exciter regulator (A10 and All), connector J41 of the load contactor (C32), connector J48 of the convenience receptacle (A22), connector J61 of generator (G1), and to terminals of the load board and terminal boards (TB2 and TB6). The harness is not utilized on 400 hertz generator sets.

h. Relay Box To Reconnection Board Harness (400 Hertz Generator Sets). The harness is connected to connector J10 of the mode II relay box (A27), connector J13 of the exciter regulator (A10 and A11), connector J48 of the convenience receptacle (A22), connector J61 of generator (G1), and to terminals of the load board and terminal boards (TB2 and TB6). The harness is not utilized on 50/60 hertz generator sets.

i. Relay Box To Fault Locator Indicator Harness. The harness is connected to connector J12 of the fault locator indicator (A9) and to connector J6

of the mode I or mode II relay box (A27).

j. Parallel Receptacle Harness. The harness is connected to connector J15 of the mode I or mode II relay box (A27). The three connectors of the harness J45, J46, and J47 are the parallel receptacles located at the rear of the generator set.

k. Relay Box to Tactical Relay Box Harness. The harness is connected to connector J51 of the tactical relay box (A29) and connector J50 of the mode I or mode II relay box (A27).

#### 5-2. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove the wiring harnesses.

#### 5-3. CLEANING.

##### WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

- a. Clean connector pins with low pressure, filtered compressed air.
- b. Clean connectors and terminal lugs with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.
- c. Remove oil and grease from wires using a clean lint-free cloth.

#### 5-4. INSPECTION.

- a. Inspect connectors for loose, bent, and damaged pins; damaged threads; and defective keys.
- b. Check terminal lugs for security and condition.
- c. Inspect harness wires for defective insulation, illegible wire numbers. Check

harness straps for condition, security, and proper spacing.

#### NOTE

Interconnecting wiring diagram is contained in the Operator and Organizational Maintenance Manual.

d. Check each harness wire for continuity from connector pin to wire end. Check connector pins for shorts to case and surrounding pins. Refer to figures 5-1 through 5-11.

#### 5-5. REBUILD.

a. Refer to figure 5-1 and rebuild relay box to control cubicle harness.

b. Refer to figure 5-2 and rebuild relay box to exciter regulator harness.

c. Refer to figure 5-3 and rebuild tactical relay box to load measurement unit harness.

d. Refer to figure 5-4 and rebuild relay box to precise relay box harness on 50/60 hertz precise generator sets.

e. Refer to figure 5-5 and rebuild relay box to governor control unit harness on precise generator sets.

f. Refer to figure 5-6 and rebuild governor control unit to governor actuator harness on precise generator sets.

g. Refer to figure 5-7 and rebuild relay box to reconnect on board harness on 50/60 hertz generator sets.

h. Refer to figure 5-8 and rebuild relay box to reconnection board harness on 400 hertz generator sets.

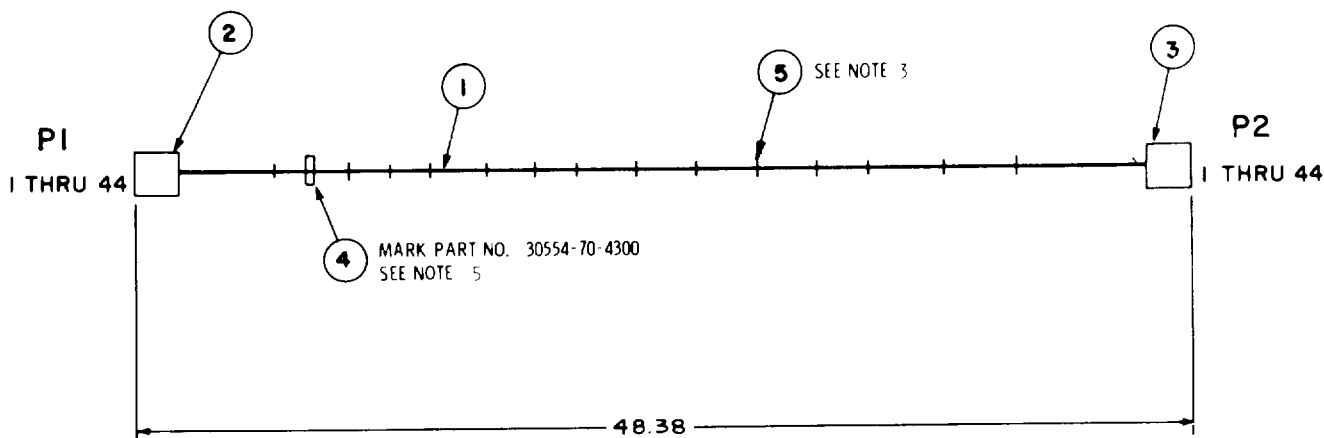
i. Refer to figure 5-9 and rebuild relay box to fault locator indicator harness.

j. Refer to figure 5-10 and rebuild parallel receptacle harness.

k. Refer to figure 5-11 and rebuild relay box to tactical relay box harness.

5-6. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install the wiring harnesses.



6			SN60WARP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-1-9	14	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3106R36-7P	1	CONNECTOR, PLUG		
2			MS3106R36-7S	1	CONNECTOR, PLUG		
1			M5088/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. **6**.
- CABLE STRAPS, FIND NO. **5** SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

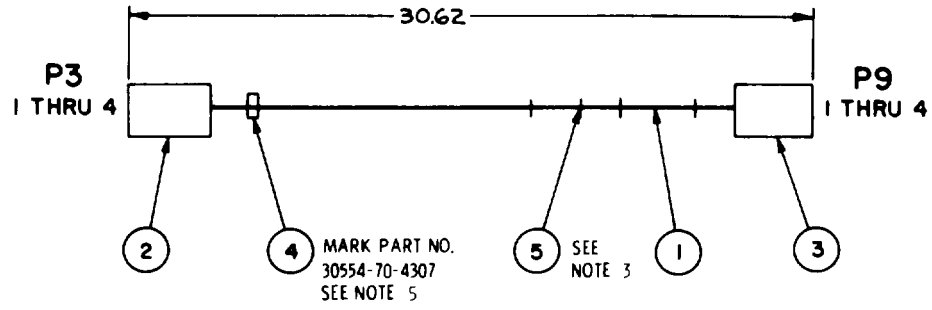
WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 5-1. Relay box to control cubicle wire harness (sheet 1 of 2)

WIRE NO.	WIRE MARKING		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	D20C16	P1-A	2	P2-A	3	46.00
2	BLACK	D21C16	P1-B	↑	P2-B	↑	46.00
3	BLACK	D22C16	P1-C		P2-C		46.00
4	BLACK	D24C16	P1-D		P2-D		46.00
5	BLACK	X7C16	P1-E		P2-E		46.00
6	BLACK	X8C16	P1-F		P2-F		46.00
7	BLACK	X14C16	P1-G		P2-G		46.00
8	BLACK	X15C16	P1-H		P2-H		46.00
9	BLACK	X16C16	P1-I		P2-I		46.00
10	BLACK	L25B16	P1-J		P2-J		46.00
11	BLACK	L26B16	P1-K		P2-K		46.00
12	BLACK	X91B16	P1-L		P2-L		46.00
13	BLACK	K32B16	P1-M		P2-M		46.00
14	BLACK	K33B16	P1-N		P2-N		46.00
15	BLACK	X31B16	P1-O		P2-O		46.00
16	BLACK	X194B16	P1-P		P2-P		46.00
17	RED	P45F16	P1-R		P2-R		46.00
18	BLACK	X29B16	P1-S		P2-S		46.00
19	BLACK	K34B16	P1-T		P2-T		46.00
20	BLACK	X90C16	P1-U		P2-U		46.00
21	RED	E39B16	P1-V		P2-V		46.00
22	RED	E38B16	P1-W		P2-W		46.00
23	RED	E37B16	P1-X		P2-X		46.00
24	RED	E35B16	P1-Y		P2-Y		46.00
25	RED	E36B16	P1-Z		P2-Z		46.00
26	RED	P199B16	P1-a		P2-a		46.00
27	BLACK	L93C16	P1-b		P2-b		46.00
28	RED	P198B16	P1-c		P2-c		46.00
29	RED	P47C16	P1-e		P2-e		46.00
30	BLACK	X195B16	P1-f		P2-f		46.00
31	RED	P44C16	P1-g		P2-g		46.00
32	RED	P62C16	P1-h		P2-h		46.00
33	RED	P56C16	P1-k		P2-k		46.00
34	RED	P80D16	P1-m		P2-m		46.00
35	BLACK	X197B16	P1-n		P2-n		46.00
36	RED	P55LL16	P1-p		P2-p		46.00
37	RED	P55X16	P1-r		P2-r		46.00
38	RED	P57016	P1-t		P2-t		46.00
39	RED	P40M16	P1-u		P2-u		46.00
40	RED	P40L16	P1-v		P2-v		46.00
41	RED	P50J16	P1-w		P2-w		46.00
42	RED	P46B16	P1-x		P2-x		46.00
43	BLACK	X12C16	P1-y	↓	P2-y	↓	46.00
44	BLACK	X9C16	P1-z	2	P2-z	3	46.00

Figure 5-1. Relay box to control cubicle wire harness (sheet 2 of 2)





WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X91D16	P3-A	2	P9-A	3	29.75
2	BLACK	X197F16	P3-B	↑	P3-B	↑	29.75
3	RED	P42B16	P3-C	↓	P9-C	↓	29.75
4	RED	P67B16	P3-D	2	P9-D	3	29.75

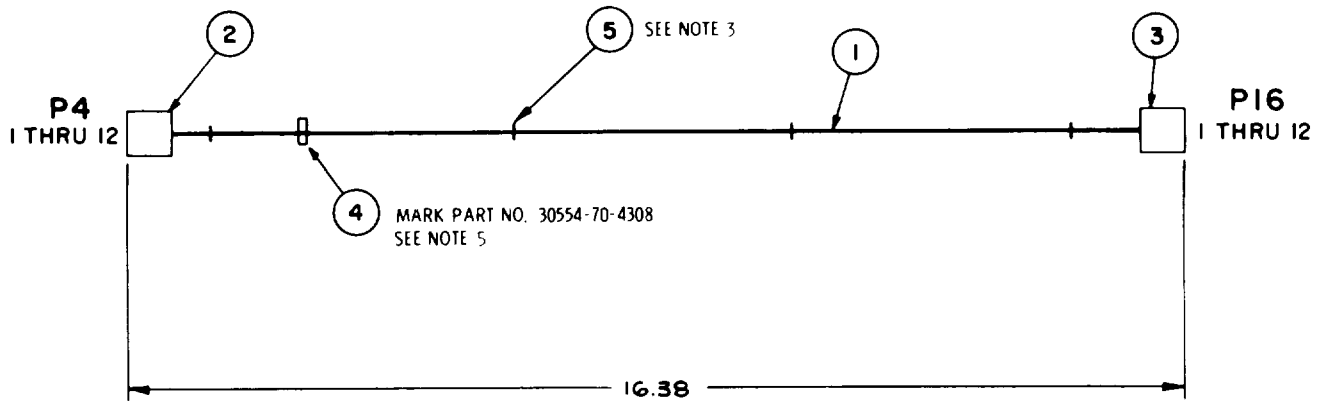
WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

6			SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-4-9	8	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3106RI4S-6S	1	CONNECTOR, PLUG		
2			MS3106RI4S-6P	1	CONNECTOR, PLUG		
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 6 .
3. CABLE STRAPS, FIND NO. 5, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 5-2. Relay box to exciter regulator wire harness



FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
6			SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-1-9	4	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3108R20-29S	1	CONNECTOR, PLUG, ANGLE		
2			MS3106R20-29S	1	CONNECTOR, PLUG		
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

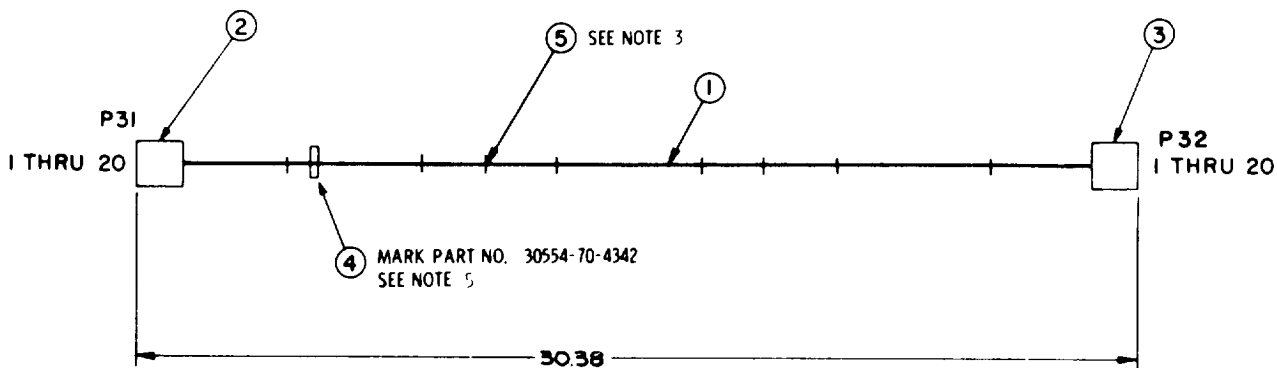
WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X7L16	P4-A	2	P16-A	3	14.00
2	BLACK	X8L16	P4-B	↑	P16-B	↑	14.00
3	BLACK	X9Z16	P4-C		P16-C		14.00
4	BLACK	X115A16	P4-D		P16-D		14.00
5	BLACK	X116A16	P4-E		P16-E		14.00
6	BLACK	X117A16	P4-F		P16-F		14.00
7	BLACK	D24K16	P4-G		P16-G		14.00
8	BLACK	X12JJ16	P4-K		P16-K		14.00
9	BLACK	X12LL16	P4-L		P16-L		14.00
10	BLACK	X12EE16	P4-M		P16-M		14.00
11	BLACK	K101A16	P4-N	↓	P16-N	↓	14.00
12	BLACK	K102A16	P4-S	2	P16-S	3	14.00

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 6.
- CABLE STRAPS, FIND NO. 5, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 5-3. Tactical relay box to load measuring unit wire harness



6		SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN GEAR	QQ-S-5/1	NOTE 2	
5		MS3367-1-9	8	STRAP, TIEDOWN		NYLON	
4		MS39020-2	1	BAND, MARKER		AL ALY	
3		MS3106R24-28S	1	CONNECTOR, PLUG			
2		MS3106R24-28P	1	CONNECTOR, PLUG			
1		MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2		
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X9L16	P31-A	2	P32-A	3	28.00
2	BLACK	X12H16	P31-B		P32-B		28.00
3	RED	P81C16	P31-C		P32-C		28.00
4	RED	P55AC16	P31-D		P32-D		28.00
5	RED	P50M16	P31-E		P32-E		28.00
6	RED	P294C16	P31-F		P32-F		28.00
7	BLACK	K119C16	P31-G		P32-G		28.00
8	RED	P57H16	P31-H		P32-H		28.00
9	BLACK	K111C16	P31-I		P32-I		28.00
10	RED	P200D16	P31-K		P32-K		28.00

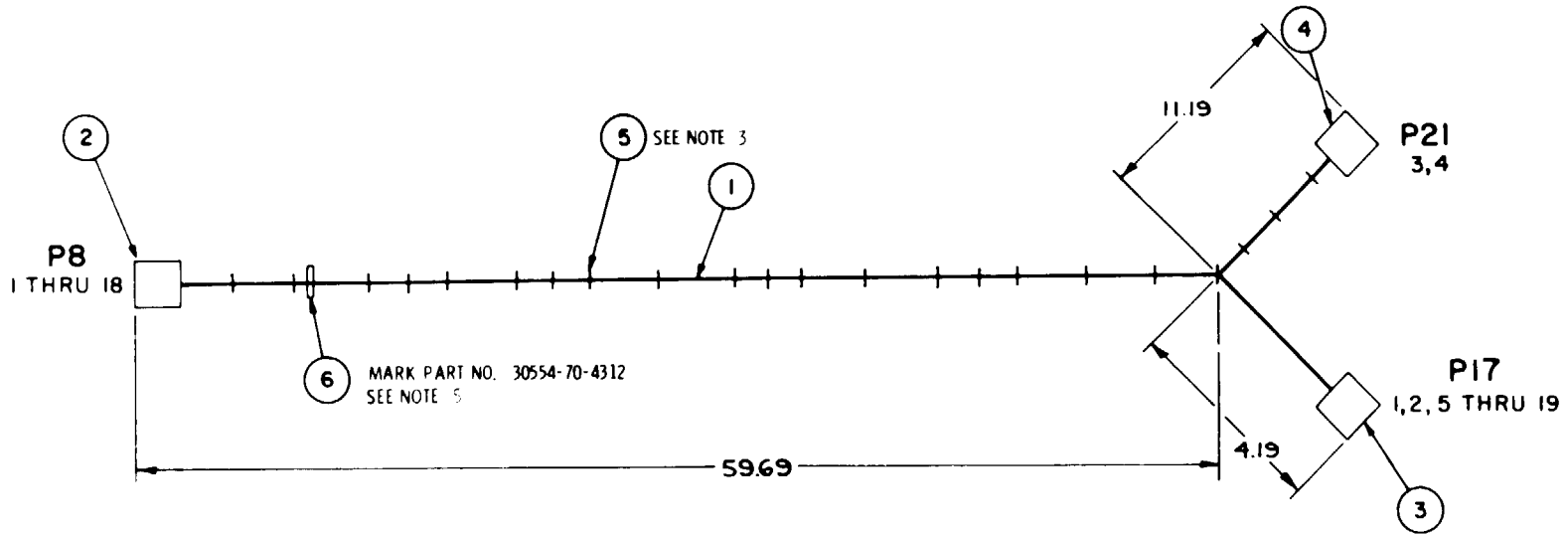
WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
11	RED	P60D16	P31-L		P32-L		28.00
12	BLACK	K32D16	P31-M		P32-M		28.00
13	BLACK	K33D16	P31-N		P32-N		28.00
14	BLACK	L93L16	P31-P		P32-P		28.00
15	BLACK	X15K16	P31-R		P32-R		28.00
16	BLACK	K102H16	P31-S		P32-S		28.00
17	BLACK	K20D16	P31-T		P32-T		28.00
18	BLACK	K101H16	P31-U		P32-U		28.00
19	RED	P210C16	P31-V	2	P32-V	3	28.00
20	RED	P55BD16	P31-Z	2	P32-Z	3	28.00

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 6.
- CABLE STRAPS, FIND NO. 5 SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 5-4. Relay box to precise relay box wire harness, 50/60 Hertz generator sets



FIND NO.	CODE IDENT	QWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
7			SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
6			MS39020-2	1	BAND, MARKER		AL ALY
5			MS3367-1-9	21	STRAP, TIEDOWN		NYLON
4			MS3106R10SL-4S	1	CONNECTOR, PLUG		
3			MS3106R22-14S	1	CONNECTOR, PLUG		
2			MS3106R24-28P	1	CONNECTOR, PLUG		
1			M5086/2-16-9	AP	WIRE, ELECTRICAL	MIL-W-5086/2	

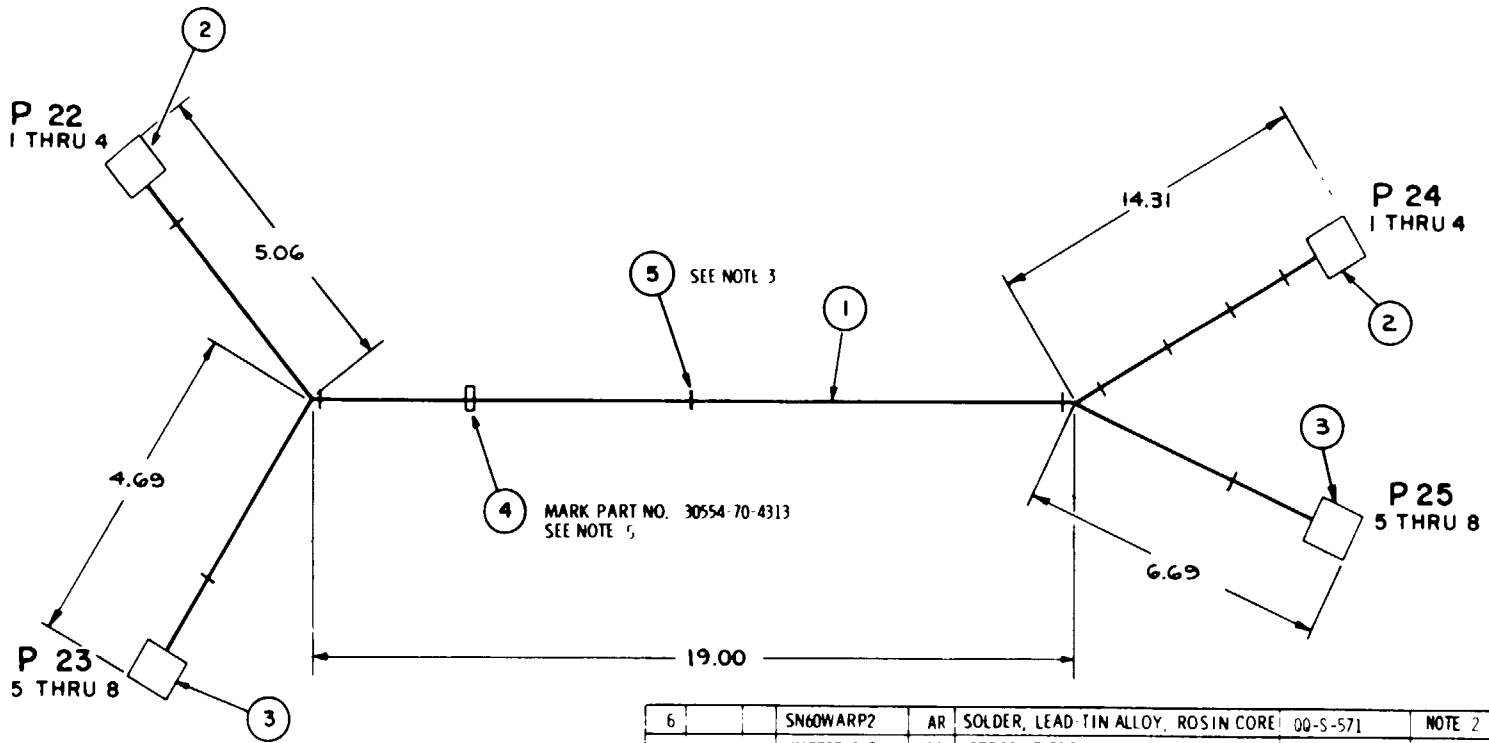
NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 7.
- CABLE STRAPS, FIND NO. 5, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X9P16	P8-A	2	P17-A	3	61.50
2	BLACK	X12S16	P8-B	↑	P17-B	3	61.50
3	RED	PR1A1F	P8-C		P21-A	4	68.50
4	RED	P55AH16	P8-D		P21-B	4	68.50
5	BLACK	X10SA1F	P8-E		P17-E	3	61.50
6	BLACK	X107A1E	P8-F		P17-F	↑	61.50
7	BLACK	X110A1F	P8-G		P17-G		61.50
8	BLACK	X106A1F	P8-H		P17-H		61.50
9	BLACK	X111A1F	P8-J		P17-J		61.50
10	BLACK	X114A1F	P8-K		P17-K		61.50
11	BLACK	X115A1F	P8-L		P17-L		61.50
12	BLACK	X32F16	P8-M		P17-M		61.50
13	BLACK	X103A1F	P8-N		P17-N		61.50
14	BLACK	X108A1F	P8-P		P17-P		61.50
15	BLACK	X109A1F	P8-P		P17-R		61.50
16	BLACK	X102A1F	P8-S		P17-S		61.50
17	BLACK	X104A1E	P8-T	↓	P17-T		61.50
18	BLACK	X101A1F	P8-U	2	P17-U	↓	61.50
19	BLACK	X113A1F	P17-C	3	P17-D	3	61.50

Figure 5-5. Relay box to governor control unit wire harness precise generator sets



FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
6			SN60WARP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-1-9	14	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3106R14S-5S	2	CONNECTOR, PLUG		
2			MS3106R14S-2P	2	CONNECTOR, PLUG		
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	K120A1F	P22-A	2	P24-A	2	36.00
2	BLACK	K121A1F	P22-B	2	P24-B	2	36.00
3	BLACK	K122A16	P22-C	2	P24-C	2	36.00
4	BLACK	K123A1F	P22-D	2	P24-D	2	36.00
5	BLACK	K124A16	P23-A	3	P25-A	3	28.00
6	BLACK	K125A16	P23-B	3	P25-E	3	28.00
7	BLACK	K126A16	P23-C	3	P25-C	3	28.00
8	BLACK	K127A16	P23-D	3	P25-D	3	28.00

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 6.
- CABLE STRAPS, FIND NO. 5, SHALL BE SPACED AT APPROX. 3.99 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 5-6. Governor control unit to governor actuator unit wire harness, precise generator sets

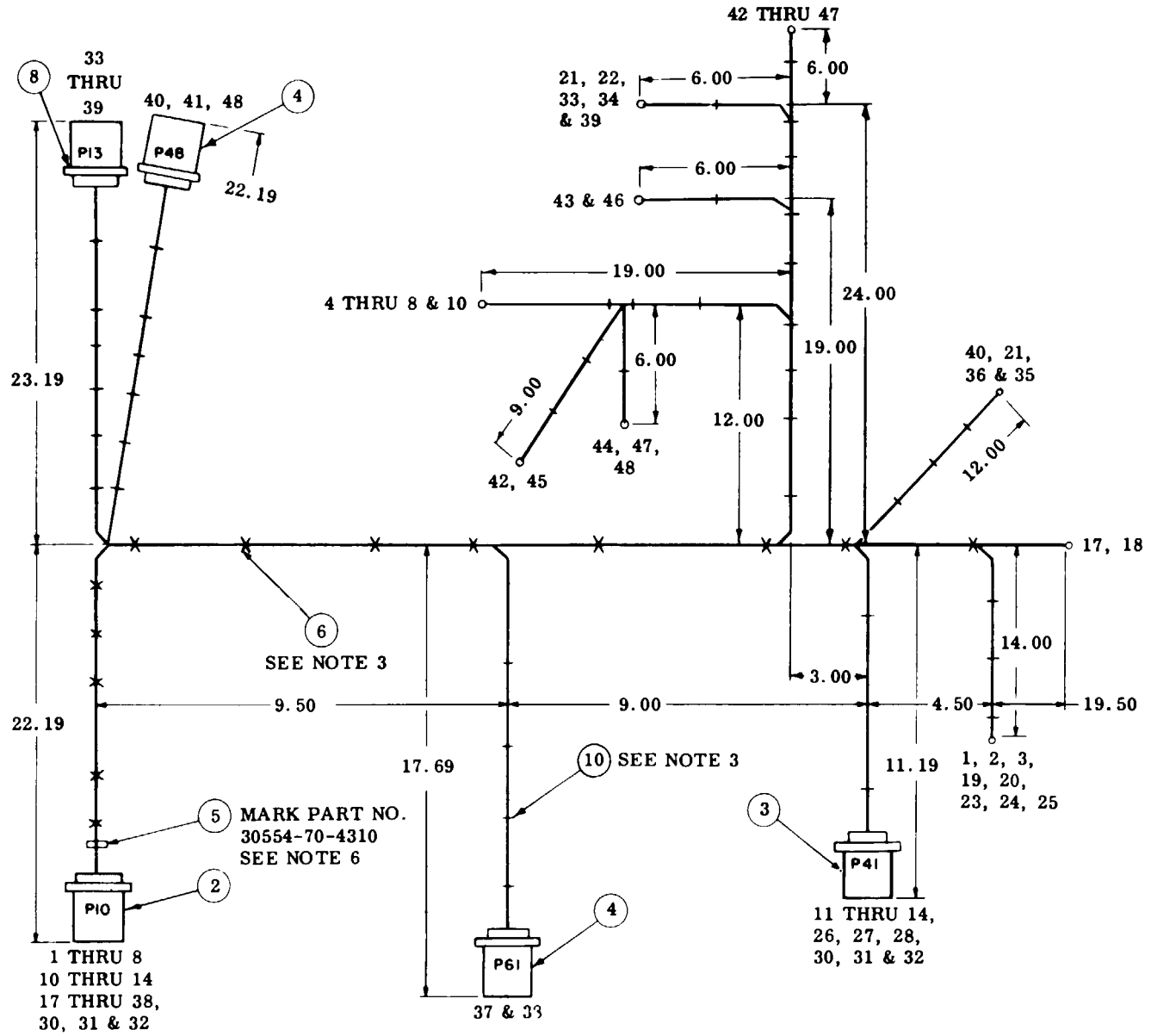


Figure 5-7. Relay box to reconnection panel wire harness, 50/60 Hertz generator sets (sheet 1 of 2)

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X7E16	P10-A	2	TB6-7	7	59.00
2	BLACK	X8E16	P10-B	↑	TB6-8	7	59.00
3	BLACK	X9AA16	P10-C	↑	TB6-9	7	59.00
4	BLACK	X19B16	P10-D		CT3-X1	13	68.00
5	BLACK	X18B16	P10-E		CT2-X1	13	↑
6	BLACK	X17B16	P10-F		CT1-X1	13	↑
7	BLACK	D22E16	P10-G	↓	CT3-X2	13	↓
8	BLACK	D21E16	P10-H	2	CT2-X2	13	68.00
9							
10	BLACK	D20E16	P10-J	2	CT1-X2	13	68.00
11	BLACK	K110E16	P10-K	↑	P41-H	3	51.00
12	RED	P55K16	P10-L	↑	P41-B	↑	↑
13	RED	P63E16	P10-M	↓	P41-A	↓	↓
14	RED	P50FF16	P10-N	2	P41-D	3	51.00
15							
16							
17	BLACK	X21S16	P10-S	2	CB2-A2	14	64.00
18	BLACK	X22S16	P10-T	↑	CB2-B2	14	64.00
19	BLACK	X12X16	P10-W		TB6-12	7	59.00
20	BLACK	X6B16	P10-X		TB6-6	7	59.00
21	BLACK	X194F16	P10-Y		TB2-5	9	68.00
22	BLACK	X195E16	P10-Z		TB2-6	9	68.00
23	BLACK	X14A16	P10-a		TB6-1	7	59.00
24	BLACK	X15F16	P10-b		TB6-2	7	59.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
25	BLACK	X16A16	P10-d		TB6-3	7	59.00
26	RED	P56J16	P10-c		P41-C	3	51.00
27	RED	P50NN16	P10-e	↓	P41-J	3	51.00
28	RED	P199D16	P10-f	2	P41-K	3	51.00
29							
30	BLACK	X97D16	P10-j	2	P41-E	3	51.00
31	BLACK	X98B16	P10-h	2	P41-F	3	51.00
32	BLACK	K112B16	P10-g	2	P41-G	3	51.00
33	BLACK	U134B16	P13-J	8	TB2-4	9	69.00
34	BLACK	U135B16	P13-K	↑	TB2-2	9	69.00
35	BLACK	X9DD16	P13-L		TB6-9	7	54.00
36	BLACK	X12SS16	P13-M		TB6-12	7	54.00
37	RED	P73C16	P13-R		P61-C	4	48.00
38	RED	PE7E16	P13-S	↓	P61-B	4	48.00
39	RED	P55AL16	P13-T	8	GND LUG	9	69.00
40	BLACK	X12MM12	P48-C	4	TB6-12	12	72.00
41	BLACK	X9MM12	P48-B	4	TB6-9	12	72.00
42	BLACK	U135A16	TB2-1	9	CT6-X2	13	35.00
43	BLACK	U135E16	TB2-2	9	CT4-X2	13	18.00
44	BLACK	U135F16	TB2-2	9	CT5-X2	13	32.00
45	BLACK	U134A16	TB2-3	9	CT6-X1	13	35.00
46	BLACK	U134E16	TB2-4	9	CT4-X1	13	18.00
47	BLACK	U134F16	TB2-4	9	CT5-X1	13	32.00

15			SN60WRAP2	AR	SOLDER LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
14			MS25036-110	2	TERMINAL, LUG, CRIMP STYLE		
13			MS25036-108	12	TERMINAL, LUG, CRIMP STYLE		
12			MS25036-158	2	TERMINAL, LUG, CRIMP STYLE		
11			MS086/2-12-9	AR	WIRE, ELECTRICAL		
10			MS3367-4-9	38	STRAP, TIEDOWN		NYLON
9			MS25036-153	12	TERMINAL, LUG, CRIMP STYLE		
8			MS3106R22-14S	1	CONNECTOR, PLUG		
7			MS25036-155	10	TERMINAL, LUG, CRIMP STYLE		
6			MS3367-1-9	14	STRAP, TIEDOWN		NYLON
5			MS39020-2	1	BAND, MARKER		AL ALY
4			MS3106R18-5S	2	CONNECTOR, PLUG		
3			MS3106R20-29S	1	CONNECTOR, PLUG		
2			MS3106R32-7S	1	CONNECTOR, PLUG		
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
P/N NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 15.
- CABLE STRAPS, FIND NO'S 6 AND 10, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- A. TRUNK BENDS TO BE 1.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
 B. BREAKOUTS TO BE .50 RADIUS.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 5-7. Relay box to reconnection panel wire harness, 50/60 Hertz generator sets (sheet 2 of 2)

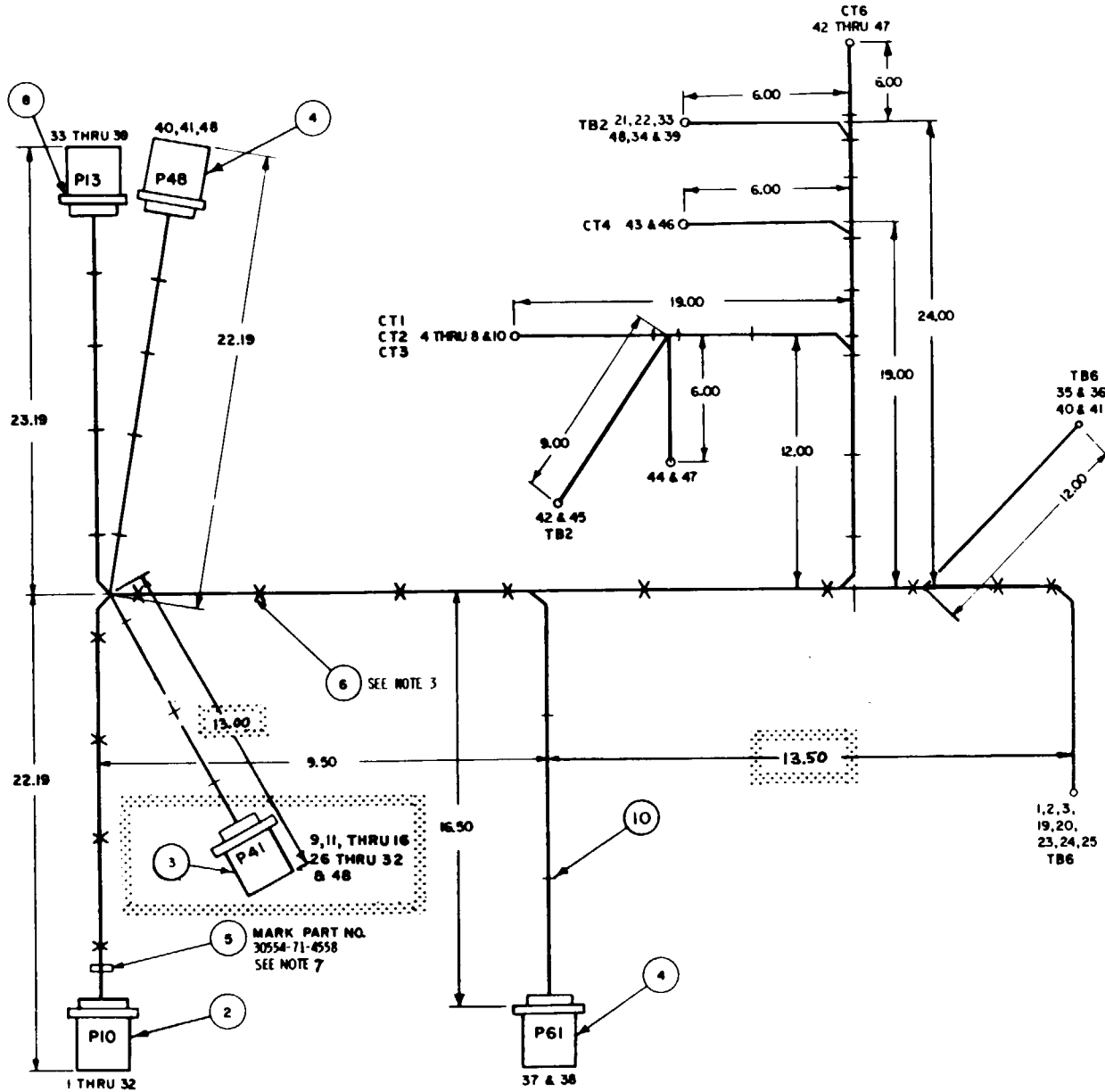


Figure 5-8. Relay box reconnection panel wire harness, 400 Hertz generator sets (sheet 1 of 2)



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X7E16	P10-A	2	TB6-7	7	59.00
2	BLACK	X8E16	P10-B	↑	TB6-8	7	59.00
3	BLACK	X9AA16	P10-C		TB6-9	7	59.00
4	BLACK	X19B16	P10-D		CT3-X1	13	68.00
5	BLACK	X18B16	P10-E		CT2-X1	13	↑
6	BLACK	X17B16	P10-F		CT1-X1	13	↓
7	BLACK	D22E16	P10-G		CT3-X2	13	↓
8	BLACK	D21E16	P10-H		CT2-X2	13	68.00
9	BLACK	P148B16	P10-I		P41-R	3	33.00
10	BLACK	D20E16	P10-J		CT1-X2	13	68.00
11	BLACK	K110E16	P10-K		P41-H	3	33.00
12	RED	P55K16	P10-L		P41-B	3	↑
13	RED	P63E16	P10-M		P41-A	3	↓
14	RED	P50FF16	P10-N		P41-D	3	↓
15	BLACK	P150B16	P10-R		P41-N	3	↓
16	BLACK	P151B16	P10-P		P41-P	3	33.00
17	BLACK	X21S16	P10-S		CB2-A2	14	40.00
18	BLACK	X22S16	P10-T		CB2-B2	14	40.00
19	BLACK	X12X18	P10-W		TB6-12	7	59.00
20	BLACK	X6B16	P10-X		TB6-6	7	59.00
21	BLACK	X194F16	P10-Y		TB2-5	9	65.00
22	BLACK	X195E16	P10-Z		TB2-6	9	65.00
23	BLACK	X14A16	P10-a		TB6-1	7	59.00
24	BLACK	X15F16	P10-b		TB6-2	7	59.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
25	BLACK	X16A16	P10-d		TB6-3	7	59.00
26	RED	P56J16	P10-c		P41-C	3	33.00
27	RED	P50NN16	P10-o		P41-J	3	↑
28	RED	P199D16	P10-i		P41-K	3	↓
29	BLACK	P149B16	P10-k		P41-T	3	↓
30	BLACK	X97B16	P10-j		P41-E	3	↓
31	BLACK	X98B16	P10-h		P41-F	3	↓
32	BLACK	K112B16	P10-g	2	P41-G	3	33.00
33	BLACK	U134B16	P13-J	8	TB2-4	9	65.00
34	BLACK	U135B16	P13-K	↑	TB2-2	9	65.00
35	BLACK	X90D16	P13-L		TB6-9	7	54.00
36	BLACK	X12SS16	P13-M		TB6-12	7	54.00
37	RED	P73C16	P13-R		P61-C	4	48.00
38	RED	P67E16	P13-S	↓	P61-B	4	48.00
39	RED	P55AL16	P13-T	8	GRD LUG	9	65.00
40	BLACK	X12MM12	P48-C	4	TB6-12	12	52.75
41	BLACK	X9MM12	P48-B	4	TB6-9	12	52.75
42	BLACK	U135A16	TB2-1	9	CT6-X2	13	31.00
43	BLACK	U135E16	TB2-2	↑	CT4-X2	13	15.00
44	BLACK	U135F16	TB2-2		CT5-X2	13	28.00
45	BLACK	U134A16	TB2-3		CT6-X1	13	32.00
46	BLACK	U134E16	TB2-4	↓	CT4-X1	13	13.00
47	BLACK	U134F16	TB2-4	9	CT5-X1	13	29.00
48	BLACK	P40AC16	P10-V	2	P41-M	3	33.00

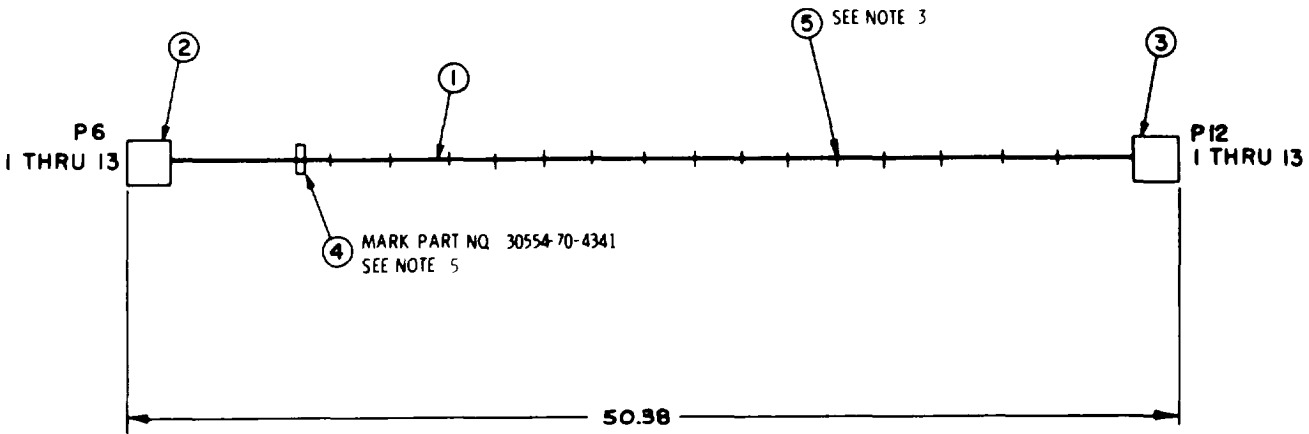
15		SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2	
14		MS25036-110	2	TERMINAL, LUG, CRIMP STYLE			
13		MS25036-108	12	TERMINAL, LUG, CRIMP STYLE			
12		MS25036-158	2	TERMINAL, LUG, CRIMP STYLE			
11		MS086/2-12-9	AR	WIRE, ELECTRICAL			
10		MS3367-4-9	29	STRAP, TIEDOWN		NYLON	
9		MS25036-153	11	TERMINAL, LUG, CRIMP STYLE			
8		MS3106R22-14S	1	CONNECTOR, PLUG			
7		MS25036-155	10	TERMINAL, LUG, CRIMP STYLE			
6		MS3367-1-9	16	STRAP, TIEDOWN		NYLON	
5		MS39020-2	1	BAND, MARKER		AL ALY	
4		MS3106R18-5S	2	CONNECTOR, PLUG			
3		MS3106R20-29S	1	CONNECTOR, PLUG			
2		MS3106R32-7S	1	CONNECTOR, PLUG			
1		MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2		
FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO.15
- CABLE STRAPS, FIND NO'S 6 AND 10, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5086 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- A. TRUNK BENDS TO BE 1.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
 B. BREAKOUTS TO BE .50 RADIUS.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 5-8. Relay box to reconnection panel wire harness, 400 Hertz generator sets (sheet 2 of 2)



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	RED	P45K16	P6-A	2	P12-A	3	48.00
2	RED	P66A16	P6-B	↑	P12-B	↑	48.00
3	RED	P209A16	P6-C		P12-C		48.00
4	RED	P201A16	P6-D		P12-D		48.00
5	RED	P202A16	P6-E		P12-E		48.00
6	RED	P203A16	P6-F		P12-F		48.00
7	RED	P204A16	P6-G		P12-G		48.00
8	RED	P205A16	P6-H		P12-H		48.00
9	RED	P206A16	P6-I		P12-I		48.00
10	RED	P207A16	P6-K		P12-K		48.00
11	RED	P208A16	P6-L		P12-L		48.00
12	RED	P209A16	P6-M	↓	P12-M	↓	48.00
13	RED	P210A16	P6-N	2	P12-N	3	48.00

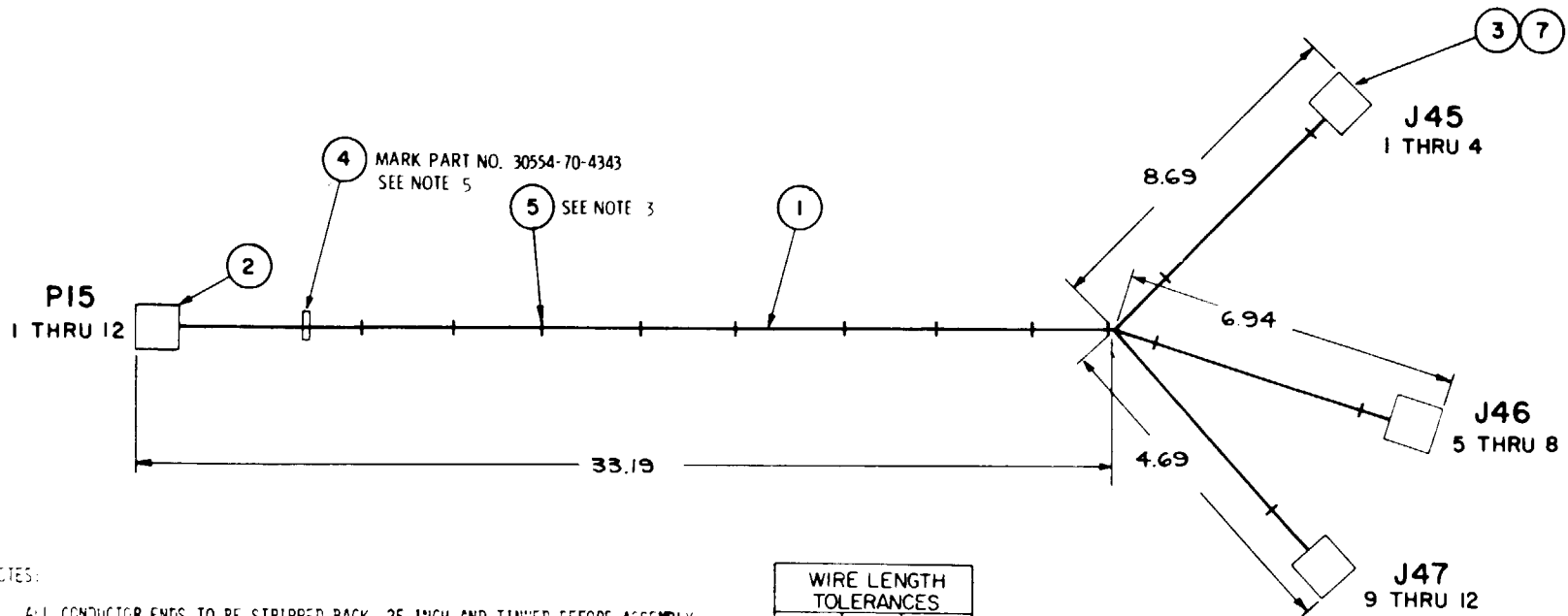
WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

6		SN60WRAP?	AR	SOLDER, LEAD TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2	
5		MS3367-1-9	15	STRAP, TIEDOWN		NYLON	
4		MS39020-2	1	BAND, MARKER		AL ALY	
3		MS3106R20-27S	1	CONNECTOR, PLUG			
2		MS3106R20-27P	1	CONNECTOR, PLUG			
1		M5086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2		
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 6
- CABLE STRAPS, FIND NO. 5 SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 5-9. Relay box to fault locator indicator wire harness



NOTES:

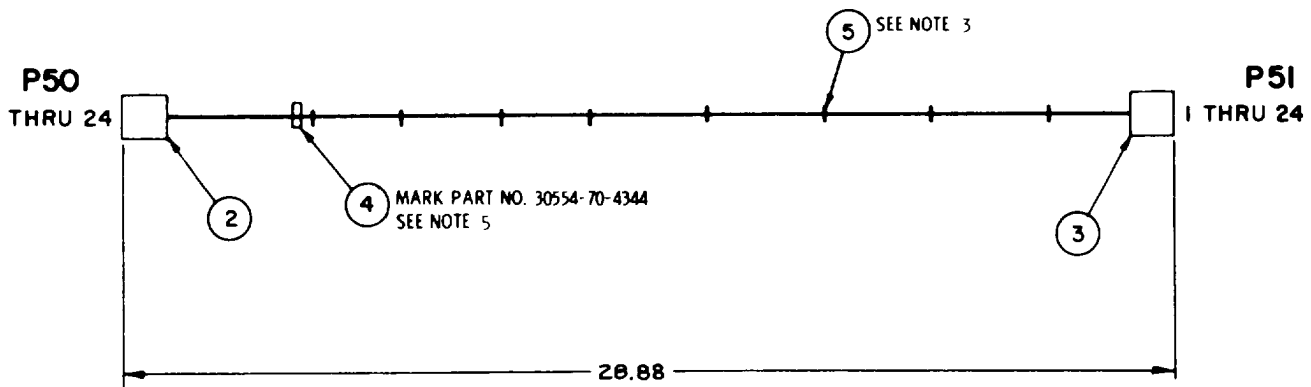
1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 6 .
3. CABLE STRAPS, FIND NO. 5. SHALL BE SPACED AT APPROX. 3.00 INCH UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
7			TYPE F, FORM Ua GRADE A, CL I CATEGORY 1	12	TUBING, INSULATION .106 ID X .016 WALL X .62 LG	MIL-I-E31	
6			SN60WRAP2	AP	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-1-9	15	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3102R18-4P	3	CONNECTOR, RECEPTACLE		
2			MS3106R20-29P	1	CONNECTOR, PLUG		
1			MS0867-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

WIRE NO	WIRE MARKING		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X112E1E	P15-A	2	J45-A	3	37.00
2	BLACK	X111F1E	P15-B		J45-B		37.00
3	BLACK	X98E1E	P15-C		J45-C		37.00
4	BLACK	X96E1E	P15-D		J45-D		37.00
5	BLACK	K112H1E	P15-E		J46-A		41.00
6	BLACK	K111J1E	P15-F		J46-B		41.00
7	BLACK	X98H1E	P15-G		J46-C		41.00
8	BLACK	X96H1E	P15-H		J46-D		41.00
9	BLACK	K112K1E	P15-J		J47-A		39.00
10	BLACK	K111L1E	P15-K		J47-B		39.00
11	BLACK	X98J1E	P15-L		J47-C		39.00
12	BLACK	X96H1E	P15-M	2	J47-D	3	39.00

Figure 5-10. Parallel receptacle wire harness



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	RED	P58C16	P50-A	2	P51-A	3	26.50
2	RED	P50S16	P50-B		P51-B		26.50
3	RED	P206C16	P50-C		P51-C		26.50
4	RED	P205C16	P50-D		P51-D		26.50
5	RED	P60B1F	P50-E		P51-E		26.50
6	RED	P203C16	P50-F		P51-F		26.50
7	RED	P209C16	P50-G		P51-G		26.50
8	RED	P62J16	P50-H		P51-H		26.50
9	BLACK	X9U16	P50-J		P51-J		26.50
10	BLACK	X12BB16	P50-K		P51-K		26.50
11	RED	P50AK16	P50-L		P51-L		26.50
12	RED	P55Z16	P50-M		P51-M		26.50

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
13	BLACK	K102E16	P50-N		P51-N		26.50
14	RED	P200T16	P50-P		P51-P		26.50
15	BLACK	X8J16	P50-R		P51-R		26.50
16	BLACK	X7J16	P50-S		P51-S		26.50
17	BLACK	X17D16	P50-T		P51-T		26.50
18	BLACK	X18D16	P50-U		P51-U		26.50
19	BLACK	X19D16	P50-V		P51-V		26.50
20	RED	P55BC16	P50-W		P51-W		26.50
21	BLACK	K101E16	P50-X		P51-X		26.50
22	RED	P63B16	P50-a		P51-a		26.50
23	RED	P62E16	P50-b		P51-b		26.50
24	BLACK	D24F16	P50-d	2	P51-d	3	26.50

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 6.
- CABLE STRAPS, FIND NO. 5 SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
6			SN6QWRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
5			MS3367-1-9	8	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3106R28-12S	1	CONNECTOR, PLUG		
2			MS3106R28-12P	1	CONNECTOR, PLUG		
1			MS0862-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 5-11. Relay box to tactical relay box wire harness

## CHAPTER 6

### GENERATOR SET CONTROL GROUP REPAIR INSTRUCTIONS

#### Section I. CONTROL CUBICLE

##### 6-1. GENERAL.

The control cubicle is located at the generator end of the set. It contains controls, switches, instruments, and circuitry necessary to start, operate, and monitor the generator set. The instruments and controls are mounted on a hinged front panel of the cubicle which permit easy access to the interior of the cubicle. Devices on the front panel are divided into an engine group and a generator group.

a. Instruments that monitor the generator output are: frequency meter M6; kilowatt meter M7; percent rated current meter M8; ac voltmeter M9; ammeter-voltmeter selector switch S8; and the synchronizing lights DS4 and DS5. Devices that control the generator output are: a frequency adjust rheostat R1 for precise sets; a voltage adjust rheostat R2; parallel unit - single unit operation switch S6; battle short switch S7 and indicator DS7; voltage sensing (remote-local) switch S5; and ac load contactor switch S3 and indicator DS6. Utility generator sets utilize a manual speed control located adjacent to the control cubicle, for adjustment of frequency through the utility governor.

b. Instruments that monitor engine operation are: oil pressure meter M1; coolant temperature indicator M2, fuel level meter M3, battery charge ammeter M4, and total running time meter M5.

Devices that control the engine are a START-RUN-STOP switch S2 and an engine primer switch S1. Also included is an engine air cleaner condition indicator DS8.

c. Located in the control cubicle are the thermal watt converter A1, control panel relay assembly A4, frequency meter transducer A2, control box relay assembly, and a wire harness. The thermal watt converter senses the generator power output and converts it to a proportional dc signal for display by the kilowatt meter. The frequency meter and transducer are a matched set. A single phase ac voltage of the generator output is applied to the transducer which produces dc signal proportional to the generator frequency for display by the frequency meter. The control box relay assembly contains stop-run relay K1, remote voltage sensing relay K6, rectifier bridge CR1, and resistor R10.

##### 6-2. THERMAL WATT CONVERTER (A1).

##### 6-3. TEST ON EQUIPMENT.

a. Symptoms and Isolation of Malfunction. A malfunction of the thermal watt converter is usually indicated by low or no kilowatt meter reading. An open circuit coil in the thermal watt converter will also effect the AC ammeter reading for the phase which is open. To isolate the malfunction, proceed as follows:

1. Loosen three captive studs and hinge control box door open.

2. Start generator set and apply load.

**WARNING**

Exercise extreme care not to touch exposed electrical connections when working inside control cubicle with generator set operating.

3. Measure input voltages at terminals V1-N1, V2-N2 and V3-N3. Voltage should be 120 VAC with the generator output voltage adjusted for rated output. If above requirement is not met, check wiring back to voltage source.

4. Measure current to terminal L1, L2, and L3. The current should vary between 0-0 75 AC amperes as the generator set load is varied from 0 to 100 percent of rated output. If there is no current shut down generator set and check for continuity between terminals L1-S1, L2-S2 and L3-S3. If there is continuity, check wiring back to current source.

5. Measure the output signal at the (+) and (-) terminals with a vacuum tube DC voltmeter. The output signal should vary between 0 to 10.4 mv as the generator set load is varied between 0 and 100 percent of rated output, If the above requirement is not met and the inputs' are correct, the thermal watt converter should be replaced.

b. Removal. Refer to Operator and Organizational Maintenance Manual and remove the thermal watt converter.

6-4. CLEANING. Clean the thermal watt converter using a clean lint-free cloth, moistened with an approved cleaning solvent and dry thoroughly.

6-5. INSPECTION. Inspect case for evidence of cracks or tears and the terminal board for cracked insulation, stripped threads, and missing jumper strips.

6-6. TEST. Connect the thermal watt converter to the test equipment as illustrated in figure 6-1 and proceed as follows:

Note

All test readings are  $\pm 20$  percent.

a. Adjust all autotransformers T1, T2, and T3 to their MIN positions.

b. Close switch S1 and open switches S2 and S3.

c. Energize the power source.

d. Adjust T1 until 1 ampere is indicated on ammeter A1. Voltmeter V1 should indicate 6.4 mv.

e. Close switch S2 and adjust T2 until 1 ampere is indicated on ammeter A2. Voltmeter V1 should indicate 13 mv.

f. Close switch S3 and adjust T3 until 1 ampere is indicated on ammeter A3. Voltmeter should indicate 18.6 mv.

g. Remove test equipment. Replace defective thermal watt converter.

6-7. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install the thermal watt converter.

6-8. FREQUENCY METER (M6) AND TRANSDUCER (A2).

6-9. TEST ON EQUIPMENT.

a. Symptoms and Isolation of Malfunction. A malfunction of the frequency meter or transducer is usually indicated by off

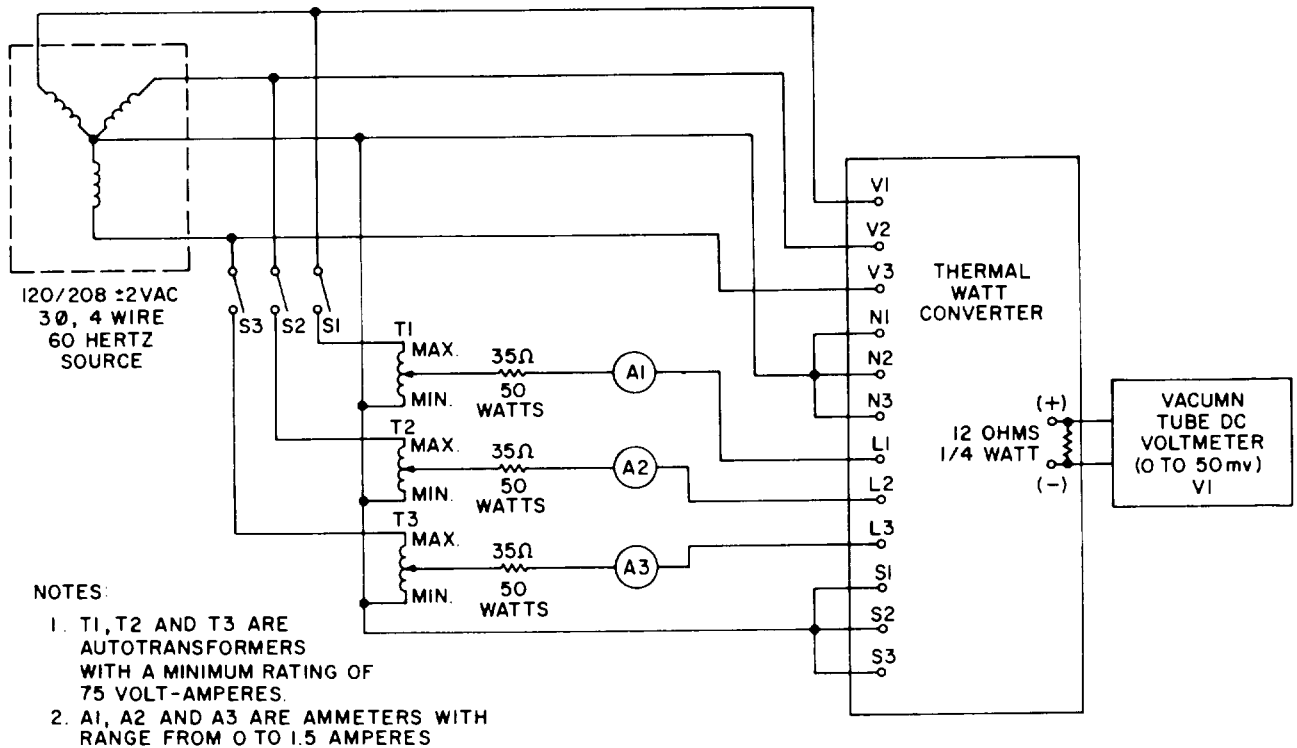


Figure 6-1. Thermal watt converter (A1) test setup

scale, high or low readings with the frequency adjusting controls set in their normal positions. To isolate the malfunction, proceed as follows:

1. Loosen three captive studs and hinge control box door open.
2. Start generator set and apply load.

#### WARNING

Exercise extreme care not to touch exposed electrical connections when working inside control cubicle with generator set operating.

3. Measure input voltage to frequency transducer (A2) at terminal 1 and 2.

Voltage should be 120 ± 10 percent vac, if not check wiring back to voltage source.

4. Connect a test frequency meter (table 2-1) to the convenience receptacle or generator output terminal. Check panel frequency meter accuracy against test meter while varying engine speed using manual speed control on utility generator sets or frequency adjust rheostat on precise generator sets. If meters do not indicate the same, replace frequency meter and transducer.

- b. Removal. Refer to Operator and Organizational Maintenance Manual and remove the frequency meter and transducer.

6-10. CLEANING. Clean the frequency meter and transducer using a clean lint-

free cloth, moistened with unapproved cleaning solvent and dry thoroughly.

6-11. INSPECTION. Inspect the frequency meter and transducer cases for cracks or tears and the electrical connectors for bent pins and insulation breakdown.

6-12. TEST.

NOTE

The frequency meter and transducer are a matched set and must be tested as a set.

a. Connect a variable frequency 120 VAC frequency generator to the AC side of the frequency transducer as shown in figure 6-2.

b. Connect a reference frequency meter across the input. The master frequency meter shall have 5 times the accuracy of the set frequency meter and transducer (1/20 of 1 percent).

c. Vary the frequency from lowest scale reading to full scale reading.

d. The error at any point on frequency meter shall not be greater than 1/4 of 1 percent.

e. Remove test equipment. Replace defective frequency meter and transducer.

6-13. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install the frequency meter and transducer.

6-14. CONTROL BOX RELAY ASSEMBLY (A4).

6-15. TEST ON EQUIPMENT.

a. Symptoms and Isolation of Malfunction. A malfunction of the control box

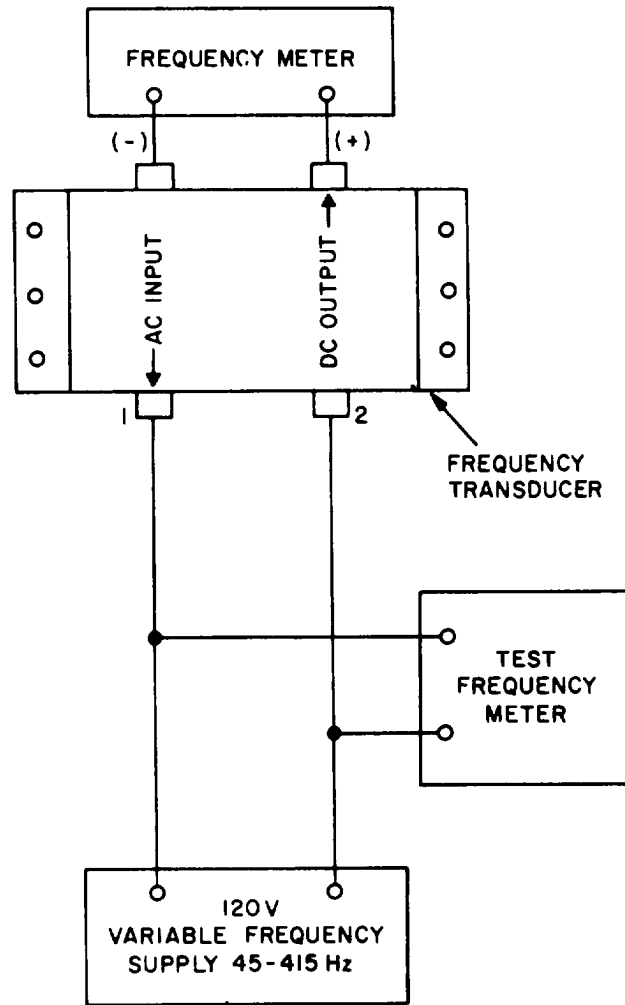


Figure 6-2. Frequency meter (M6) & transducer (A2) test setup

relay assembly (A4) is usually indicated by failure of the generator set to run when the start- run-stop switch (S2) is positioned to RUN or by inability to control voltage from a remote location. To isolate the malfunction proceed as follows:

1. Loosen three captive studs and hinge control box door open.

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside control cubicle with generator set operating.



### NOTE

Steps 2. through 7. pertain to stop-run relay K1 and steps 8. through 10. pertain to remote voltage sensing relay K6. All test readings should be  $\pm 20$  percent.

2. Energize DC circuit breaker.

3. Start engine. If engine shuts down when start-run-stop switch is positioned to RUN, restart engine and hold switch to START. Measure voltage at relay assembly terminal board across terminals 2 and 8. Voltage should be 24 VDC.

4. If voltage across terminals 2 and 8 is not 24 VDC, shut down generator set. Disconnect wire P50A from terminal 9 and insulate wire end.

5. Restart generator set and measure voltage across terminals 2 and 9. Voltage should be 24 VDC. Connect wire P50A.

6. If voltage across terminals 2 and 9 is not 24 VDC, shut down generator set. Remove wire P80E from terminal 8 and check resistance across terminals 2 and 8. Resistance should be 300 ohms. If not replace stop-run relay K1.

7. If values in steps 2. through 6. are met and circuit is still inoperative, remove control box relay assembly (A4) and bench test.

8. Connect a suitable cable between one of the convenience receptacle outlets (J55) and remote voltage sensing connector (J29). Position convenience receptacle circuit breaker (CB3) OFF. Start engine and position the remote local voltage switch (S5) to the REMOTE position and place convenience receptacle circuit breaker (CB-3) ON. Measure voltage at relay assembly terminal board across terminals 4 and 12, 5 and 11, 6 and 10. Voltage should be 120 VAC nominal.

9. If voltages in step 8. are correct and the remote voltage sensing circuit is still inoperative, shut down generator set. Remove wires X29A and X31A from terminals 4 and 12. Measure resistance at terminals, resistance should be approximately 7K ohms. If not replace remote voltage sensing relay K6.

10. If values in steps 8. and 9. preceding are obtained and circuit is still inoperative, replace control box relay assembly (A4).

### b. Removal.

1. Disconnect harness at rear of control cubicle.

2. Loosen three captive studs and hinge open control box door.

3. Tag and disconnect wiring to control box relay assembly terminal boards.

### NOTE

The control box relay assembly is mounted inside the control box on the lower center sections of the rear wall.

4. Remove the four nuts located at the back of the rear wall, securing the control box relay to the control cubicle assembly.

### 6-16. TEST.

a. Connect the control box relay assembly to the test equipment as illustrated in figure 6-3.

b. Perform test specified in table 6-1.

### NOTE

All voltage values are  $\pm 20$  percent.

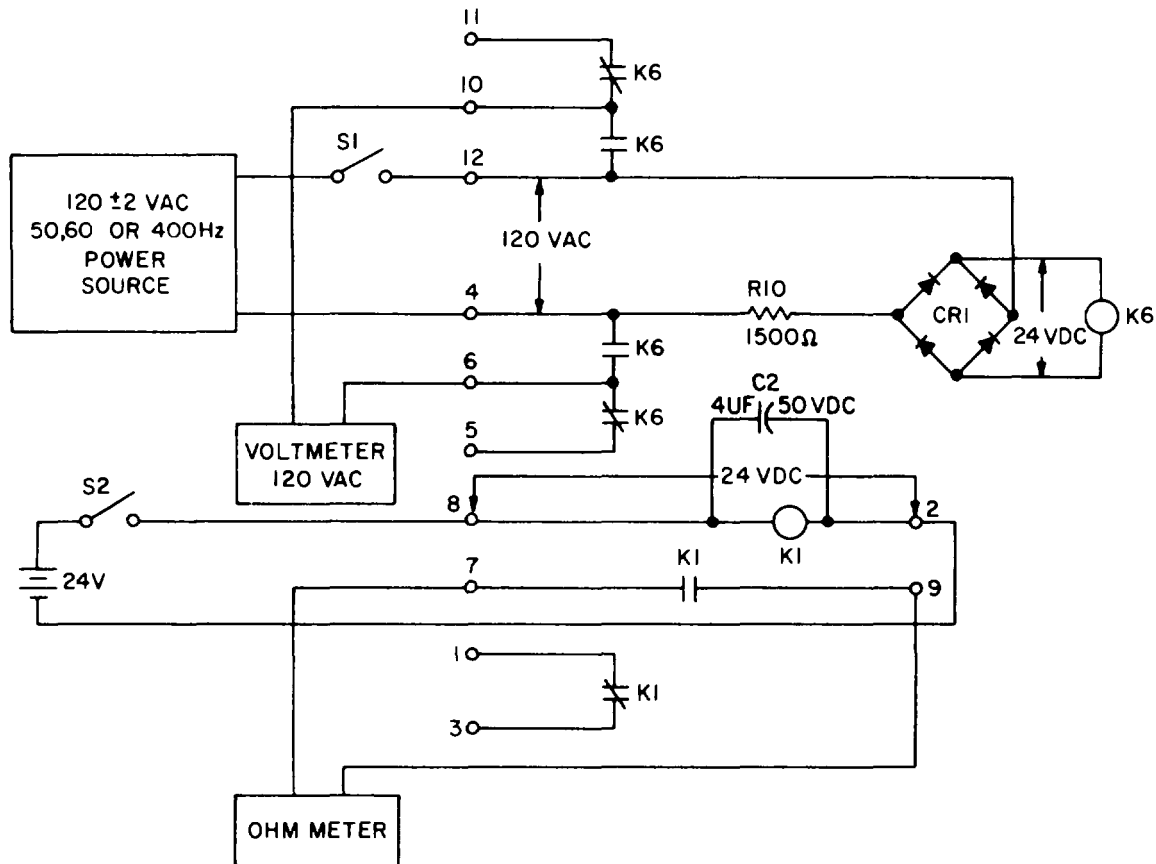


Figure 6-3. Control box relay assembly (A4) test setup

### 6-17. DISASSEMBLY.

#### NOTE

Test control box relay assembly as outlined in paragraph 6-16, then disassemble only to the extent necessary to effect repair.

- a. Refer to figure 6-4 and disassemble the control box relay assembly in the order of index numbers assigned.

#### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- b. Exercise care when unsoldering components to avoid damage resulting from application of excessive heat.

- 6-18. CLEANING. Clean the control box relay assembly using a clean lint-free cloth, moistened with an approved cleaning solvent and dry thoroughly.

### 6-19. INSPECTION.

- a. Inspect terminal boards for cracked insulation, circuit integrity, warping, burned or discolored areas and illegible stenciling.

- b. Check forward and reverse resistance of diodes. Measured from anode (+) to cathode (-), value should be low. Reverse leads, value should be infinity.

Table 6-1. Control Box Relay Assembly (A4) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
<p><u>WARNING</u></p> <p>Exercise extreme care when applying high voltages as they will cause injury to personnel if they come in contact with them.</p> <p><u>CAUTION</u></p> <p>When applying 120 VAC voltages to control box relay assembly terminals, insure correct placement of power supply leads. Damage to other components could result if leads are inadvertently misplaced.</p>				
1.	Apply 120 VAC, 60 Hertz power supply to terminals 4 and 12 of the control box relay assembly. Measure voltage at terminals 6 and 10.	Voltage measured should be 120 VAC.	Resistor R10 defective.  Full wave rectifier bridge CR1 defective.  Defective relay K6.	Check resistor with ohmmeter.  Check CR1 with ohmmeter.  Measure dc voltage across relay K6. If voltage is above 18 vdc and improper results still occur, relay K6 is defective.
2.	Apply 24 vdc power supply across terminals 2 and 8 of control panel relay assembly. Check continuity across terminals 7 and 9 with ohmmeter.	There should be continuity across terminals 7 and 9.	Defective relay K1.	Replace defective relay.

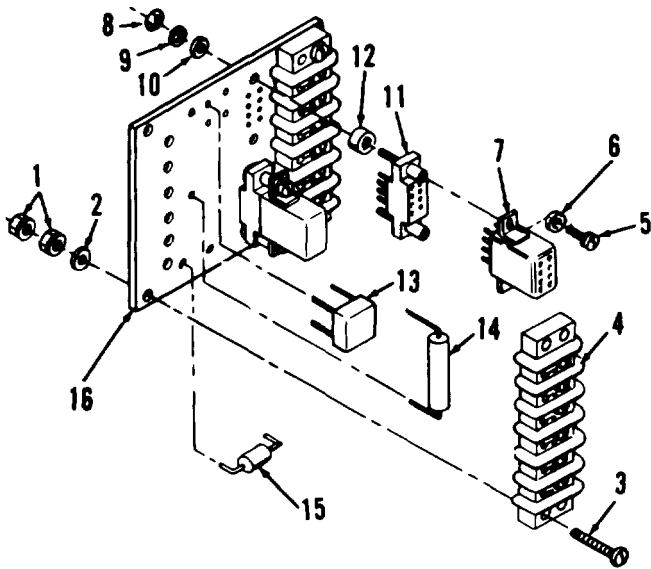


Figure 6-4. Control box relay assembly, exploded view

Legend to figure 6-4:

- |                       |                               |
|-----------------------|-------------------------------|
| 1. Nut (8)            | 10. Lock washer (4)           |
| 2. Washer (4)         | 11. Relay socket (2)          |
| 3. Screw (4)          | 12. Spacer                    |
| 4. Terminal board (2) | 13. Silicone bridge rectifier |
| 5. Screw (4)          | 14. Fixed resistor            |
| 6. Washer (4)         | 15. Capacitor                 |
| 7. Relay (2)          | 16. Terminal board            |
| 8. Nut (4)            |                               |
| 9. Washer (4)         |                               |

c. Check resistor for proper ohmic value. (15 K Ohms.)

d. Check capacitor for proper capacitance value.

e. Inspect relay sockets for cracked insulation and broken pin receptacles.

f. Test plug in relays for actuation as illustrated in figure 6-5.

#### 6-20. REPAIR.

a. Restencil illegible reference designations.

#### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

b. Repair printed circuits by soldering a jumper wire across defective area.

c. Replace all defective components.

d. Solder replacement components using solder conforming to Federal Specification QQ-S-571 Sn 60.

#### 6-21. REASSEMBLY.

Refer to figure 6-4 and reassemble control box relay assembly in reverse order of index numbers assigned. Pay particular attention to the following.

a. When replacing soldered components, use a suitable heat sink. Solder joints and/or component leads shall not project more than 0.094 inch beyond the surface of the board.

#### WARNING

Insulating Compound, MIL-I-46058 is flammable and slightly toxic to eyes, skin and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Spray or brush a conformal coating, 0.005 inch thick, of a transparent dielectric compound corresponding to Specification MIL-I-46058, Grade S, Type PUR to the assembly.

#### NOTE

The compound shall securely anchor the components to the terminal board. Terminals for connection to external circuits shall not be coated.

c. Test control box relay assembly as outlined in paragraph 6-16.

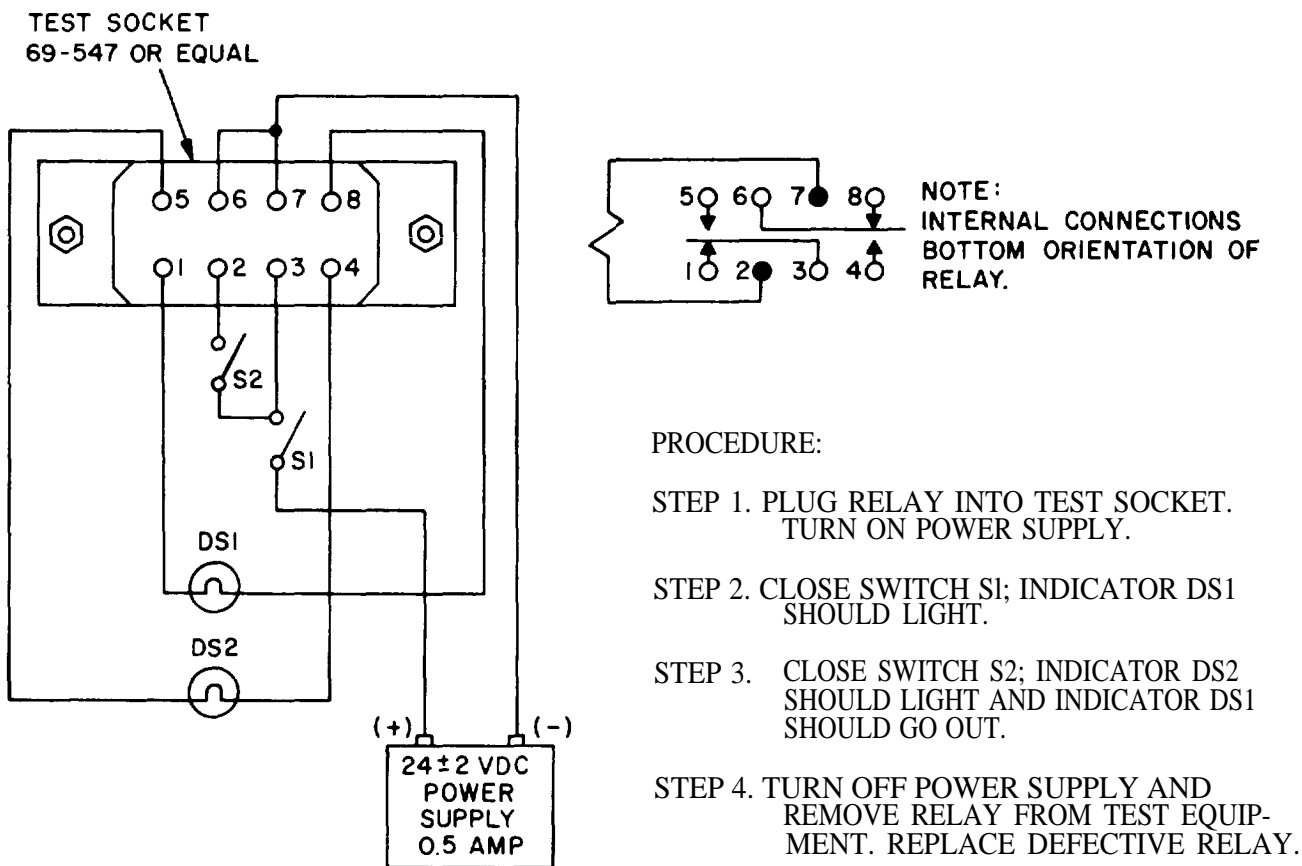


Figure 6-5. Plug in relay test setup

## 6-22. INSTALLATION.

- a. Position the control box relay assembly inside the control cubicle and secure it to the rear wall with four nuts.
- b. Connect wiring to the control box relay assembly terminal boards. Refer to figure 1-7 and check wires for proper connection.
- c. Close and secure control box door.
- d. Connect harness at rear of control cubicle.

## 6-23. AC CURRENT METER (M8).

### 6-24. TEST ON EQUIPMENT.

- a. Symptoms and Isolation of Malfunction. A malfunction of the AC current meter is usually indicated by abnormal readings when a known load is connected to the generator set. To isolate the malfunction proceed as follows:
  1. Loosen three captive studs and hinge control box door open.
  2. Connect suitable test ammeter in series with AC current meter.

3. Start generator set and apply full rated load.

4. Check meter indication, AC current meter should indicate 100 percent and test ammeter should indicate 0.75 amperes. Check indication at each phase by rotating voltmeter-ammeter selector switch (S8), readings should be the same.

5. If current reading is incorrect check wiring back to current source.

6. If current is correct remove AC current meter.

b. Removal. Refer to Operator and Organizational Maintenance Manual and remove the AC current meter.

6-25. CLEANING. Clean the AC current meter using a clean, lint-free cloth, moistened with an approved cleaning solvent and dry thoroughly.

6-26. INSPECTION. Inspect case for evidence of cracks or tears and electrical connector for security.

6-27. TEST. Connect the AC current meter to the test equipment as illustrated in figure 6-6 and proceed as follows:

a. Adjust auto-transformer T1 so that ammeter MI reads 1 ampere. AC current meter should indicate 133 percent load.

b. Adjust auto-transformer T1 so that meter MI reads 0.75 ampere. AC current meter should indicate 100 percent load.

c. Remove test equipment. Replace AC current meter if meter error is greater than 2 percent of full scale value.

6-28. INSTALLATION. Refer to Operator and Organizational Maintenance Manual and install the AC current meter.

#### 6-29. CONTROL CUBICLE.

6-30. TEST ON EQUIPMENT.

a. Symptoms and Isolation of Malfunction. A malfunction of the control cubicle is usually indicated by the conditions described and isolated in paragraphs 6-3, 6-9, 6-15 and 6-24. If a malfunction exists which is not traceable to those assemblies, perform a continuity check on the wires comprising the control cubicle assembly harness.

b. Removal. Refer to paragraph 2-6 and figure 2-2 and remove the control cubicle assembly.

6-31. DISASSEMBLY. Refer to figure 6-7 and disassemble control cubicle assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Loosen three captive studs (23) and hinge open control box door (25).

b. Tag and disconnect wires of harness (15) from components.

c. Refer to Operator and Organizational Maintenance Manual and remove components from control box door (25), and the thermal watt converter and frequency transducer from the box (36).

d. Remove the control box relay from the rear wall of box (36).

e. Hinge (32) and receptacle (35) are riveted to box (36) and should be removed only if damaged.

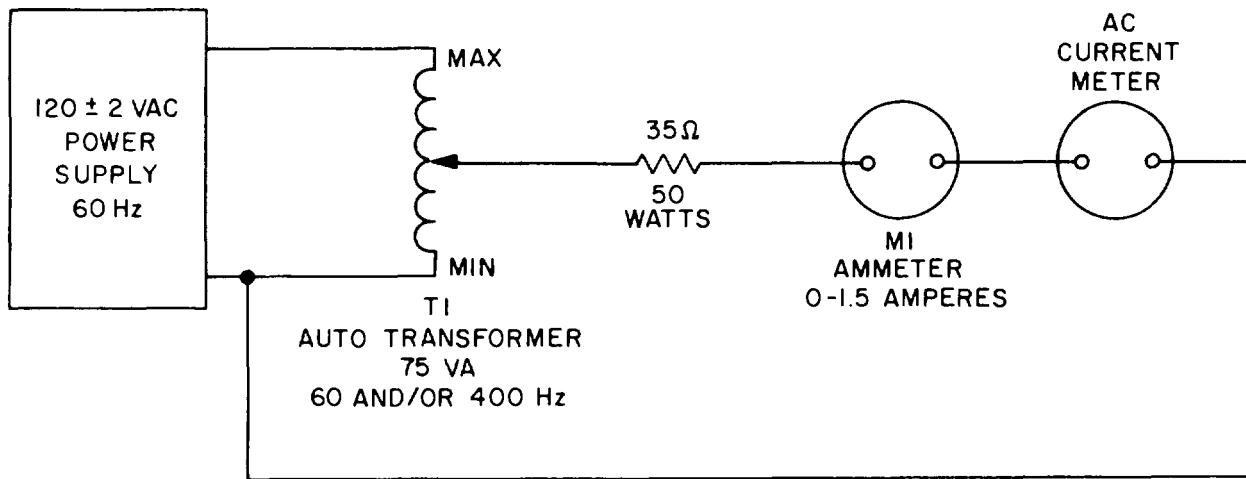


Figure 6-6. AC current meter (M8) test setup

6-32. CLEANING.

a. Clean electrical components and instruments with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean metal parts in unapproved cleaning solvent and dry thoroughly.

6-33. INSPECTION.

**NOTE**

Figure 1-6 is the schematic for the control cubicle.

a. Inspect meters and gauges for damaged cases and faces.

b. Check switches for continuity.

c. Inspect terminal boards for cracked insulation, stripped threads, and missing jumper strips.

d. Check capacitors for opens and shorts.

e. Check resistor for continuity and proper ohmic values.

f. Check rheostats for continuity and for proper adjustable range of resistance.

g. Inspect terminal lugs for security and condition.

h. Inspect wiring for defective insulation and electrical connectors for damaged threads; bent, loose, or missing pins. Check each harness wire from connector pin to wire end for continuity, refer to figure 6-8. Check connector pins for shorts to case and surrounding pins.

i. Inspect sheet metal parts for bent corners, distortion, cracks, tears, and dents.

6-34. REPAIR.

a. Straighten dents or distorted areas of the box using proper tools.

**WARNING**

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

b. Minor cracks may be repaired by welding.

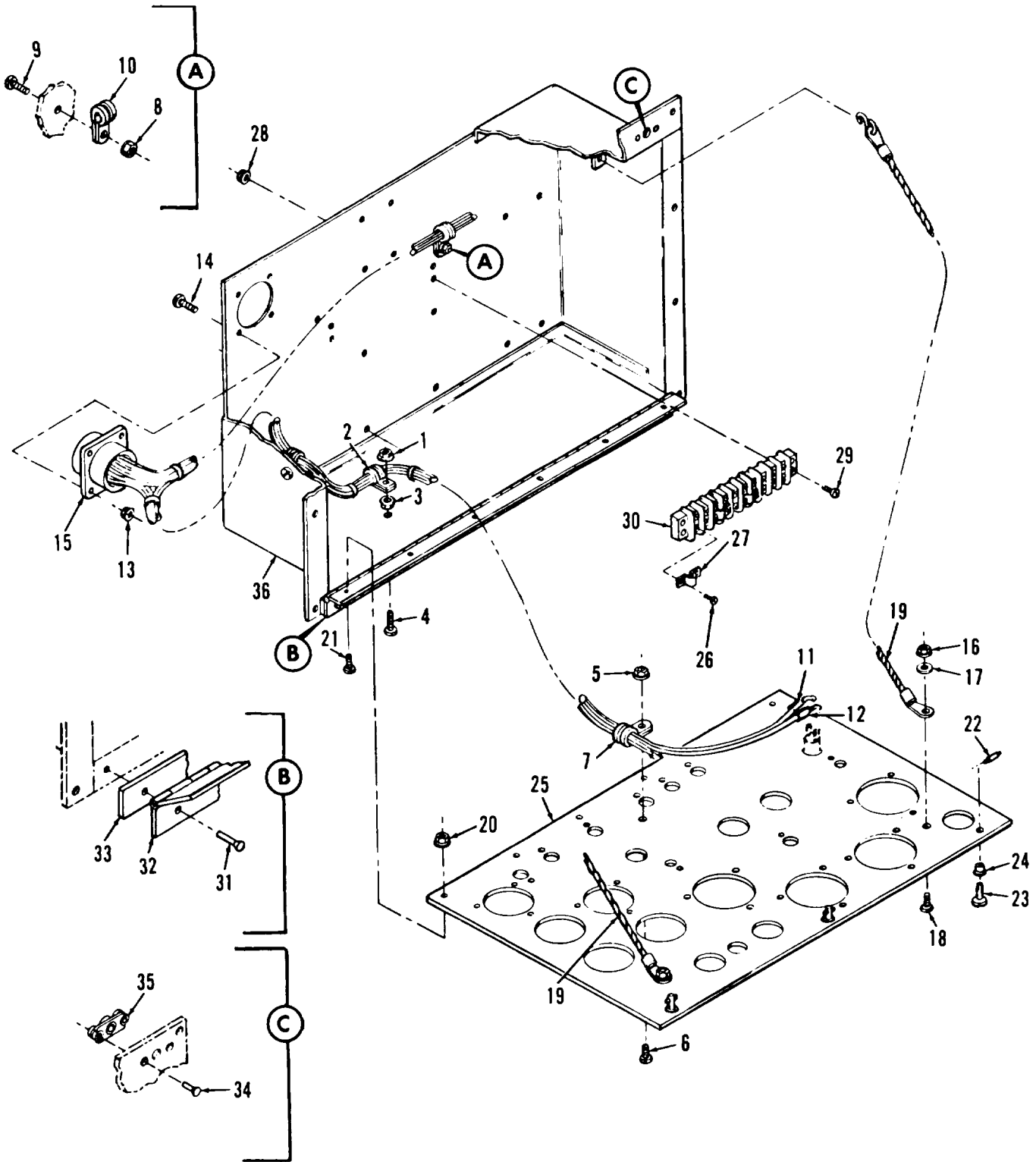


Figure 6-7. Control cubicle exploded view



Legend to figure 6-7:

- |                   |                               |
|-------------------|-------------------------------|
| 1. Nut (2)        | 19. Door holder (2)           |
| 2. Clamp (2)      | 20. Nut (6)                   |
| 3. Nut (2)        | 21. Screw (6)                 |
| 4. Screw (2)      | 22. Cross pin (3)             |
| 5. Nut            | 23. Stud (3)                  |
| 6. Screw          | 24. Grommet (3)               |
| 7. Clamp          | 25. Control box door          |
| 8. Nut            | 26. Screw (6)                 |
| 9. Screw          | 27. Terminal board jumper (3) |
| 10. Clamp         | 28. Nut (2)                   |
| 11. Insulator (3) | 29. Screw (2)                 |
| 12. Insulator (3) | 30. Terminal board            |
| 13. Nut (4)       | 31. Rivet (6)                 |
| 14. Screw (4)     | 32. Hinge                     |
| 15. Harness       | 33. Spacer                    |
| 16. Nut (2)       | 34. Rivet (6)                 |
| 17. Washer (2)    | 35. Receptacle (3)            |
| 18. Screw (2)     | 36. Box                       |

c. Repaired areas and those surfaces requiring refinishing shall be cleaned with a suitable abrasive paper, then primed and repainted.

d. Re-stencil as required.

6-35. REBUILD. Rebuild the control cubicle wire harness (15, figure 6-7) according to figure 6-8.

6-36. REASSEMBLY. Refer to figure 6-7 and reassemble control cubicle assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Install control box relay on rear wall of box (36). Secure in position with four nuts.

b. Refer to Operator and Organizational Maintenance Manual and install components

on control box door (25), and thermal watt converter and frequency transducer in box (36).

c. Install harness (15) connector in box (36) with key way on top. Connect wires of harness to components, refer to figure 1-7.

d. When installing clamp (2, figure 6-7) nearest control box door (25), leave nut (1) loose enough to permit harness to pivot when control box door is opened and closed.

6-37. TEST. Refer to figure 1-7 and perform continuity test of circuitry.

6-38. INSTALLATION. Refer to paragraph 2-6 and figure 2-2 and install the control cubicle assembly.

6-39. ADJUSTMENT. Refer to Operator and Organizational Maintenance Manual and zero adjust all instruments.

6-14 Change 3

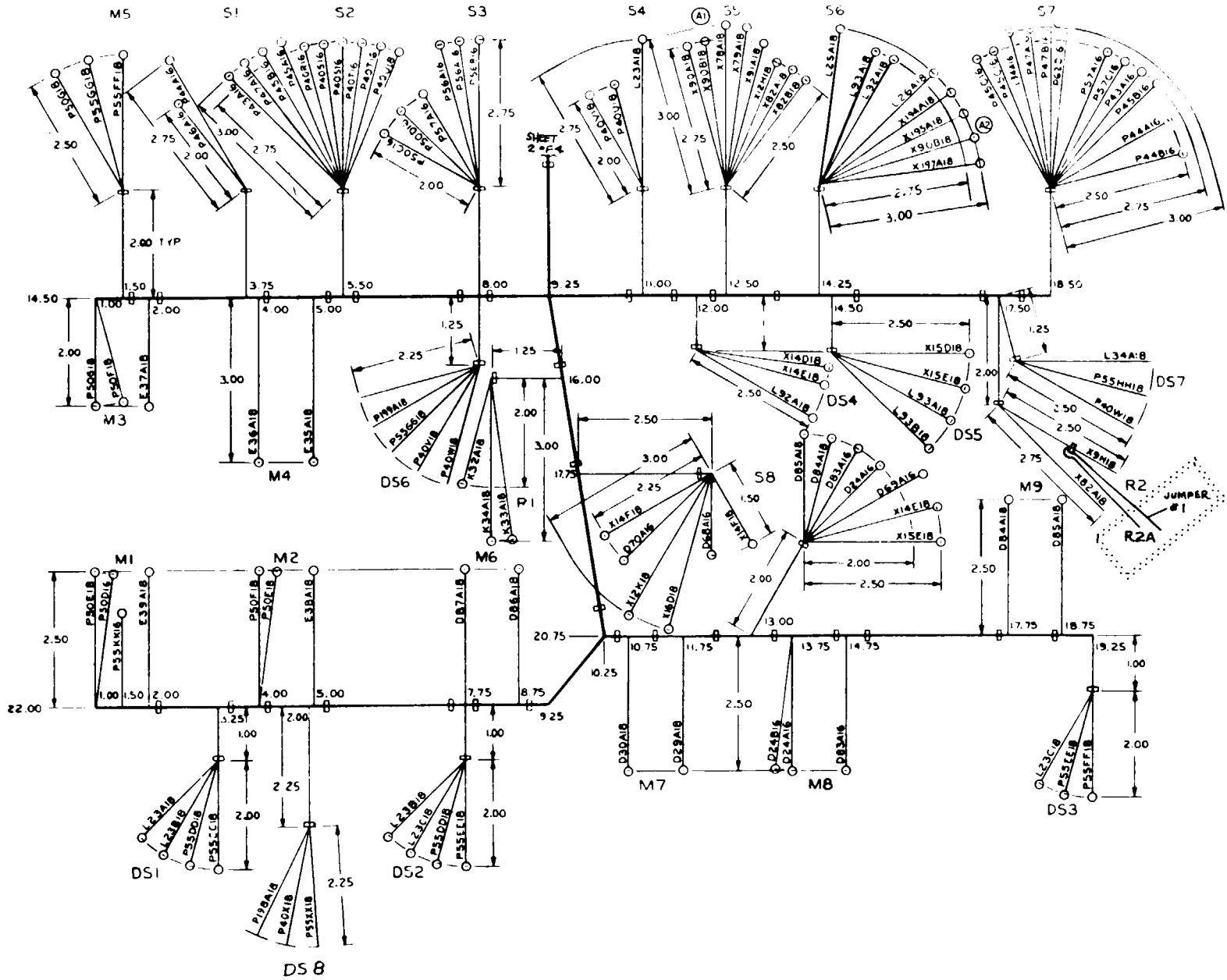


Figure 6-8. Control cubicle wire harness (Sheet 1 of 4)

WIRE MARKING NO	FROM		TO		WIRE FIND NO	CUT LENGTH IN	MARKING COLOR
	STATION NO	LUG FIND NO	STATION NO	LUG FIND NO			
X9H18	TB1-7	5	R2-L	4 STRIP	2	43	BLACK
X12D16	J1-y	--	TB1-1	11	1	9	
X12E18	A2-1	4	TB1-1	5	2	10	
X12G18	TB1-1	5	A4-5	5	2	7 5	
X12H18	TB1-1	5	S5-4	4	2	36	
X12J18	TB1-2	5	A1-N3	4	2	15	
X12K18	TB1-2	5	S8-17	4	2	38	
X12L18	A1-N1	4	A1-N2	4	2	5 5	
X12M18	A1-N2	4	A1-N3	4	2	5 5	
X14D18	J1-G	--	DS4-1	4	2	31	
X14E18	S8-12	4	DS4-1	4	2	18	
X14F18	S8-12	4	S8-24	4	2	4 5	
X15D18	J1-H	--	DS5-1	4	2	33 5	
X15E18	S8-22	4	DS5-1	4	2	20	
X16D18	J1-I	--	S8-13	4	2	34	
X29A18	J1-S	--	A4-12	5	2	23	
X31A18	J1-O	--	A4-4	5	2	14	
X78A18	A4-10	5	S5-3	4	2	51 5	
X79A18	A4-6	5	S5-6	4	2	40	
X82A18	S5-1	4	R2-M	5/8 STRIP	2	14	
X82B18	A4-11	5	S5-1	4	2	50	
X90A18	J1-U	--	S5-2	4	2	32	
X90B18	S6-7	4	S5-2	4	2	11 5	
X91A18	J1-L	--	S5-5	4	2	32 5	
X7D18	J1-E	--	A1-V1	4	2	23 5	BLACK
X8D18	J1-F	--	A1-V2	4	2	23 5	
X9D18	J1-z	--	TB1-6	11	1	12	
X9F18	TB1-7	5	A1-V3	4	2	12	
X9G18	A2-2	4	TB1-6	5	2	12 5	
X194A18	J1-P	--	S6-11	4	2	36	
X195A18	J1-f	--	S6-10	4	2	36	
X197A18	J1-n	--	S6-8	4	2	36	
*JUMPER#1	R2-L	1/4 STRIP	R2A-M	5/8 STRIP	2	3.0	BLACK

\* USED ON 400 HERTZ SETS ONLY

13	CLASS 1	12% in	INSULATION TUBING ELECTRICAL HEAT SHRINKABLE BLACK 187 DIA	MIL-I-23053
12	69 661-14	1	CONNECTOR, RECEPTACLE, ELECTRICAL	
11	MS25036-153		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1 NO 9 STUD SIZE NO 16-14 W SIZE	
10	MS25036-154		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1 1 4 STUD SIZE NO 16-14 W SIZE	
9	MS25036-108		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1 NO 10 STUD SIZE NO 16-14 W SIZE	
8	MS25036-106		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1 NO 6 STUD SIZE NO 16-14 W SIZE	
7	MS25036-150		TERMINAL LUG CRIMP STYLE COPPER, INS., CLASS 1, 1 4 STUD SIZE, NO 22-18 W SIZE	
6	MS25036-103		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1, NO 10 STUD SIZE, NO 22-18 W SIZE	
5	MS25036-149		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1, NO 8 STUD SIZE, NO 22-18 W SIZE	
4	MS25036-102		TERMINAL LUG CRIMP STYLE, COPPER, INS., CLASS 1, NO 6 STUD SIZE, NO 22-18 W SIZE	
3	MS18034-1-2		STRAP, CABLE ADJUSTABLE, SELF-CLINCHING, PLASTIC, TYPE I, CLASS 1	
2	M5086 2-18-9	AR	WIRE ELECTRICAL, 600-VOLT, COPPER AIRCRAFT, NO AM-18	MIL-W-5086/2
1	M5086 2-16-9	AR	WIRE ELECTRICAL, 600-VOLT, COPPER AIRCRAFT, NO AM-16	MIL-W-5086/2
FIND NO	PART OR IDENTIFYING NO	QTY RECD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

NOTES

- CONTACT PINS ARE SUPPLIED WITH CONNECTOR (ITEM 12) AND SHALL BE USED IN THEIR RESPECTIVE HOLES
- CUT INSULATION TUBING (ITEM 13) INTO 38 PIECES, .375 LONG AND INSTALL AROUND WIRES AND PINS ATTACHED TO THE CONNECTOR (ITEM 12) THEN APPLY HEAT OF 400° F FOR 3-5 SEC. FOR PROPER SHRINKAGE
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, PARA 3 9 3 & 3 9 3 1 EXCEPT THAT LENGTH BETWEEN ADJACENT GROUPS OF NUMBERS SHALL NOT EXCEED SIX INCHES

Figure 6-8. Control cubicle wire harness (Sheet 4 of 4)

Change 3

6-19

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

## Section II. DC CIRCUIT BREAKER BOX

### 6-40. GENERAL.

The dc circuit breaker box is located at the rear of the generator set to the right of the control cubicle assembly panel. The circuit breaker box contains a 7.5 ampere circuit breaker CBI, associated wiring, and a connector for electrical connection to the generator set dc system. 400 hertz generator sets also include an expanded scale voltmeter and generator/bus selector switch, used for paralleling operations. Circuit breaker CB1 is electrically connected between the batteries and the START-RUN-STOP switch S2 in the dc system. It protects all control circuits energized from the batteries except those for the winterization heater and dc alternator. In the close position the pushbutton only shows black. When tripped, the button is extended and the white portion is visible.

### 6-41. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove dc circuit breaker box.

### 6-42. DISASSEMBLY.

Refer to figure 6-9 and disassemble dc circuit breaker box in the order of index numbers assigned. Pay particular attention to the following:

- a. Remove screws (1) and separate cover (6) and chassis (10) so that wires can be disconnected from circuit breaker (9) and expanded scale voltmeter (9G).
- b. Tag and disconnect electrical wiring from circuit breaker and voltmeter.

### 6-43. CLEANING.

Clean parts with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

### 6-44. INSPECTION.

Inspect dc circuit breaker box components as follows:

- a. Inspect sheet metal parts for dents, cracks, and distortion.
- b. Inspect connectors for bent, broken, and missing pins. Refer to table 6-2 and test wires and connectors for continuity, shorts to case and surrounding pins. Check terminal lugs for condition and security.
- c. Check circuit breaker automatic tripping with load application above 7.5 ampere.

### 6-45. REPAIR.

Repair defective wiring in accordance with table 6-2.

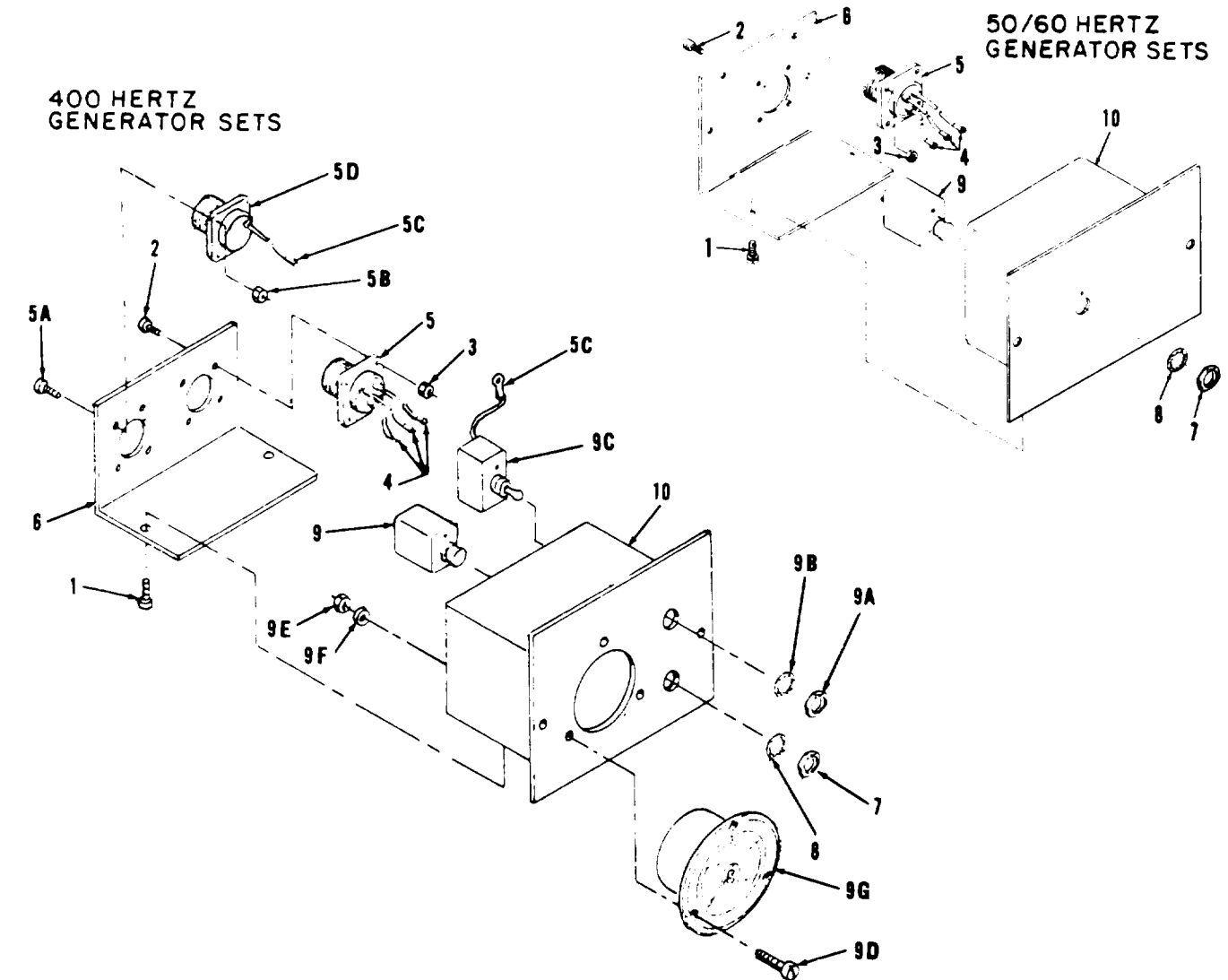
### 6-46. REASSEMBLY.

Refer to figure 6-9 and reassemble dc circuit breaker box in the reverse order of index numbers assigned. Pay particular attention to the following:

- a. Install connectors (5 and 5D) with keyway up.

### 6-47. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install DC circuit breaker box.



- |      |                               |      |                          |
|------|-------------------------------|------|--------------------------|
| 1.   | SCREW AND WASHER ASSEMBLY (4) | 8.   | WASHER                   |
| 2.   | SCREW AND WASHER ASSEMBLY (4) | 9.   | CIRCUIT BREAKER          |
| 3.   | NUT AND WASHER ASSEMBLY (4)   | *9A. | NUT                      |
| 4.   | TERMINAL LUG (3)              | *9B. | LOCK WASHER              |
| 5.   | CONNECTOR                     | *9C. | TOGGLE SWITCH            |
| *5A. | SCREW (4)                     | *9D. | SCREW (3)                |
| *5B. | NUT (4)                       | *9E. | NUT (3)                  |
| *5C. | TERMINAL LUG (2)              | *9F. | LOCK WASHER (3)          |
| *5D. | CONNECTOR                     | *9G. | EXPANDED SCALE VOLTMETER |
| 6.   | COVER                         | 10.  | CHASSIS ASSEMBLY         |
| 7.   | NUT                           |      |                          |

\*USED ONLY ON 400 HERTZ GENERATOR SETS.

Figure 6-9. DC circuit breaker box, exploded view



Table 6-2. Circuit Breaker Box Hookup Wire Data

WIRE INDENT. NO.	FROM	TERMINATION NOTE	TO	TERMINATION NOTE	WIRE LENGTH (INCHES)
P40	J39-A	1, 4, 6, 7	CB1-2	2	4
P141	J39-B	1, 4, 6, 7	CB1-1	2	4
P141	J39-C	1, 4, 6, 7	CB1-1	2	4
*X9	J70-C	1, 5, 6, 7	S10-1	1, 6, 7	6
*X12	J70-B	1, 5, 6, 7	M10-2	3	6
*X27	J70-A	1, 5, 6, 7	S10-3	1, 6, 7	6
*X28	M10-1	3, 5	S10-2	1, 6, 7	6

\*400 hertz generator sets only.

NOTES

- 1<sub>0</sub> Solder, use Federal Specification QQ-S-571, Sn 60.
2. Secure end with terminal lugs, MS25036-156.
3. Secure ends with terminal lugs, MS25036-154.
4. Wire is M5086/2-12-9 per MIL-W-5086.
5. Wire is M5086/2-16-9 per MIL-W-5086.
6. Use 5/8 inch long insulation tubing over each contact after soldering.
7. Insulation is TYPE F FORM Ua, GRADE A, CLASS 1, CAT. 1 per MIL-I-631.

### Section III. FAULT LOCATING INDICATOR BOX

#### 6-48. GENERAL.

The fault locating indicator box (A9) is a self-contained unit with solid state circuitry. On its front panel are ten red malfunction indicators, each for a specific fault, a one ampere fuse to protect against overload, and a two pole, two position, spring loaded switch. The function of the indicator box is to illuminate a particular malfunction indicator when one of the protective devices senses a malfunction and closes its malfunction signal contacts. This causes a dc signal to be impressed across a series parallel RC network for one of the ten SCR, silicon controlled rectifier, circuits in the fault locating indicator box (refer to figure 1-8). When the voltage across the capacitor is sufficient, the current to the gate of the SCR will be sufficient to trigger it. The particular indicator lamp in series with this SCR will be energized. Relay K1 is also energized and its normally closed contacts open to deenergize the fault signal input to the SCR. When the switch is momentarily positioned to TEST or RESET, the SCR will be turned off because its negative return from cathode is open. All indicator lamps will be energized, and relay K1 will stay energized. When the switch is released back to normal position, and if the fault is cleared, the indicator lights will de-energize and the circuit will be quiescent. If the malfunction is still present the SCR and indicator lamp for that particular malfunction will again energize. With no malfunction input and the switch momentarily positioned to TEST or RESET, all indicator lamps will energize. With its release again, all lamps will be de-energized and the circuit is again quiescent. The purpose of capacitor C 11 is to block

transient d. c. voltage and frequency chatter from causing a false malfunction indication.

#### 6-49. TEST ON EQUIPMENT.

a. Symptom and Isolation of Malfunction. A malfunction of the fault locating indicator box is usually the absence of a fault indication during a fault condition. Another malfunction is a false indication which cannot be reset when a no fault condition exists. To isolate the malfunctions proceed as follows :

#### NOTE

Refer to figures 1-8 and 1-9 for circuitry, and component layout and wiring.

#### 1. No Indication.

(a) Press the switch S1 to TEST OR RESET, all the indicator lights DS1 through DS10 should illuminate.

(b) Check for defective indicator lamp if one or two do not illuminate.

(c) If no lamp illuminates check fuse F1.

(d) If fuse F1 is not defective remove plug P12 and check pins A(+) and B(-) for 24 VDC.

(e) With the above requirements met and indicators not illuminating, check wiring to fault sensor. For example high coolant pins C-K on connector P12 with fault simulated should have continuity. Reconnect P12 and simulate a high coolant fault if indicator lamp DS7 does not illuminate, repair or replace the fault indicator box. Similar tests procedure will apply to remaining faults.



2. False Fault Indication Cannot Be Reset.

(a) Remove P12 and check for continuity from pin C to applicable pin of P12 for the circuit showing false indication. Open circuit should be indicated.

(b) If circuit is open, remove, repair or replace the fault indicator box.

b. Removal. To remove the fault locating indicator box (located adjacent to control cubicle), disconnect plug P12 from the receptacle connector (J12) in the rear wall of the box, then remove the four screws securing the box to the rear housing.

#### 6-50. TEST.

Connect the fault locator to test equipment as illustrated in figure 6-10 and perform test specified in procedural analysis table 6-3.

#### NOTE

Figure 1-8 is the fault locating indicator box schematic. Refer to this schematic when checking individual components for their required values or operating characteristics.

#### 6-51. DISASSEMBLY.

Refer to figure 6-11 and disassemble fault locating indicator box in the order of index numbers assigned. Pay particular attention to the following:

#### NOTE

Disassemble the fault locating indicator box only to the extent necessary to accomplish repair.

a. Remove cover (2) by removing screws (1).

b. Tag and disconnect wires of harness (19) from components.

#### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

c. Exercise care not to apply excessive heat when unsoldering components.

d. Remove relay (22) by removing screw (20) and lockwasher (21).

#### 6-52. CLEANING.

Clean all components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

#### 6-53. INSPECTION.

a. Harness.

1. Inspect harness wiring for defective insulation and continuity.

2. Inspect harness connector for damaged threads; bent, loose or missing pins and for shorts.

b. Electrical Components.

1. Check electrical components for opens, shorts, continuity, and proper values.

2. Check diodes for forward and reverse values. Measured from anode (+) to cathode (-) value should be low. Reverse leads, value should be infinity.

c. Printed Circuit Board.

1. Inspect printed circuit boards (component side) for damage, burns, discolored areas, and signs of overheating.

2. Inspect components for security.

3. Inspect circuits of printed circuit boards for breaks and damage.

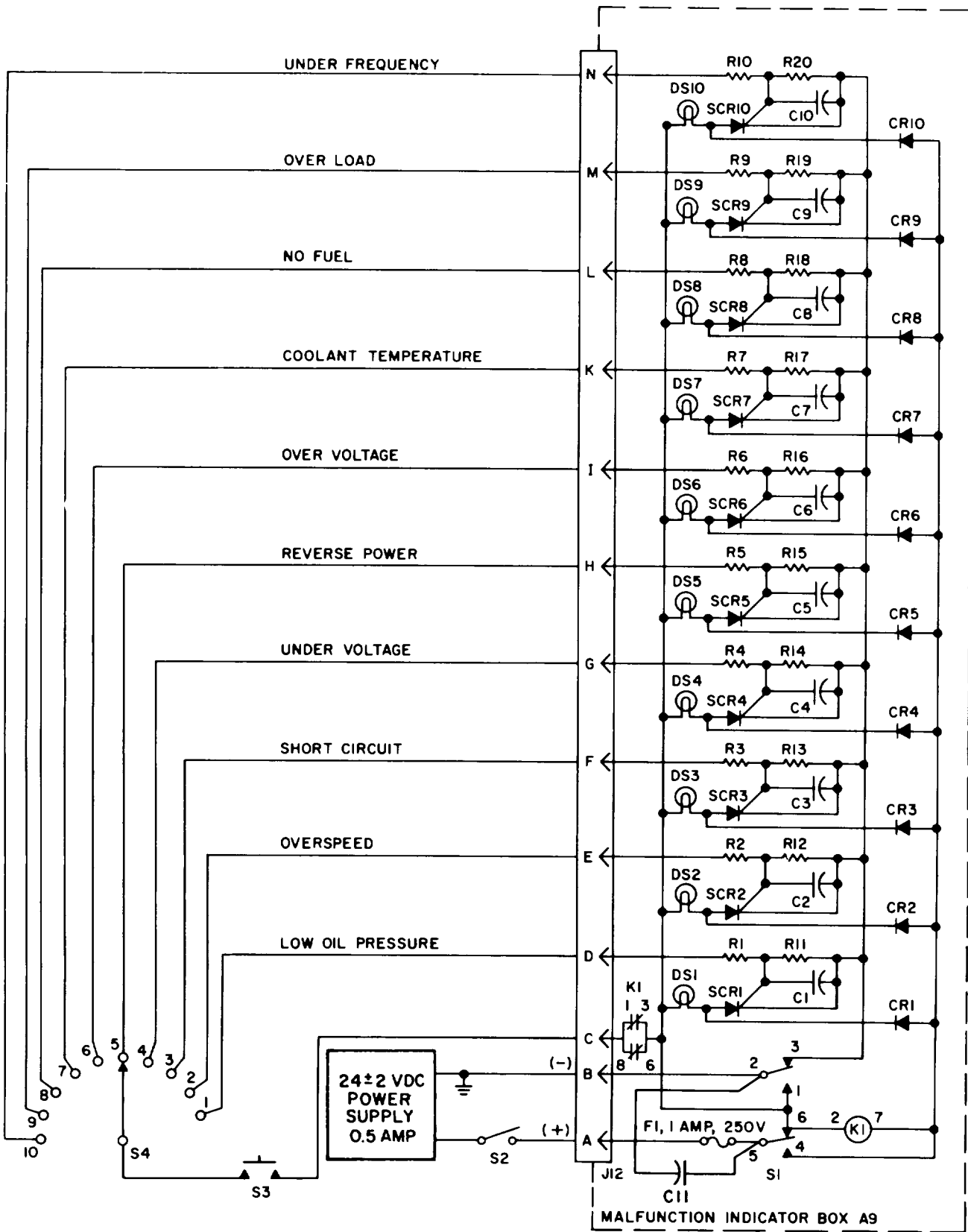


Figure 6-10. Fault locating indicator box (A9), test setup

Table 6-3. Fault Locating Indicator Box (A9) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
1.	With switch S2 open, energize the 24 vdc power supply. Close switch S2 and leave switch S1 in the normal spring maintained position.	None of the fault locator indicators should energize.	Shorted or defective switch S1 on fault locator box.  Shorted or defective silicon controlled rectifier SCR1 through SCR10.	Check continuity with ohmmeter between terminals 2 and 1, and 4 and 5 of switch S1. There should be no continuity.  Measure voltage at anode of SCR in particular indicator circuit which was energized. If voltage is less than 24 volts, the SCR is defective.
2.	Rotate switch S4 to position 1 and momentarily depress switch S3. Momentarily depress switch S1 to TEST OR RESET. Repeat this procedure for each position of switch S4.	The particular indicator (DS1 through DS10) for particular position of S4 should energize after momentarily depressing S3. It should then deenergize after momentarily depressing S1 to TEST OR RESET.	Defective switch S1.  Relay K1 contacts open or defective.  Defective components in gate bias circuit of particular SCR circuit.	Check continuity of switch.  Check relay K1 in accordance with figure 6-5.  Check applicable resistors R1 through R20, and capacitors C1 through C10.

Table 6-3. Fault Locating Indicator Box (A9) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE OR IMPROPER RESULT	CHECK OUT PROCEDURE
2. (cont)	Rotate switch S4 to position 1 and momentarily depress switch S3. Momentarily depress switch S1 to TEST OR RESET. Repeat this procedure for each position of switch S4. (continued)	The particular indicator (DS1 through DS10) for particular position of S4 should energize after momentarily depressing S3. It should then deenergize after momentarily depressing S1 to TEST OR RESET (continued)	Defective silicon controlled rectifier (SCR1 through SCR10).  Defective indicator lamp (DS1 through DS10).  Fuse F1 is defective.	Measure voltage across anode and cathode of particular SCR for indicator circuit that had improper test results with S3 depressed and held. If voltage is 24 vdc, and gate to cathode voltage is present (approx. 1 vdc), SCR is defective.  Check lamps by applying 24 vdc.  Check continuity of fuse.
3.	Position switch S1 to TEST OR RESET and hold	All of the indicator lights DS1 through DS10 should be energized when S1 is held to TEST OR RESET.	Defective indicator lamps.  Defective switch S1.  Defective diodes CR1 through CR10.	Check lamps.  Check continuity of switch S1.  Check diodes by measuring voltage across diode while S1 is in TEST OR RESET position. The voltage should be less than 1 vdc.

4. Inspect base of printed circuit board for cracks, warping, burned or discolored areas and illegible stenciling.

- d. Inspect sheet metal parts for bent corners, distortion, cracks, tears and dents.
- e. Check terminal lugs for security and condition.
- f. Inspect relay socket for damage, shorts to case, and surrounding pins.
- g. Inspect for damaged indicator lenses.
- h. Check fuse for continuity.

6-54. REPAIR.

- a. Repair or fabricate fault locating indicator box wiring harness according to figure 6-12.
- b. Repair or fabricate fault locating indicator box heating wire in accordance with table 6-4.
- c. Replace indicator lenses, if cracked.
- d. Replace fuse if defective.
- e. When replacing feed thru terminals, swage in place.
- f. Repair printed circuit board as follows:
  - 1. Restencil all illegible reference designations.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

CAUTION

- Prolonged use of soldering equipment could cause damage to components due to excessive heat.
- 2. Repair printed circuits by soldering a jumper wire across defective area.
  - 3. Replace all defective components.
  - 4. Solder replacement components on the printed circuit boards using solder conforming to Federal Specification QQ-S-571 Sn 60.

WARNING

Insulating Compound, MIL-I-46058 is flammable and slightly toxic to eyes, skin and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

5. Solder joints and/or component leads must not project more than 0.094 inch beyond surface of board.

6. After replacement of components on the printed circuit boards, coat the boards with protective coating, conforming to Military Specification MIL-I-46058, grade S, type PUR, 0.005 minimum thickness. Air bubbles should be prevented during coating so that legibility of identification or information markings are not impaired. The coating shall be applied so that it anchors the components to the board. Terminals utilized for connection to external circuits shall not be coated.

g. Straighten dented or distorted sheet metal parts using proper tools. Blend in repaired area with suitable abrasive paper. Prime and touch up damaged painted surfaces.

6-55. REASSEMBLY.

Refer to figure 6-11 and reassemble fault locating indicator box in the reverse order of index numbers assigned. Pay particular attention to the following:

NOTE

Mount connector (J12) with keyway in top position.

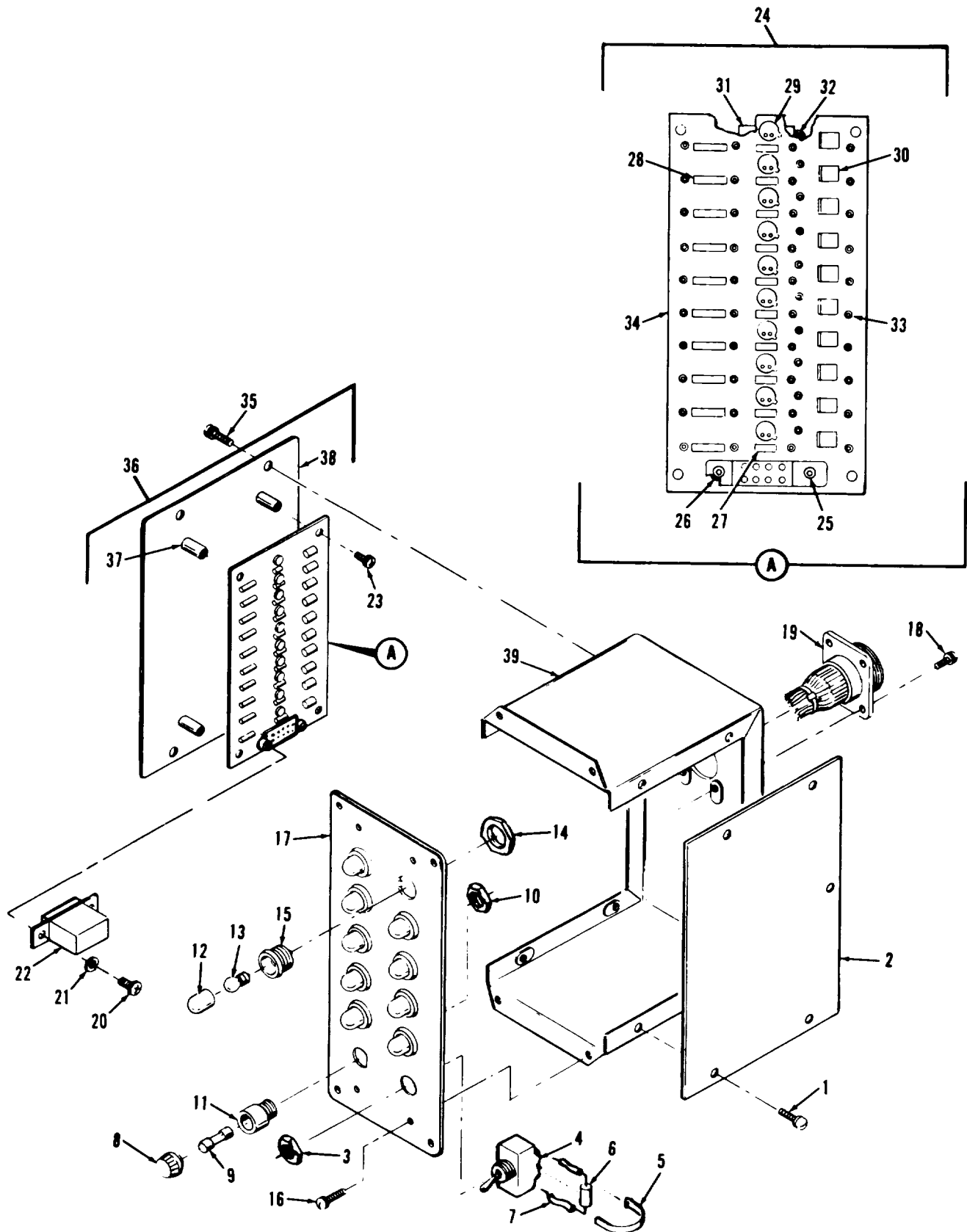


Figure 6-11. Fault locating indicator box, exploded view

Legend to figure 6-11:

- |                                  |                                       |
|----------------------------------|---------------------------------------|
| 1. Screw (5)                     | 21. Washer (2)                        |
| 2. Cover                         | 22. Relay                             |
| 3. Nut                           | 23. Screw (4)                         |
| 4. Toggle switch                 | 24. Fault indicator component board   |
| 5. Strap (2)                     | 25. Relay socket                      |
| 6. Capacitor                     | 26. Standoff                          |
| 7. Insulation (2)                | 27. Resistor (10)                     |
| 8. Fuse cap                      | 28. Resistor (10)                     |
| 9. Fuse                          | 29. Silicon controlled rectifier (10) |
| 10. Nut                          | 30. Silicon rectifier (10)            |
| 11. Fuseholder                   | 31. Capacitor (10)                    |
| 12. Indicator lenses (10)        | 32. Insulation                        |
| 13. Incandescent lamp (10)       | 33. Terminal stud (50)                |
| 14. Nut (10)                     | 34. Board                             |
| 15. Light indicator housing (10) | 35. Screw (4)                         |
| 16. Screw (4)                    | 36. Bottom plate                      |
| 17. Fault indicator panel        | 37. Standoff (4)                      |
| 18. Screw (4)                    | 38. Plate                             |
| 19. Wiring harness               | 39. Chassis                           |
| 20. Screw (2)                    |                                       |

a. Connect hookup wires and wires of harness to components. Refer to tables 6-4 and figures 6-12 and 1-9 for proper connection.

b. Exercise care not to apply excessive heat to components when soldering connections.

c. Install relay (22, figure 6-11) in relay socket (25) squarely so as not to damage pins.

d. Test fault locating indicator box as specified in paragraph 6-50.

e. Install cover (2) by installing screws (1).

#### 6-56. INSTALLATION.

Install the fault locating indicator box in the rear housing and secure in position with four screws. Connect plug P12 to receptacle connector J12 located in the rear wall of the box.

Table 6-4. Fault Locating Indicator (A9) Hook Up Wire Data

COLOR	WIRE	WIRE LENGTH INCHES	FROM	TO
WHT	27	1-1/2	S1-1	S1-6
WHT	28	2-1/2	S1-6	XDS6
WHT	29	1-1/4	XDS6	XDS10
WHT	30	1-1/4	XDS10	XDS9
WHT	31	1-1/4	XDS9	XDS8
WHT	32	1-1/4	XDS8	XDS7
WHT	33	1-1/4	XDS7	XDS1
WHT	34	1-1/4	XDS1	XDS2
WHT	35	1-1/4	XDS2	XDS3
WHT	36	1-1/4	XDS3	XDS4
WHT	37	1-1/4	XDS4	XDS5
WHT	38	3/4	S1-5	XF1
WHT	39	3/4	XK1-8	XK1-1
WHT	40	1	XK1-6	XK1-2
WHT	41	1/2	XK1-3	XK1-2
WHT	42	1-1/2	XK1-7	TB1-50

NOTES

1. Solder. Use Federal Specification QQ-S-571, Sn 60.
2. Wire is in accordance with MIL-STD-454, requirement 20.
3. Use wire conforming to MIL-W-16878, Type 22 black or white.
4. Protect capacitor C11 leads using insulated sleeving.



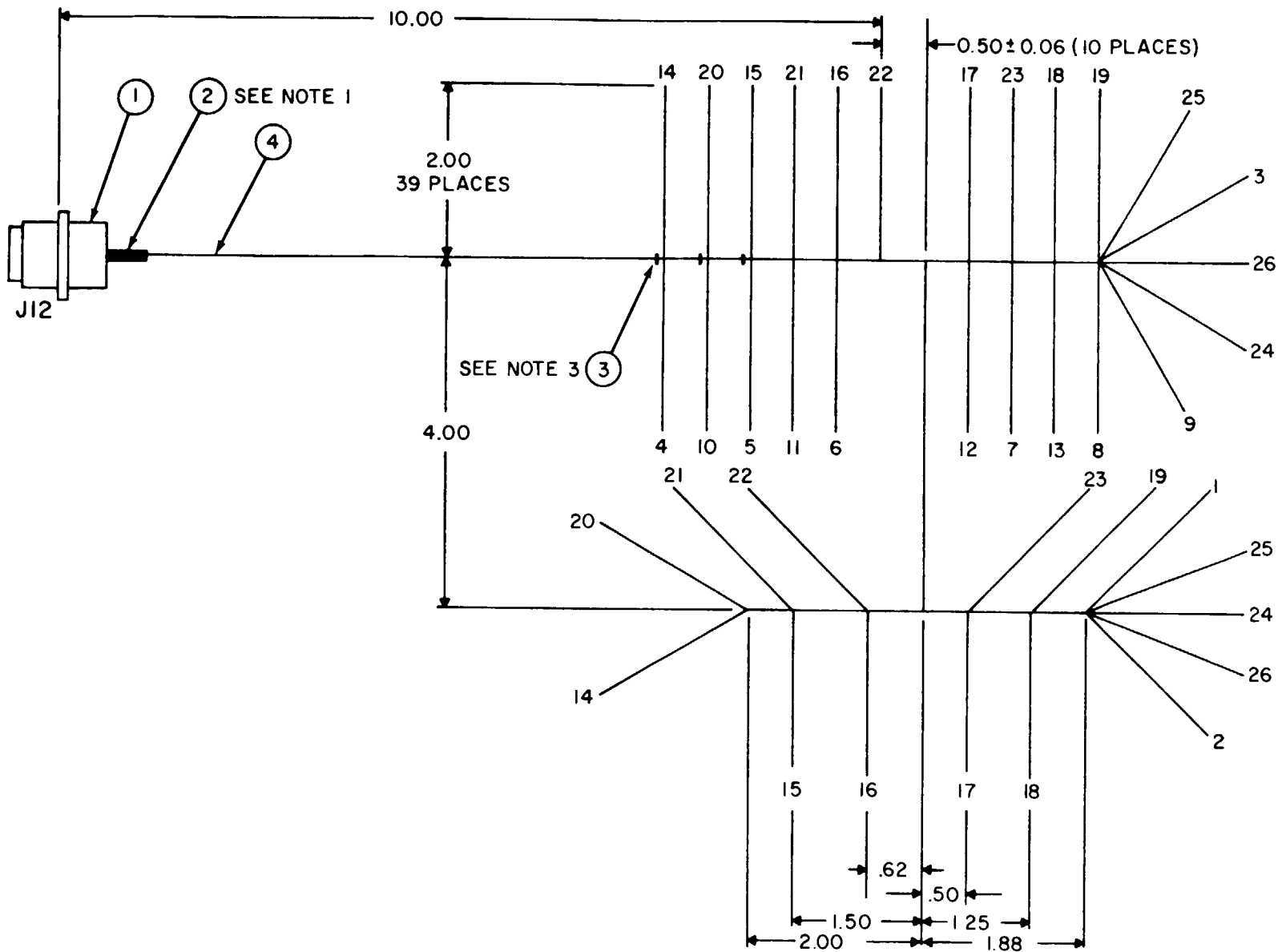


Figure 6-12. Fault locating indicating box wiring harness (Sheet 1 of 2)

WIRE NO.	TERMINATION			WIRE FIND NO.
	FROM	FIND NO.	TO	
1	J12-A	1	XF1	4
2	J12-B	1	SI-2	4
3	J12-C	1	XX1-1	4
4	J12-D	1	TB1-1	4
5	J12-E	1	TB1-3	4
6	J12-F	1	TB1-5	4
7	J12-G	1	TB1-7	4
8	J12-H	1	TB1-9	4
9	J12-I	1	TB1-10	4
10	J12-K	1	TB1-2	4
11	J12-L	1	TB1-4	4
12	J12-M	1	TB1-6	4
13	J12-N	1	TB1-8	4
14	XDS1	-	TB1-21	4
15	XDS2	-	TB1-25	4
16	XDS3	-	TB1-29	4
17	XDS4	-	TB1-33	4
18	XDS5	-	TB1-37	4
19	XDS6	-	TB1-39	4
20	XDS7	-	TB1-23	4
21	XDS8	-	TB1-27	4
22	XDS9	-	TB1-31	4
23	XDS10	-	TB1-35	4
24	SI-6	-	XX1-3	4
25	SI-3	-	TB1-40	4
26	SI-4	-	TB1-50	4

NOTES:

1. AFTER SOLDERING, INSTALL INSULATION. FIND NO. 2, .62 LONG, OVER EACH CONTACT OF CONNECTOR, FIND NO. 1.
2. EACH WIRE NOT TERMINATING AT FIND NO. 1 SHALL BE STRIPPED .25+ .06 INCH AND TINNED.
3. INSTALL STRAPS, FIND NO. 3 AT APPROXIMATELY ONE INCH INTERVALS AND AT EACH WIRE BREAKOUT (25 MINIMUM).
4. OPTIONAL WIRING: ALL WIRES MAY BE WHITE INSTEAD OF COLOR CODED.
5. MARK WIRES WITH WIRE NO. 5 (SEE TABLE) AT INTERVALS OF 3 INCHES.

4	*		TYPE-E-22	AR	WIRE. ELEC. INSULATED HIGH TEMP. 600 V. NO. 22 AWG SIZE (302 IN.)	MIL-W-16878 4	
3	*		MS 17821-1-9	AR	STRAP. CABLE. ADJUSTABLE		SEE NOTE 3
2	*		TYPE-F, FORM Ua, GRADE-a, CLASS I CATEGORY 1	AR	INSULATION. ELECTRICAL	MIL-I-631	
1		B	69-502-7	1	CONNECTOR. RECEPTACLE		
FIND NO.	SYM	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
LIST OF MATERIAL							

Figure 6-12. Fault locating indicating box wiring harness (Sheet 2 of 2)

#### Section IV. CONVENIENCE RECEPTACLE ASSEMBLY

##### 6-57. GENERAL.

The 50/60 hertz convenience receptacle assembly (A22) contains a 125 volt, 15 ampere duplex receptacle, while the 400 hertz type contains a 125 volt, 15 ampere receptacle and a 125/250 volt, 30 ampere receptacle. Each receptacle has a spring-loaded weatherproof cover. Both types have their receptacles connected in parallel electrically, and have their receptacles protected by a 15 ampere circuit breaker.

##### 6-58. 50/60 HERTZ CONVENIENCE RECEPTACLE ASSEMBLY.

6-59. REMOVAL, To remove the assembly (located below the control cubicle), disconnect plug P48 from the receptacle connector J48 in the rear of the assembly, then remove the six screws and lockwashers securing the assembly to the rear housing.

6-60. DISASSEMBLY. Refer to figure 6-13 and disassemble the 50/60 hertz convenience receptacle assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Remove six screw assemblies (1) and separate the cover (9) from the housing (24).

b. Tag and disconnect wires from connector (4) circuit breaker (20) and the duplex receptacle (17).

6-61. CLEANING. Clean all components with a lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

##### 6-62. INSPECTION.

a. Inspect connectors for bent, broken and missing pins. Refer to table 6-5, and check wires for continuity, shorts to case and surrounding pins.

b. Check terminal lugs and soldered connections for condition and security.

c. Check circuit breakers and receptacles for continuity.

d. Inspect sheet metal parts for dents, cracks, and distortion.

##### 6-63. REPAIR.

a. Repair defective wiring in accordance with table 6-5.

b. Straighten dented or distorted sheet metal parts using proper tools.

6-64. REASSEMBLY. Refer to figure 6-13 and reassemble 50/60 hertz electronic component assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Connect wires in accordance with table 6-5.

b. Install connector plug (4) with keyway up.

6-65. INSTALLATION. Install the 50/60 hertz convenience receptacle assembly in the rear housing and secure in position with six screws and lockwashers. Connect plug P48 to connector J48 in the rear of the assembly.

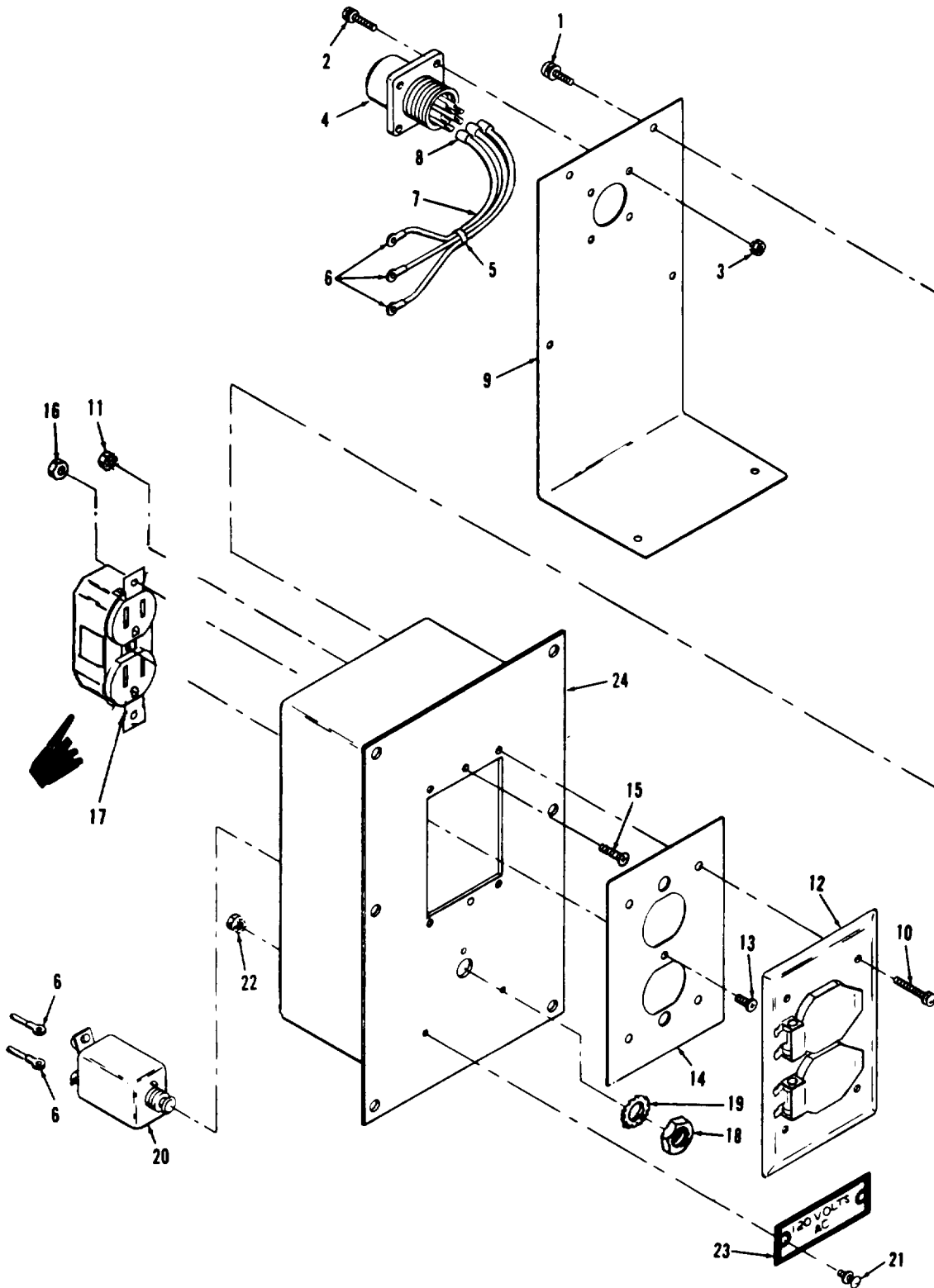


Figure 6-13. 50/60 hertz convenience receptacle assembly, exploded view

Legend to figure 6-13:

- |                        |                          |
|------------------------|--------------------------|
| 1. Screw assembly (6)  | 13. Screw (2)            |
| 2. Screw assembly (4)  | 14. Gasket               |
| 3. Nut assembly (4)    | 15. Screw assembly (2)   |
| 4. Connector           | 16. Screw assembly (2)   |
| 5. Cable strap         | 17. Duplex receptacle    |
| 6. Terminal lug        | 18. Nut                  |
| 7. Wire (5)            | 19. Lock washer          |
| 8. Insulating tubing   | 20. Circuit breaker      |
| 9. Cover               | 21. screw (2)            |
| 10. Screw assembly (4) | 22. Nut (2)              |
| 11. Nut assembly (4)   | 23. Identification plate |
| 12. Cover              | 24. Housing              |

6-66. 400 HERTZ CONVENIENCE  
RECEPTACLE ASSEMBLY.

6-67. REMOVAL. To remove the assembly (located below the control cubicle), disconnect plug P48 from the receptacle connector J48 in the rear of the assembly, then remove the six screws and lockwashers securing the assembly to the rear housing.

6-68. DISASSEMBLY. Refer to figure 6-14 and disassemble the 400 hertz convenience receptacle assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Remove six screw assemblies (1) and separate the cover (5) from the housing (26).

b. Tag and disconnect wires from connector (4), circuit breaker (22), and receptacles (13 and 19).

6-69. CLEANING. Clean all components with a clean lint-free cloth moistened in an

approved cleaning solvent and dry thoroughly.

6-70. INSPECTION.

a. Inspect connectors for bent, broken and missing pins. Refer to table 6-6, and test wires for continuity, shorts to case and surrounding pins.

b. Check terminal lugs and soldered connections for condition and security.

c. Check circuit breakers and receptacles for continuity.

d. Inspect sheet metal parts for dents, cracks, and distortion.

6-71. REPAIR.

a. Repair defective wiring in accordance with table 6-6.

b. Straighten dented or distorted sheet metal parts using proper tools.

Table 6-5. 50/60 Hertz Convenience Receptacle Assembly

WIRE IDENT NO.	FROM	TERMINATION NOTE	TO	WIRE LENGTH (INCHES)	TERMINATION NOTE	COLOR IDENT
X9JJ12	J48-B	2	CB3-1	7	3	Black
X12NN12	J48-C	2	J55-2	12	3	Black
JUMPER No. 1	J55-1	3	CB3-1	6	3	None
G1A12	J55-3	3	GROUND LUG	11	3	Black

NOTES

1. Marking of wire numbers shall be in accordance with Military Specification MIL-W-5088.
2. Solder, using Federal Specification QQ-S-571, Sn 60.
3. Secure ends with terminal lugs, MS25036-156.
4. Strip all wires 0.38 inch.
5. Wire is M5086/2-12-9 per MIL-N-5086.
6. Use 5/8 inch long insulation tubing over each contact after soldering.
7. Insulation is TYPE F FORM Ua, GRADE A, CLASS 1, CATA-1 per MIL-I-631.
8. Cable straps MS3367-4-9 are to be installed at 3 inch intervals to form harness.

Table 6-6. 400 Hertz Convenience Receptacle Assembly

WIRE IDENT NO.	FROM	TERMINATION NOTE	TO	WIRE LENGTH (INCHES)	TERMINATION NOTE	COLOR IDENT
X12NN16	J48-C	3	J55-1	18	4	'Black
X9JJ16	J48-B	3	CB3-2	14	4	Black
JUMPER NO. 1	J55-1	4	J56-RED	6	2	None
X24A12	J55-2	4	CB3-1	8	4	Black
JUMPER NO. 2	J56-BLK	2	CB3-1	6	4	None
JUMPER NO. 3	J55-3	4	J56-W	6	2	None
G1A16	J55-3	4	GROUND LUG	9	4	Black

NOTES

1. Marking of wire numbers shall be in accordance with Military Specification MIL-W-5088.
2. Strip all wires back 0.38 inches.
3. Solder, use Federal Specification QQ-S-571 Sn 60.
4. Secure end with terminal lubs, MS25036-156.
5. Wire is M5086/2-12-9 per MIL-N-5086.
6. Use 5/8 inch long insulation tubing over each contact after soldering.
7. Insulation is TYPE F FORM Ua, GRADE A, CLASS 1, CATA-1 per MIL-I-631.
8. Cable straps MS3367-4-9 are to be installed at 3 inch intervals to form harness.

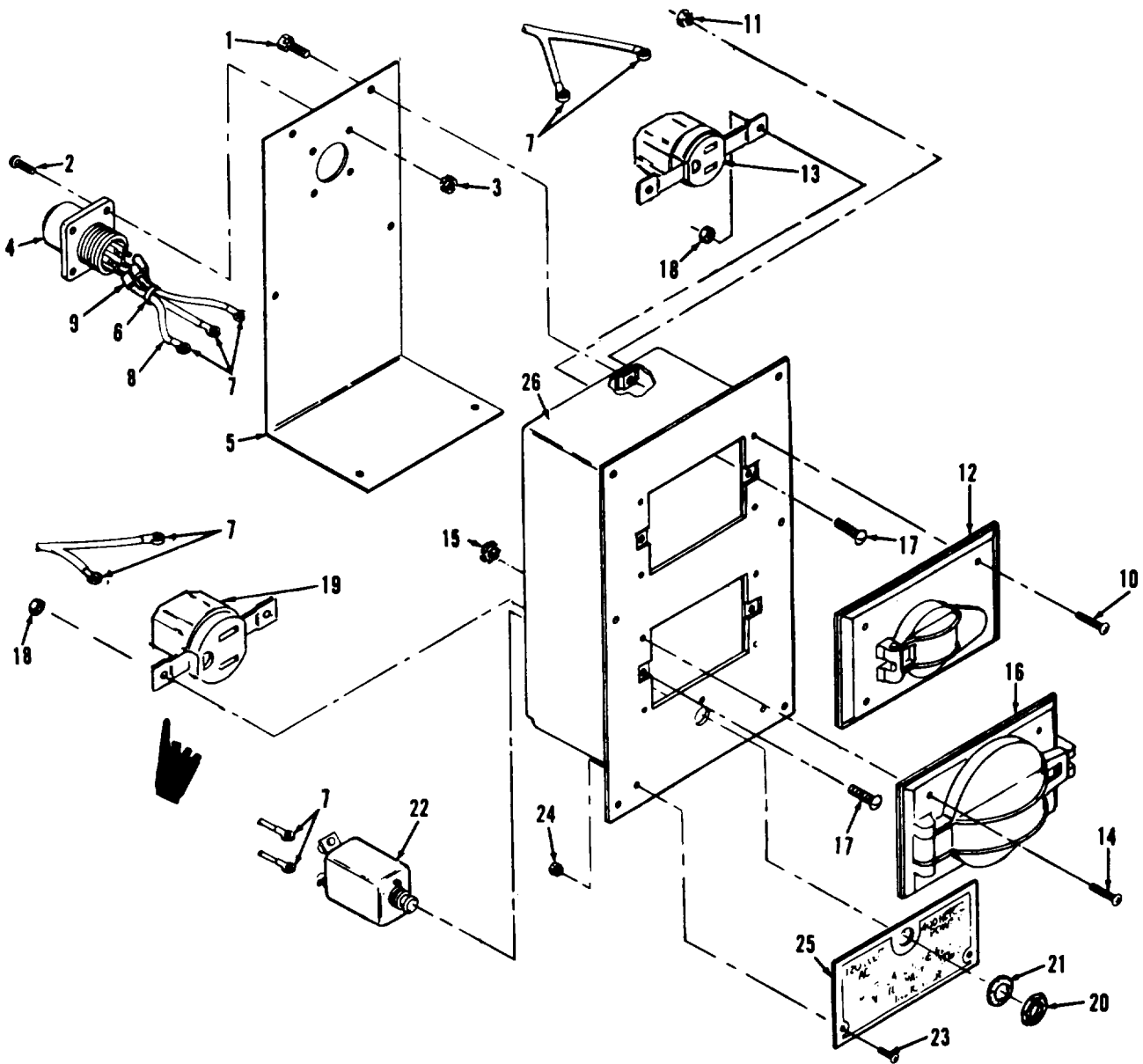


Figure 6-14. 400 hertz convenience receptacle assembly, exploded view

Legend to figure 6-14:

- |                       |                                   |                                   |
|-----------------------|-----------------------------------|-----------------------------------|
| 1. Screw assembly (6) | 11. Nut (4)                       | 19. Single receptacle (30 ampere) |
| 2. Screw assembly (4) | 12. Cover gasket                  | 20. Nut                           |
| 3. Nut assembly (4)   | 13. Single receptacle (15 ampere) | 21. Lock washer                   |
| 4. Connector          | 14. Screw assembly (4)            | 22. Circuit breaker               |
| 5. Cover              | 15. Nut assembly (4)              | 23. Screw assembly (2)            |
| 6. Cable strap (4)    | 16. Cover                         | 24. Nut assembly (2)              |
| 7. Terminal lug (9)   | 17. Nut assembly (4)              | 25. Identification plate          |
| 8. Wire (9)           | 18. Screw assembly (4)            | 26. Housing                       |
| 9. Insulation tubing  |                                   |                                   |
| 10. Screw (4)         |                                   |                                   |



6-72. REASSEMBLY, Refer to figure 6-14 and reassemble 400 hertz electronic component assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Connect wires in accordance with table 6-6.

b. Install connector (4) with keyway up.

6-73. INSTALLATION. Install the 400 hertz convenience receptacle assembly in the rear housing and secure in position with six screws and lock washers. Connect plug P48 to connector J48 in the rear of the assembly.

## Section V. EXCITER-REGULATOR

### 6-74. GENERAL.

a. The exciter All, (figures 1-11 and 1-13) and voltage regulator A 10 operate as integral components of the excitation system. The excitation system energizes the main rotor field coils of the generator and regulates the magnitude of the magnetic field thus produced so as to maintain a constant voltage output from the stator of the generator under all rated load conditions.

b. The excitation system is comprised of a dynamic exciter, a static exciter assembly, a voltage regulator assembly, current transformers and a cross current compensation network to permit parallel operation of two or more generator sets.

1. The static exciter and voltage regulator are electronic assemblies packaged in a single enclosure and mounted outside the generator housing.

2. The dynamic exciter consists of a field coil stator integral with the generator housing, a set of rotor coils and solid state rectifiers mounted on the generator shaft. The static exciter energizes the field coils of the dynamic exciter. The resultant field couples with the rotor coils of the exciter. The induced currents are

rectified and then fed to the coils of the generator rotor, the fields of which induce the output currents in the coils of the generator stator. Brushes or slip rings are not required. The disposition of the rotors and stators of both the dynamic exciter and the generator including the rectifier ring are shown in figure 7-1.

c. The exciter-regulator circuitry is illustrated in figures 1-10 and 1-12. The assembly operates as follows:

1. The regulated exciter field voltage at pins S-R of connector J13 is obtained by means of saturable core transformer T 1. The inductance of this transformer can be varied with the control winding 5-7 so that the voltage ratio between the windings 1-2 and 3-4 may be increased or decreased in proportion to the direct current flowing in the winding 5-7. When the magnitude of the control current increases the inductance decreases and there is a lowered magnetic coupling between the windings which carry the alternating currents, hence a lowered voltage output. The reverse occurs when the control current is decreased.

2. The input at J-K of connector J13 derives from current transformers

CT4, CT5, CT6, on the load lines of the generator (figures 1-4 and 1-5). The voltage at L-M of connector J13 is from phase C (T9 - T12 on generator). The two inputs are combined by T1 (figures 1-24 and 1-26) under control of winding 5-7, then rectified by bridge CR1 through CR4 and fed to the exciter field stator winding from S-R of connector J13. In the event of a short circuit, the voltage at L-M can drop to zero but there is a high voltage at J-K from the current transformers so that the exciter provides sufficient field for the generator output to actuate the protective devices to shut down the set.

3. The voltage at S-R of connector J13 is compared to the reference voltage at Q1 (located in voltage regulator A10) and Zener diode VR1 of the differential amplifier Q1 - Q2. Any difference or error signal at the collector of Q2 is amplified by Q5 - Q6 and Q3 - Q4 and then fed to the control winding 5-7 of the control transformer T1 which increases or decreases the exciter field coil current to reduce the error signal to zero thereby maintaining the output of the generator set within the range as preset by R33. The networks R31-C1 and R32-C3 are utilized for phase shift compensation. If hunting is present, adjustment of R32 will provide the proper amount of feedback to eliminate the hunting. Adjustment of R31 will smooth and improve the transient response.

4. The voltage at pins A-B of connector J9 is derived from phase C (T9 - T12 on generator) through the operators voltage adjust rheostat and from the cross current compensation network (figures 1-4 and 1-5) when two or more generator sets are connected in parallel. This voltage is stepped down in transformer T5, rectified by bridge CR12 - 15, filtered by R16, R22, C2, C5 and fed to the reference side of the differential amplifier Q1- Q2.

5. The generator output voltage is determined by the level of the reference voltage and is controlled by the setting of R33 which adjusts the range voltage and operators rheostat (R2, figures 1-4 and 1-5 ) which sets the actual output. During parallel operation, the reference voltage is dependent on the cross current compensation network. For example, if one generator draws more current, the network will increase the magnitude of the reference voltage causing the voltage regulator to sense more voltage and thereby causing a decrease in current to the exciter field stator winding. This provided parallel operation with droop.

6. Power for the transistor amplifiers and the control winding (5-7 of T1) current is obtained from pins L-M of connector J13 thru stepdown transformer T4 and bridge rectifier CR8 through CR11. Diode CR17 and resistor R21 provide positive feedback to the amplifiers to enhance the gain.

7. When the start switch of the generator set is actuated, 24 volts D. C. is applied to the exciter field stator windings at pins S-R of connector J13 thru the limiting resistor R17A, R17B and isolation diode CR16 from input pins C-D of connector J11 (field flashing). The purpose is to quickly build up the magnetic field in the main rotor windings to produce an immediate output from the generator. The flashing voltage is then automatically removed.

#### 6-75. TEST AND REMOVAL.

a. Symptom and Isolation of Malfunction. A malfunction of the voltage regulator section (A10) is usually indicated by a high generator output voltage with no control. A malfunction of the exciter section (A11) is usually indicated by no generator output or by low output voltage when the load is

applied. To isolate the malfunction proceed as follows:

**WARNING**

Exercise extreme care not to touch electrical connections when working on the exciter-regulator assembly with the generator set operating.

**NOTE**

Remove cover from exciter regulator to gain access to test points, see figure 6-15.

1. With the generator set operating at rated speed, measure the voltage across (A10)TB1-7 and (A10)TB1-8 (nominal voltage is 105 VAC). Refer to figures 1-10 and 1-12. If sensing voltage at TB1-7 and TB1-8 is normal measure voltage across (A10)TB2-6 and (A10)TB2-7, minimum voltage should be 50 VAC.

(a) If there is no voltage at TB2-6 and TB2-7 measure voltage across (A11)TB2-2 and (A11)TB2-3 which is the generator coil voltage (T9-T12). Shut down generator set if voltages are normal.

(b) Measure for continuity from plug P11 pin H to plug P11 pin G, the reading should be 21 ohms. Pins G, and H of J11 should read 13 ohms, observe polarity.

(c) If circuit is open replace exciter (A11). If all readings are normal, replace regulator (A10).

2. To check exciter regulator performance when there is no generator output voltage, connect a dc voltmeter (0-50 volt scale) across resistor (A11)R17 and observe for field flashing voltage when generator set is started.



Figure 6-15. Location of exciter regulator and mode I, mode II, precise and tactical relay assemblies

(a) If flashing voltage is observed connect an ac voltmeter (0-150 volt scale) across choke (A11)L1 and observe for ac voltage when the field is flashed.

(b) If voltage is observed across choke but the generator output voltage does not build up, shut down generator set and check for shorted diode CR1, CR2, CR3, or CR4. If diodes are shorted, replace the exciter.

(c) If diodes checkout, disconnect wires U135C16 and U134C16 from (A11)TB1-2 and TB1-3, connect wires together.

(d) Start generator set; if voltage builds up check for short circuit in booster transformers CT4, CT5, or CT6, refer to figures 1-4 and 1-5. Check transformer wiring.

(e) If voltage doesn't build up, transformer (A11)T1 is defective.

3. To inspect for the cause of low output voltage when the generator set is under load, shut down generator set and check for an open diode (A11)CR1, CR2, CR3, or CR4. If defective, replace the exciter assembly.

(a) If diodes are not defective, connect ac ammeter (0-25 amp scale) in series with wire from TB1-6 and TB1-6 terminal and measure current from the booster transformers CT4, CT5 or CT6.

(b) With the generator set under full rated load, the reading should be  $14 \pm 2$  amps. A low reading indicates an open current transformer (CT4, CT5, or CT6).

(c) If voltage reading is normal, connect a dc ammeter (0-25 amp) in series with the exciter field and a dc voltmeter (0-30 volt scale) across (A11)TB1-5(+) and (A11)TB1-6.

(d) Start the generator set and measure exciter field voltage and current under full rated load. The reading should be  $10 \pm 2$  volts dc at 6 to 8 amps for 50/60 hz units, and  $22 \pm 4$  volts dc at 14 to 16 amps for 400 hz units.

(e) If readings are low, replace exciter-regulator. If readings are normal or high, test generator diodes for an open condition.

b. Removal. Disconnect plug P13 and P9 from the exciter regulator, then remove the four screws and nuts securing the assembly in position. See figure 6-15.

#### 6-76. TEST.

a. Connect the exciter-regulator to test equipment as illustrated in figure 6-16 and perform test specified in procedural analysis table 6-7.

#### NOTE

Figures 1-10 and 1-12 are the exciter-regulator schematics. Refer to these schematics when checking individual components for their required values or operating characteristics.

b. Remove test equipment.

#### 6-77. DISASSEMBLY.

Refer to figure 6-17 and disassemble the exciter regulator in the order of index numbers assigned. Pay particular attention to the following:

#### NOTE

The exciter-regulator assembly should be tested prior to disassembly as specified in paragraph 6-76. Disassemble the exciter-regulator assembly to the extent necessary to accomplish repair.

a. Remove cover (2, figure 6-17) by removing eight screw assemblies (1).

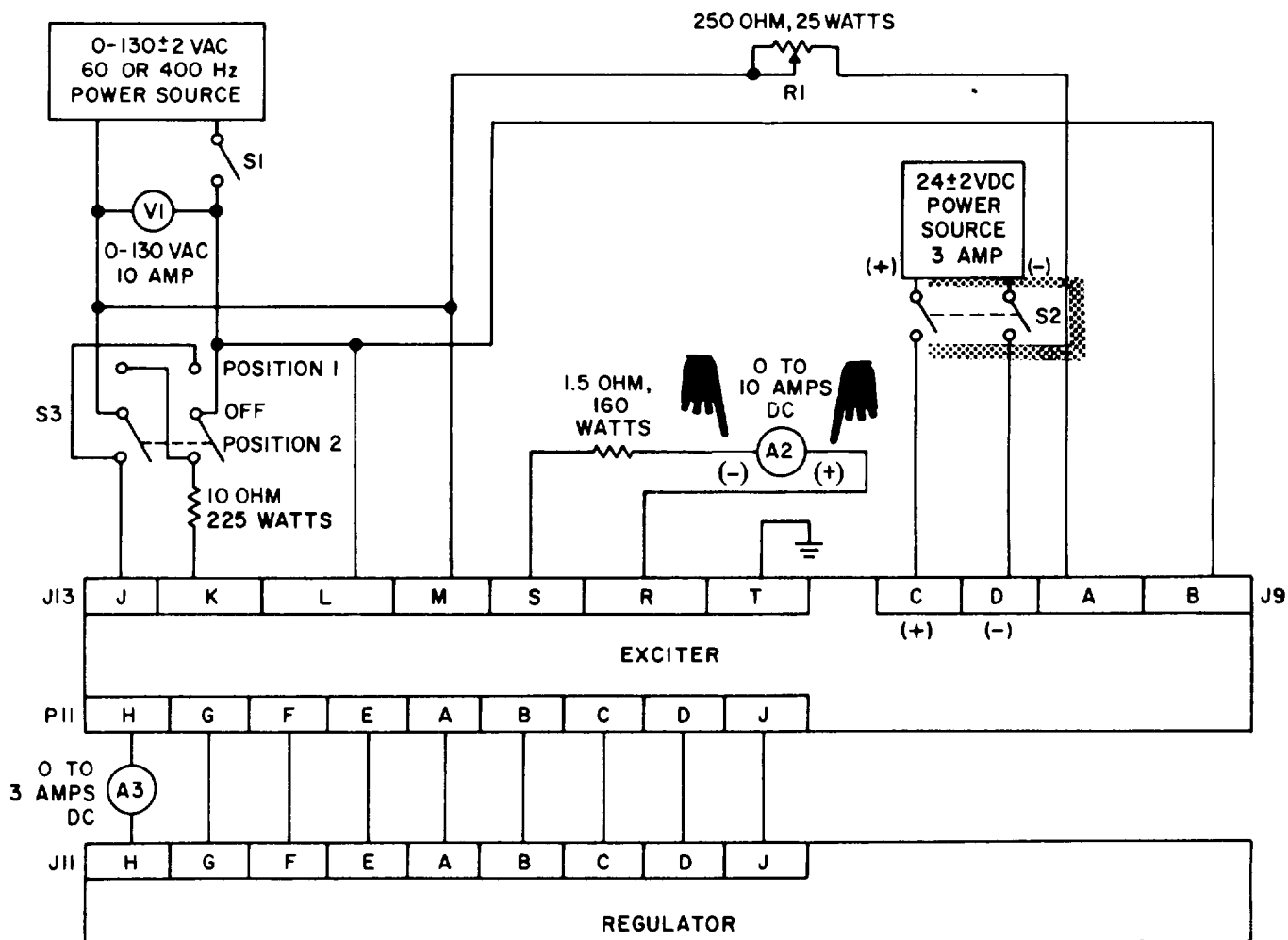


Figure 6-16. Exciter regulator (A10, A11) test setup

Table 6-7. Exciter-Regulator (A10-A11) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
1.	Connect the static exciter-regulator to the test equipment depicted in figure 6-16 and open all switches.	(make certain that regulator board is properly connected to static exciter).	(Refer to Schematic Diagram Figures 1-10 and 1-12)	
2.	Energize the 24 VDC power source, while slowly adjusting the current output of the power source from zero until a reading of 1 amp is observed on Ammeter A2.	Ammeter A2 should indicate approximately 1 ampere.	Defective component in field flashing circuit.	Check resistors R17A, R17B, diode CR16, bridge CR1-4 and continuity of T1 winding 3-4.
3.	Open switch S2. Energize 60 Hz/400 Hz power source, close switch S1 and adjust so V1 reads 120 volts. Adjust R1 so that A3 reads 0.	A2 should read $4.8 \pm 10\%$ amps for 50/60 Hz unit, 6.5 to 9.5 amp for 400 Hz unit.	Open reactor L1. Defective transformer T1. Shorted diode in bridge CR1-4. Shorted capacitor C1. See step 9.	Make continuity check of L1 and T1. Check all diodes in CR1-4. Check C1. Replace where necessary. See step 9.
4.	Readjust R1 so that A3 reads 1.9 amperes.	A2 should read approximately .45 amp for 50/60 Hz unit, 1.8 to 2.0 amp for 400 Hz unit.	Shorted CR-7. Defective bridge CR1-4, L1, T1, shorted C3. See step 10.	See step 10. Check CR-7, CR1-4, L1, T1, C3. Replace where necessary.

Table 6-7. Exciter-Regulator (A10-A11) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
5.	Readjust R1 so that A3 reads zero then put switch S3 in position 1.	A2 should increase over reading in step 3 to $9.9 \pm 10\%$ amp for 50/60 Hz unit, 9.2 to 11.5 amp for 400 Hz unit.	Leads to J and K on connector J13 reversed.	Recheck step 3.
6.	Set switch S3 in position 2.	A2 should decrease from step 5.	Recheck step 5.	
7.	Set switch S3 in "OFF" position and set R1 to zero ohms. Adjust voltage at V1 until A3 begins to increase from 0.	The increase at A3 should occur when V1 equals 104 VAC.	Range pot R33 improperly adjusted.	Reset pot R33 so that A3 begins increase at 104 VAC.
8.	Refer to schematic diagram figure 1-10 and 1-12. With power input at 120 VAC adjust R1 so that A3 reads 0.			

Change 7 6-45

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

Table 6-7. Exciter-Regulator (A10-A11) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
9.	Measure voltage between the following points in schematic Figure 1-10 and 1-12. FROM (-) TO (+) a. TB1-2 TB1-1  b. TB1-2 TB1-6  c. TB1-2 TB1-3  d. TB1-2 Q5-C see NOTE 2.  e. TB1-2 TB2-8	a. 17 VOLTS  b. 50 VOLTS  c. 0  d. 8.2 VOLTS  e. 50 VOLTS	a. Defective T5, CR12-15, R16, R1, R2, C2 and C5.  b. Defective T4, CR8-11.  c. Defective Q1-Q2, R3, R4, R5, R6, P7, R8, C4, VR1.  d. Defective Q5 or Q6. Incorrect value R8, R9, R18, R19, R20.  e. Defective Q3, Q4, R9 or CR17.	a. Check T5 for shorted or open windings, check diodes in bridge. Check for open resistors or shorted capacitors.  b. Check diodes in bridge. Check T4 windings for opens or shorts.  c. Check and replace Q2, C4. Check resistor for proper value and opens.  d. Check and replace transistors where necessary. Check resistor values.  e. Check and replace transistors where necessary. Check resistor and diode.



Table 6-7. Exciter-Regulator (A10-A11) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
9.	Measure voltage between the following points in schematic Figure 1-10 and 1-12. (cont)  f. Q1-B TB2-1	f. 5 VOLTS	f. Defective VR1.	f. Check and replace if necessary.
10.	Readjust R1 so that A3 reads 2.4 amperes maximum and measure the voltage between the same points as follows:  a. TB1-2 TB1-1 b. TB1-2 TB1-6 c. TB1-2 TB1-3 d. TB1-2 Q5-C sec NOTE 2 e. TB1-2 TB2-8	(Check for shorted CR7 if A3 will not read 2.4 amperes).  a. 19.8 VOLTS b. 50 VOLTS c. 2.6 VOLTS d. 2 VOLTS e. 1 VOLT	a. See 9a. b. See 9a. c. Shorted C4. See 9c d. Shorted or open CR17. See 9d. e. See 9e.	a. See 9a. b. See 9b. c. Check and replace C4. See 9c. d. Check and replace CR17 See 9d. e. See 9e.

Change 10 6-47

P-9-TM-457-35 TO 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

Table 6-7. Exciter-Regulator (A10-A11) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
10.	Readjust R1 so that A3 reads 2.4 amperes maximum and measure the voltage between the same points as follows: (continued)  f. Q1-B TB2-1	(Check for shorted CR7 if A3 will not read 2.4 amperes). (continued)  f. 5 VOLTS	f. See 9f.	f. See 9f.
NOTES:	<ol style="list-style-type: none"> <li>1. All voltages in steps 9 and 10 above are <math>\pm 20\%</math>.</li> <li>2. To reach test point EE, remove screws holding printed circuit board and test from below board.</li> <li>3. If regulation is unsatisfactory after check-out, recheck CR17 for open or short and R21 for correct value.</li> <li>4. If stability is unsatisfactory, Check R14, R31, R32 for correct values and C1, C3 for opens or shorts.</li> <li>5. Prior to starting test, set variable resistors R31, R32, and R33 on voltage regulator to mid-points. During step 9 it may be necessary to readjust R33 so test conditions can be met. If readjustment is required, repeat steps 5 through 8, record results, reverify step 9, then continue test. Leave R33 at position at which step 9 conditions are met.</li> </ol>			

b. Tag and disconnect wires of wiring harnesses (18) from components. Note polarity and location of components when tagging .

**WARNING**

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- c. Exercise care not to apply excessive heat when unsoldering components.
- d. Refer to figure 6-18 and disassemble the voltage regulator assembly (4, figure 6-17) to the extent necessary to accomplish repair.
- e. Refer to figure 6-19 and disassemble the voltage regulator sub-assembly (3, figure 6-18) to the extent necessary to accomplish repair.

6-78. **CLEANING.**

Clean all components with a clean lint-free cloth moistened with an approved Cleaning solvent and dry thoroughly.

6-79. **INSPECTION.**

- a. Inspect the exciter-regulator components in accordance with paragraph 6-53.
- b. Inspect terminal boards for cracked, insulation, stripped threads and missing jumper strips.
- c. Inspect wiring harnesses for evidence of insulation breakdown and security of connections, refer to figure 6-20, and figure 6-21.

6-80. **REPAIR.**

- a. Repair voltage regulator subassembly wiring in accordance with table 6-8.
- b. Repair printed card circuits according to paragraph 6-54, step f.
- c. Straighten dented or distorted

sheet metal parts using proper tools. Blend in repaired area with suitable abrasive paper. Prime and touch up damaged surfaces.

d. Broken T5 transformer leads can be repaired by soldering a 1.5 inch long, MIL-W-16878/2C 18 AWG stranded, Stress-relief wire from the transformers broken lead to its soldering terminal on the board (see figure 6-17).

6-81. **REBUILD.**

Rebuild the exciter regulator wiring harnesses according to figures 6-20 and 6-21.

6-82. **REASSEMBLY.**

Refer to figure 6-17 and reassemble the exciter-regulator in the reverse order of index numbers assigned. Pay particular attention to the following:

**NOTE**

Mount connectors with keyway in top position.

- a. Refer to figure 6-19 and reassemble the voltage regulator sub-assembly.
- b. Refer to figure 6-18 and reassemble the voltage regulator assembly.
- c. Secure components mechanically prior to wiring.
- d. Connect wires on voltage regulator sub-assembly to components according to table 6-8.
- e. Connect wiring harnesses in accordance with figures 6-20 and 6-21.
- f. Exercise care not to apply excessive heat when soldering components.
- g. Check wiring to components. Refer to figures 1-11 or 1-13.
- h. Test exciter-regulator as specified in paragraph 6-76.
- i. Install the exciter after adjustments on page 6-51.

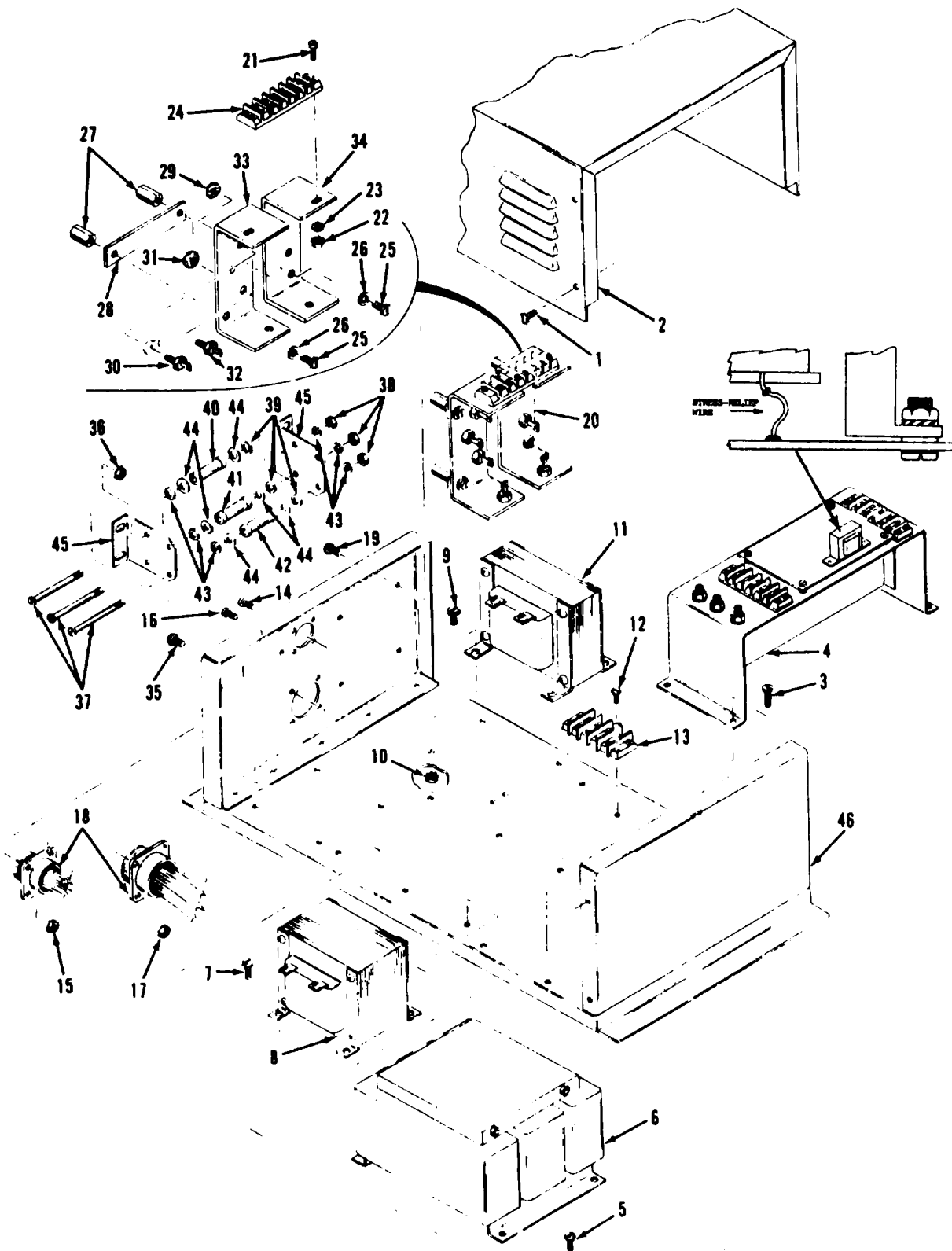


Figure 6-17. Exciter regulator, exploded view

Legend to figure 6-17:

- |                               |                         |
|-------------------------------|-------------------------|
| 1. Screw assembly (8)         | 24. Terminal board      |
| 2. Cover (2)                  | 25. Screw               |
| 3. Screw assembly (4)         | 26. Standoff            |
| 4. Voltage regulator assembly | 27. Shoulder washer (4) |
| 5. Screw assembly (4)         | 28. Insulated plate (2) |
| 6. Transformer                | 29. Nut                 |
| 7. Screw assembly (4)         | 30. Rectifier diode (2) |
| 8. Control transformer        | 31. Nut                 |
| 9. Screw assembly (4)         | 32. Rectifier diode (3) |
| 10. Nut assembly (4)          | 33. Heatshield diode    |
| 11. Reactor                   | 34. Heatshield diode    |
| 12. Screw assembly (2)        | 35. Screw assembly (4)  |
| 13. Terminal board            | 36. Nut assembly (4)    |
| 14. Screw assembly (4)        | 37. Screw (4)           |
| 15. Nut assembly (4)          | 38. Nut (4)             |
| 16. Screw assembly (4)        | 39. Lock washer (4)     |
| 17. Nut assembly (4)          | 40. Resistor (2)        |
| 18. Wiring harness            | 41. Resistor            |
| 19. Screw assembly            | 42. Resistor            |
| 20. Bridge rectifier assembly | 43. Mica washer (8)     |
| 21. Screw (2)                 | 44. Washer (8)          |
| 22. Nut assembly (2)          | 45. Bracket (2)         |
| 23. Washer (2)                | 46. Chassis             |

### 6-83. INSTALLATION.

Refer to figure 6-15 and install the exciter regulator. Secure the assembly in position with four screws and nuts, then connect plugs P9 and P13.

### 6-84. ADJUSTMENT.

a. Set voltage range resistor R33 in a position so that generator output voltage can be adjusted at any loads between no load and rated load. Adjust VOLTAGE ADJUSTMENT resistor R2 (on control cubicle) to meet the following requirements.

1. Between 395 and 480 volts for the 240/416 volt connection and between 197 and 240 volts for the 120/208 volt connection; (60 Hz Mode I set).

2. Between 380 and 426 volts for the 240/416 volt connection and between 190 and 213 volts for the 120/208 volt connection; (50 Hz Mode I set).

3. Between 395 and 458 volts for the 240/416 volt connection and between 197 and 229 volts for the 120/208 volt connection; (400 Hz Mode II set).

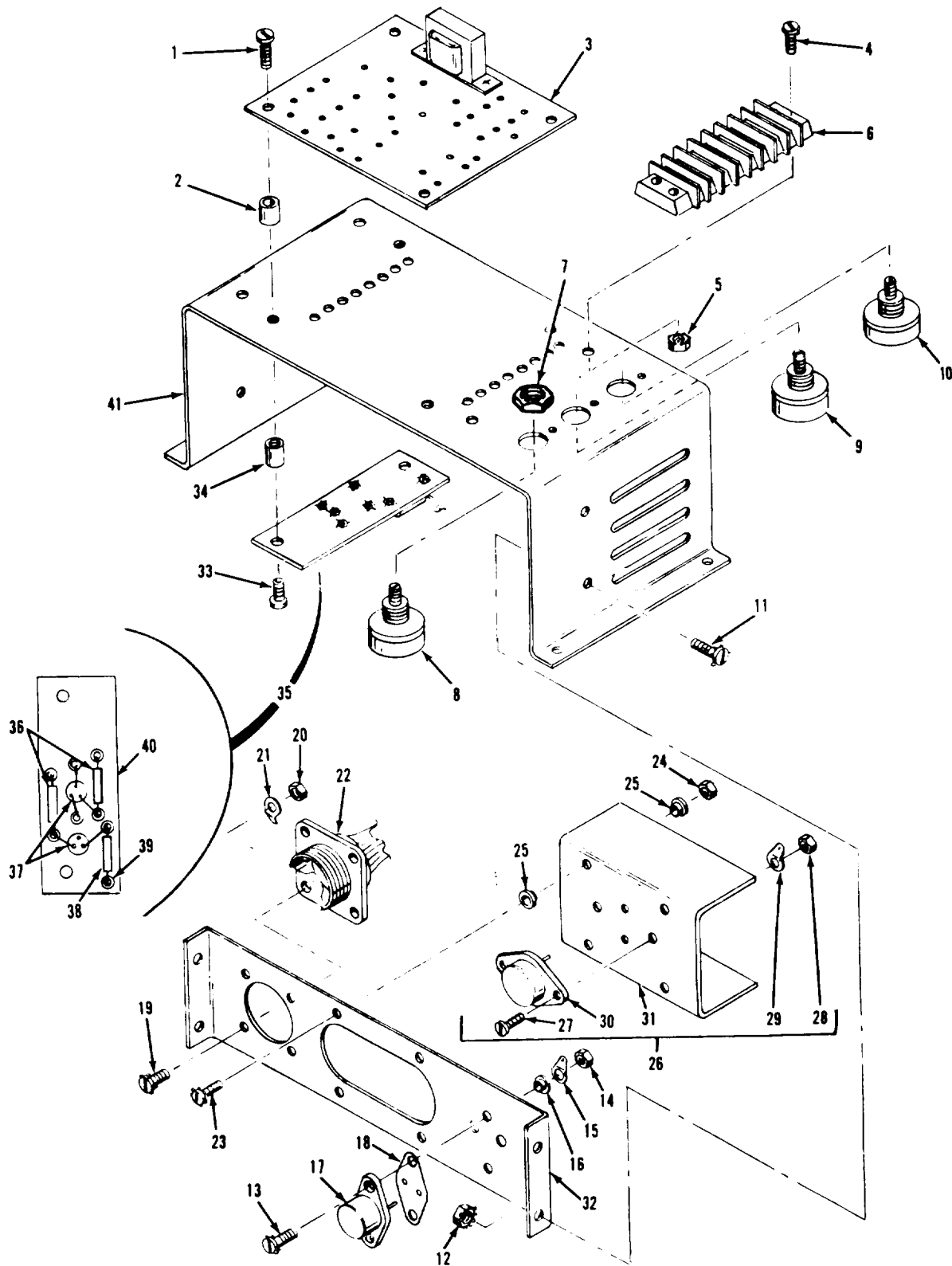


Figure 6-18. Voltage regulator exploded view

Legend to figure 6-18:

- |                          |                              |
|--------------------------|------------------------------|
| 1. Screw assembly (4)    | 22. Wiring harness           |
| 2. Standoff (4)          | 23. Screw assembly (4)       |
| 3. Voltage regulator     | 24. Self locking nut (4)     |
| 4. Screw assembly (4)    | 25. Shoulder washer (8)      |
| 5. Nut assembly (4)      | 26. Heatsink assembly        |
| 6. Terminal board (2)    | 27. Screw assembly (2)       |
| 7. Nut                   | 28. Self locking nut (2)     |
| 8. Variable resistor     | 29. Terminal lug             |
| 9. Variable resistor     | 30. Transistor               |
| 10. Variable resistor    | 31. Heatsink                 |
| 11. Screw assembly (4)   | 32. Bracket                  |
| 12. Nut assembly (4)     | 33. Screw assembly (2)       |
| 13. Screw assembly (2)   | 34. Standoff (2)             |
| 14. Self locking nut (2) | 35. Component board assembly |
| 15. Terminal lug         | 36. Resistor (2)             |
| 16. Shoulder washer (2)  | 37. Transistor (2)           |
| 17. Transistor           | 38. Resistor                 |
| 18. Mica washer          | 39* Eyelet (8)               |
| 19. Screw assembly (4)   | 40. Component board          |
| 20. Nut assembly (4)     | 41. Chassis assembly         |
| 21. Terminal lug         |                              |

b. Set feedback resistor R32 and rate resistor R31 to mid-point, and start generator set. If voltage is stable turn feedback resistor R32 counterclockwise until voltage becomes unstable, then turn clockwise until voltage is stable.

1. If voltage is still unstable turn

feedback resistor R32 slowly counterclockwise until voltage is stable.

2. If voltage stability is still not achieved, adjust rate resistor R31 slightly counterclockwise from mid-point and readjust with feedback resistor R32.

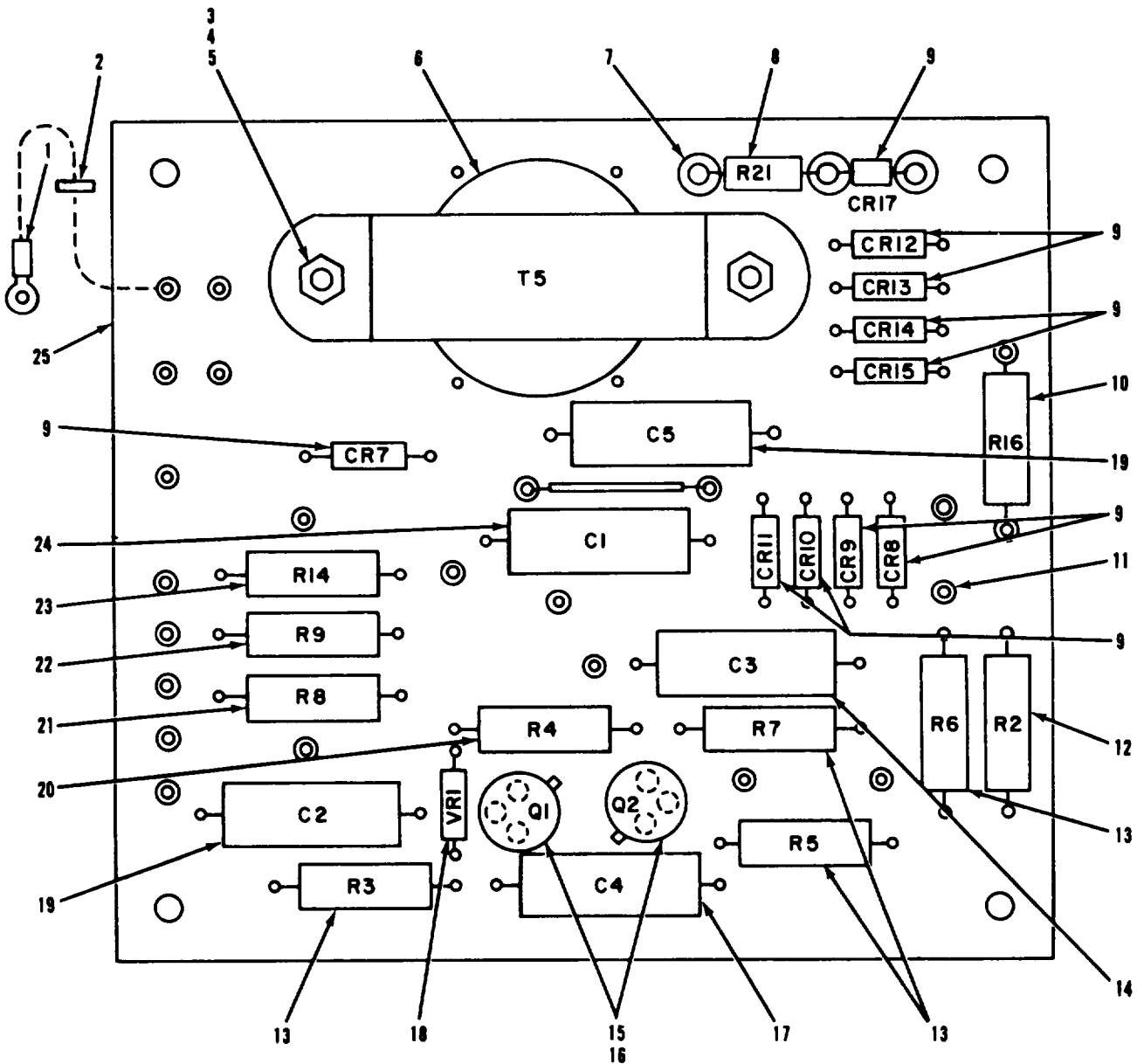


Figure 6-19. Voltage regulator subassembly

Legend to figure 6-19:

- |                       |                        |                           |
|-----------------------|------------------------|---------------------------|
| 1. Terminal lug (17)  | 10. Resistor           | 19. Capacitor (2)         |
| 2. Cable strap (16)   | 11. Eyelet (24)        | 20. Resistor              |
| 3. Screw assembly (2) | 12. Resistor           | 21. Resistor              |
| 4. Nut assembly (2)   | 13. Resistor (4)       | 22. Resistor              |
| 5. Washer (2)         | 14. Capacitor (14)     | 23. Resistor              |
| 6. Transformer        | 15. Transistor (2)     | 24. Capacitor             |
| 7. Eyelet (3)         | 16. Transistor pad (2) | 25. Printed circuit board |
| 8. Resistor           | 17. Capacitor          |                           |
| 9. Diode              | 18. Diode              |                           |



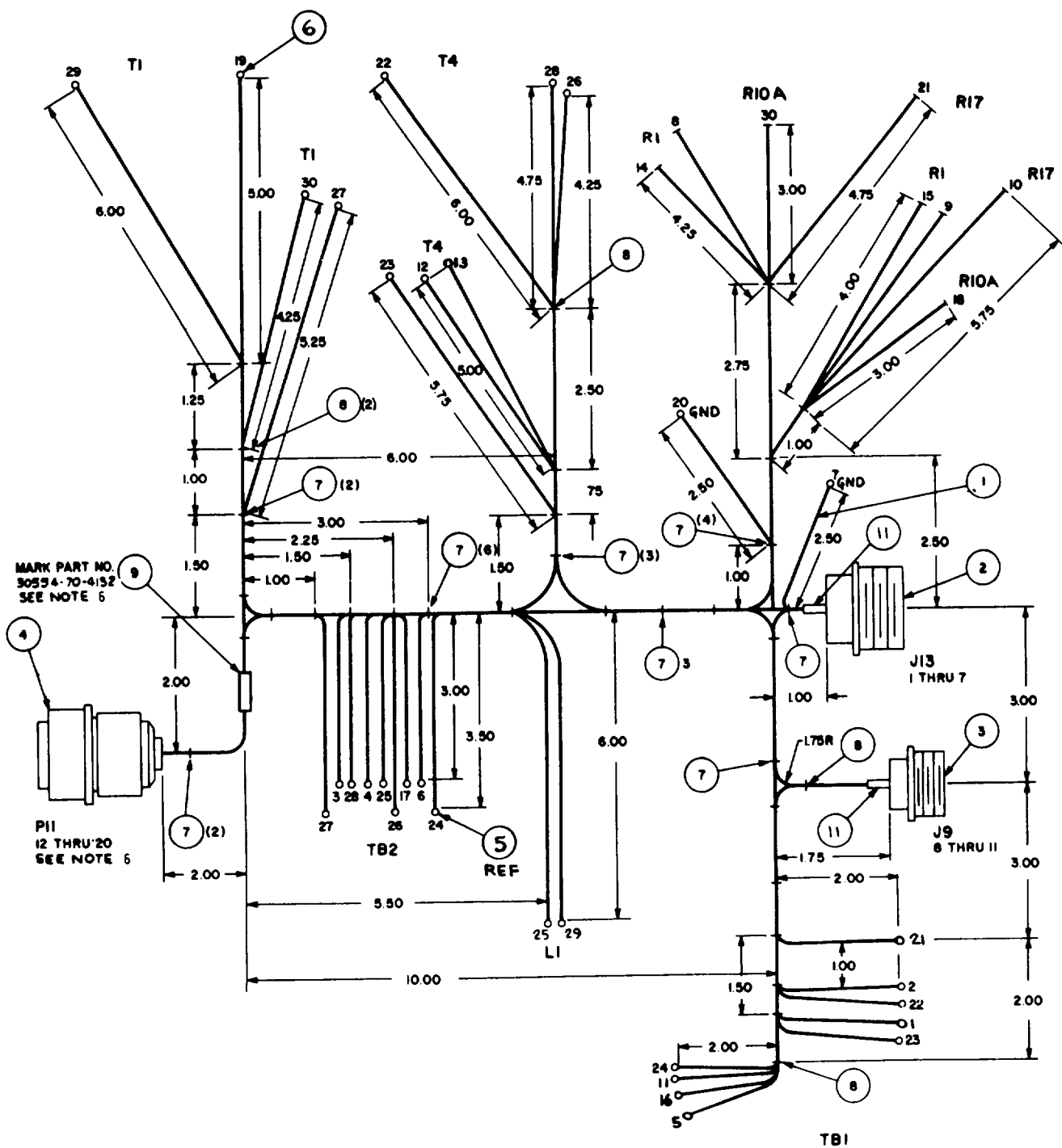


Figure 6-20. Exciter regulator wiring harness (Sheet 1 of 2)

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	U134C16	J13-J	—	TB1-3	5	10.50
2	BLACK	U135C16	J13-K	—	TB1-2	5	10.50
3	BLACK	X9EE16	J13-L	—	TB2-3	5	13.50
4	BLACK	X12TT16	J13-M	—	TB2-2	5	13.00
5	RED	P73B16	J13-R	—	TB1-5	5	11.00
6	RED	P67D16	J13-S	—	TB2-1	5	12.00
7	RED	P55AK16	J13-T	—	GND	6	4.00
8	BLACK	X91E16	J9-A	—	R1-1	-	14.50
9	BLACK	X197H16	J9-B	—	R1-2	-	12.50
10	RED	P42C16	J9-C	—	R17A-2	-	14.50
11	RED	P67C16	J9-D	—	TB1-6	5	9.00
12	BLACK	X146A16	P11-A	—	T4-3	6	18.25
13	BLACK	X147A16	P11-B	—	T4-4	6	18.25
14	BLACK	X91H16	P11-C	—	R1-1	-	24.00
15	BLACK	X197J16	P11-D	—	R1-2	-	22.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
16	RED	P73E16	P11-E	—	TB1-5	5	24.00
17	RED	P67H16	P11-F	—	TB2-1	5	10.25
18	BLACK	V159A16	P11-G	—	R10A-2	-	22.00
19	BLACK	V160A16	P11-H	—	T1-5	6	13.75
20	RED	P55AJ16	P11-J	—	GND	6	18.50
21	RED	P72A16	TB1-1	5	R17A-1	-	16.25
22	BLACK	U135D16	TB1-2	5	T1-3	6	24.75
23	BLACK	U134D16	TB1-3	5	T1-4	6	20.00
24	RED	P67J16	TB1-6	5	TB2-1	5	20.50
25	BLACK	X12UU16	TB2-2	5	L1-2	6	12.75
26	BLACK	X12VV16	TB2-2	5	T4-1	6	18.00
27	BLACK	X9FF16	TB2-3	5	T1-2	6	11.25
28	BLACK	X96G16	TB2-3	5	T4-2	6	17.00
29	BLACK	X154A16	L1-1	6	T1-1	6	21.75
30	BLACK	X153A16	T1-7	6	R10A-1	-	26.00

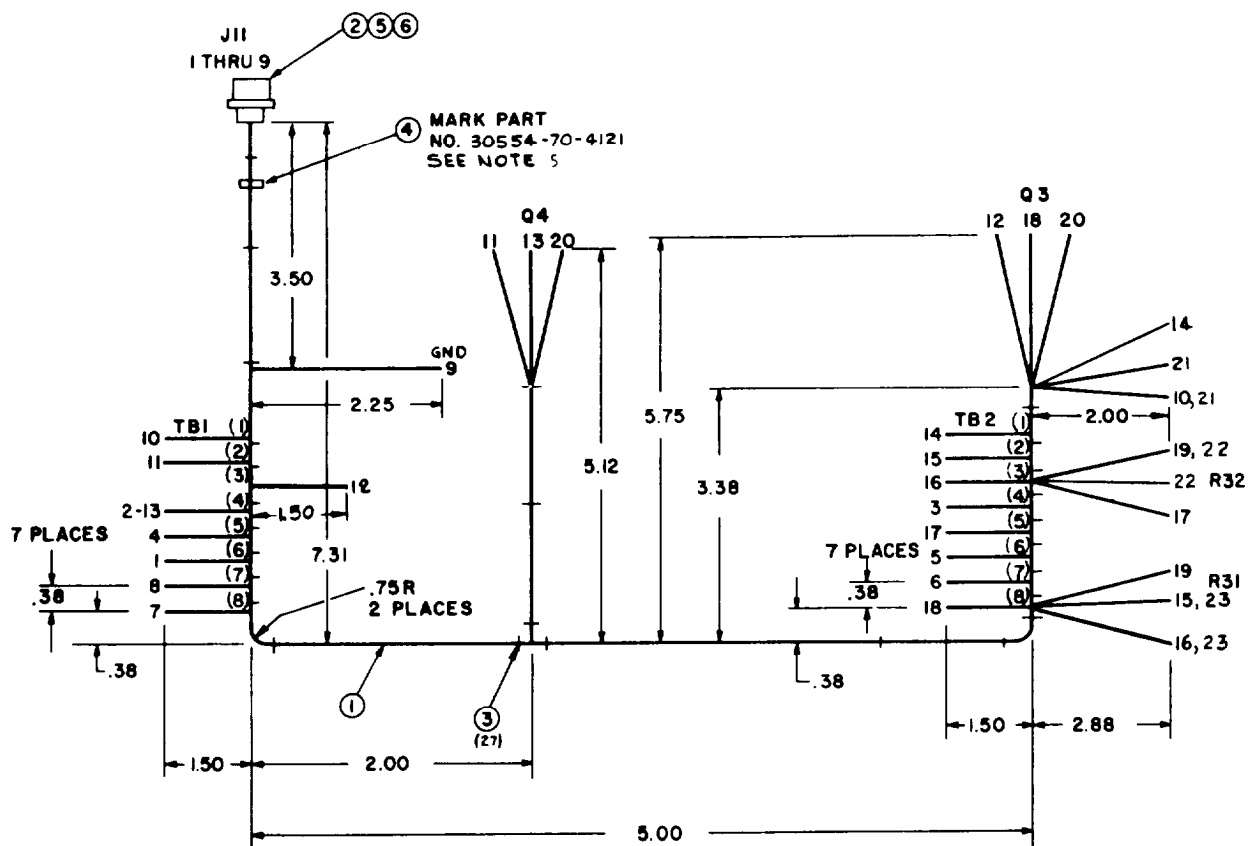
FIND NO.	CODE IDENT	QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
11			TYPE F, FORM UA GRADE A, CL I CATEGORY 1	TUBING INSULATION .106 ID X .020 WALL X .62 Lg	MIL-I-631	
10			MS60WRAP2	SOLDER, LEAD-TIN ALLOY ROSIN CORE	QQ-S-571	NOTE 2
9			MS39020-2	BAND, MARKER		AL ALY
8			MS3367-4-9	STRAP, TIEDOWN		NYLON
7			MS3367-1-9	STRAP, TIEDOWN		NYLON
6			MS25036-108	TERMINAL, LUG, CRIMP STYLE		
5			MS25036-106	TERMINAL, LUG, CRIMP STYLE		
4			MS3106R18-1P	CONNECTOR, PLUG		
3			MS3102R14S-6P	CONNECTOR, RECEPTACLE		
2			MS3102R22-14P	CONNECTOR, RECEPTACLE		
1			MS086/2-16-9	WIRE, ELECTRICAL	MIL-W-5086/2	

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE FIND NO. 10 AND SOLDER.
- CABLE STRAPS, FIND NO'S 7 AND 8, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- A. TRUNK BENDS TO BE 1.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
B. BREAKOUTS TO BE .50 RADIUS.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

Figure 6-20. Exciter regulator wiring harness (Sheet 2 of 2)



- NOTES:
1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
  2. USE SOLDER, FIND NO. 5.
  3. CABLE STRAPS, FIND NO. 3, SHALL BE SPACED AT APPROX. 1.50 APART UNLESS OTHERWISE SPECIFIED.
  4. SOLDER.
  5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.
  6. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 INCHES

WIRE NO.	IDENTIFICATION	FROM	TERMIN FND NO.	TO	TERMIN FND NO.	LG REF
1	RED -0396	J11-G	SOLDER	TB1-6	SOLDER	8.00
2	BLUE -0381	J11-H	SOLDER	TB1-4	SOLDER	7.00
3	W/BLK -0392	J11-F	SOLDER	TB2-4	SOLDER	16.00
4	W/RED -0386	J11-E	SOLDER	TB1-5	SOLDER	7.50
5	GRAY -0385	J11-A	SOLDER	TB2-6	SOLDER	15.00
6	GRAY -0385	J11-B	SOLDER	TB2-7	SOLDER	14.50
7	W/BLUE -0389	J11-C	SOLDER	TB1-8	SOLDER	9.00
8	W/BLUE -0389	J11-D	SOLDER	TB1-7	SOLDER	8.50
9	BLACK -0384	J11-J	SOLDER	GND	SOLDER	6.00
10	BROWN -0383	TB1-1	SOLDER	R33-1	SOLDER	15.00
11	YELLOW -0379	TB1-2	SOLDER	Q4-E	SOLDER	11.50
12	GREEN -0380	A2-E3	SOLDER	Q3-B	SOLDER	14.50
13	BLUE -0381	TB1-4	SOLDER	Q4-C	SOLDER	11.00
14	W/BRN -0391	TB2-1	SOLDER	R33-3	SOLDER	4.00
15	VIOLET -0382	TB2-2	SOLDER	R31-1	SOLDER	7.00
16	W/VIOLET -0390	TB2-3	SOLDER	R31-3	SOLDER	6.50
17	W/GRN -0388	TB2-5	SOLDER	R32-3	SOLDER	4.50
18	BLUE -0381	TB2-8	SOLDER	Q3-C	SOLDER	7.00
19	W/VIOLET -0390	R31-3	SOLDER	R32-1	SOLDER	7.00
20	GREEN -0380	Q3-E	SOLDER	Q4-B	SOLDER	14.00
21	BROWN -0383	R33-1	SOLDER	R33-2	SOLDER	3.50
22	W/VIOLET -0390	R32-1	SOLDER	R32-2	SOLDER	3.50
23	VIOLET -0382	R31-1	SOLDER	R31-2	SOLDER	3.50

OVER	INCL	TOL ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

6		TYPE F, FORM Ua	INSULATION, ELECTRICAL				
		GRADE A, CL 1	Q27 1D X .012 WALL (R22 ANG)	MIL-I-631			
		CATEGORY 1	X .375 LG., COLOR - TRANSPARENT				
5		SNGOWRAP-2	SOLDER, LEAD-TIN ALLOY ROSIN CORE	QQ-S-571	NOTE 4		
4		MS39020-1	1 BAND, MARKER		AL ALY		
3		MS5547-4-9	27 STRAP, TIE DOWN		NYLON		
2		MS3102R18-1S	1 CONNECTOR, RECEPTACLE				
1		TYPE C-22	AR WIRE, ELECTRICAL	MIL-W-1687B/2			
FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

Figure 6-21. Voltage regulator wiring harness

Table 6-8. Voltage Regulator Sub-Assembly Wire Data

WIRE IDENT NO.	FROM	TERMINATION NOTE	TO	WIRE LENGTH (±0.25 inches)	TERMINATION NOTE	COLOR IDENT
1	Terminal 1	1	TB1-1	8.0	3	Brown
2	Terminal 2	1	TB1-2	8.0	3	Yellow
3	Terminal 3	1	TB1-3	8.0	3	Green
4	Terminal 4	1	TB1-4	8.0	3	Blue
5	Terminal 5	1	TB1-5	8.0	3	W/Red
6	Terminal 6	1	TB1-6	8.0	3	Red
7	Terminal 7	1	TB1-7	8.0	3	W/Blue
8	Terminal 8	1	TB1-8	8.0	3	W/Blue
9	Terminal 11	1	TB2-1	11.0	3	W/Brown
10	Terminal 12	1	TB2-2	9.0	3	Violet
11	Terminal 13	1	TB2-3	9.0	3	W/Violet
12	Terminal 14	1	TB2-4	9.0	3	W/Black
13	Terminal 15	1	TB2-5	12.0	3	W/Green
14	Terminal 18	1	TB2-6	11.0	3	W/Grey
15	Terminal 19	1	TB2-7	10.0	3	W/Grey
16	Terminal 24	1	TB2-8	14.0	3	Blue
17	Terminal 17	1	Terminal 25	5.0	1	W/Blue
18	Terminal 27	1	TB2-8	5.0	3	Blue

NOTES

1. Solder, use Federal Specification QQ-S-571, Sn 60
2. Strip all wires back 0.38 inches.
3. Secure ends with terminal lugs #6 in accordance with MS25036-101.
4. Secure wires with cable straps MS3367-1-9.

## Section VI. MODE I RELAY BOX ASSEMBLY

### 6-85. GENERAL.

The Mode I relay box assembly (A27) is a junction box which is utilized to interconnect certain electronic components, for 50/60 hertz precise and utility generator set operation. The relay box contains a DC relay assembly, cross current transformer, a variable resistor, a shorting plug, the engine crank relay (K3), the battery charging ammeter shunt (R13) and interconnecting harnesses.

a. The dc relay assembly (A5) is a component mounted printed circuit board. It contains the field flash relay K5 (figure 1-14), parallel operation voltage sensor rectifier bridge CR4 and relay K7, fuel level relay K8, start circuit diode CR3, fuel pumps diode CR6, and paralleling lights resistors R6 through R9. Resistor R3, rectifier bridge CR4, and relay K7 are connected in parallel with winding T6-T9 of the generator assembly. When the generator output is connected for 120/208 VAC output; T9 is reconnected to T3 and T6 is connected to T12. The voltage across this phase coil is rectified by CR4 and then applied to relay K7. This causes its contacts to short out resistors R9 and R6 in series with the synchronizing lights DS4 and DS5. When the generator output voltage is reconnected for 240/416 VAC; terminals T6 and T9 are connected together. This de-energizes relay K7, and resistors R6 and R9 are connected in series with synchronizing lights DS4 and DS5.

b. The variable resistor (R29) is a potentiometer which permits adjustment of reactive KVA between sets operating in parallel. Its slotted shaft, when rotated

clockwise, will cause the corresponding set to increase its share of the total reactive KVA.

c. The shorting plug connected to Mode I relay box connector J31 converts the Mode I relay box from precise to utility set operation. Removing this shorting plug allows the precise relay box harness to be connected to J31, thus connecting from utility to precise set operation.

### 6-86. DC RELAY ASSEMBLY (A5).

### 6-87. TEST ON EQUIPMENT.

a. Symptoms and Isolation of Malfunction. A malfunction of the DC relay assembly (A5) is usually indicated by failure of one or more of the following circuits to function normally: the generator field flashing circuit, synchronizing lights circuit, engine fuel pump circuit, engine cranking circuit, or the low fuel level fault circuit. To isolate the malfunction, refer to figure 1-14 and proceed as follows:

#### WARNING

Exercise extreme care not to touch electrical connections when working on the electrical components with generator set operating.

#### NOTE

Remove cover from mode I relay box to gain access to the test points, see figures 6-15 and 6-22.

1. Start engine, as engine comes up to speed, measure voltage across terminals

A5-1 and A5-15 (20-32 VDC), A5-13 and A5-15 (20-32 VDC), and terminals A5-2 and A5-14 (20-32 VDC). If there is no voltage measured at terminals A5-2 to A5-14, replace the A5K5 relay.

2. With the generator set connected for 240/416 volts and operating at rated speed and voltage, the voltage measured across terminals A5-18 and A5-22 should be 0 volts AC. Measure the resistance from terminals A5-19 to A5-20, and terminals A5-7 to A5-8 with an ohm-meter. The meter should read 7.5K ohms. If the above measurement is 2.5K ohms, replace

the A5K7 relay. If resistance is infinite, replace whichever resistor measures open.

3. With the generator set connected for 120/208 volts and operating at rated speed and voltage, measure the voltage across terminals A5-18 and A5-22. The nominal voltage should read 120 VAC. Measure resistance from terminal A5-19 to A5-20, and terminals A5-7 to A5-8 with an ohmmeter. The meter should read 2.5K ohms. If the measurements are infinity, replace resistor R7 or R8, if resistance measured is 7.5K ohms, replace relay A5K7.

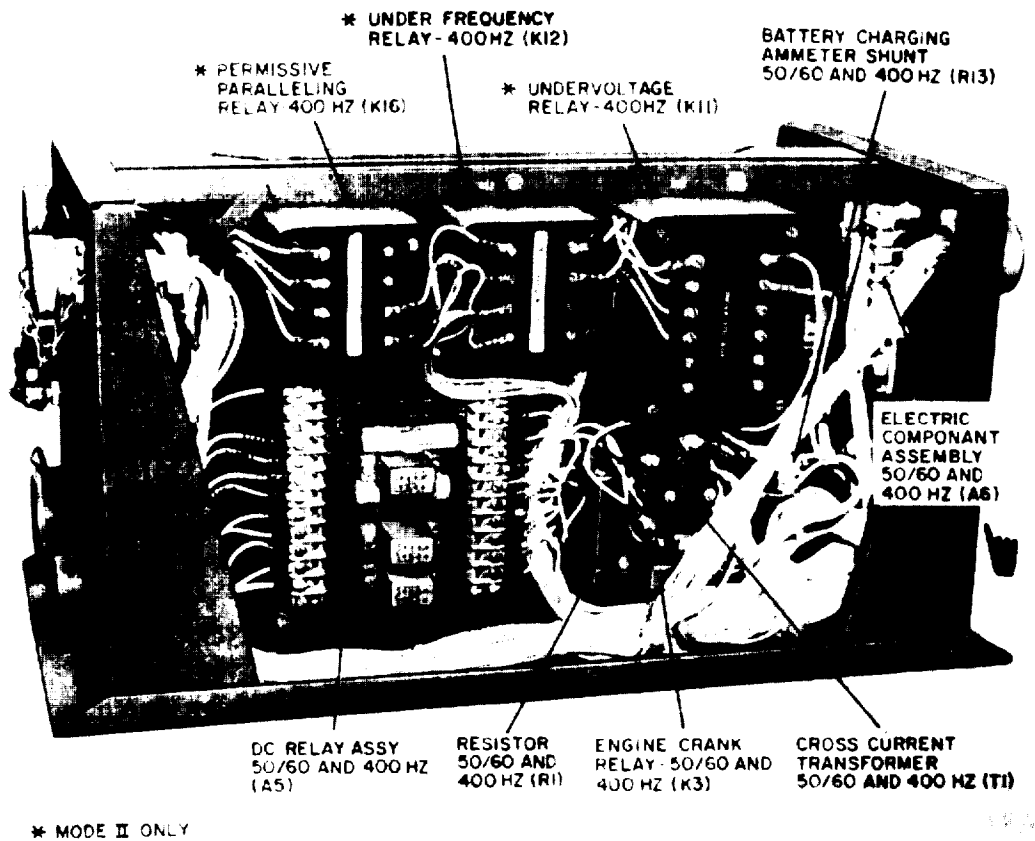


Figure 6-22. Mode I and mode II relay box assembly, cover removed

4. Place the battle short switch S7 to the ON position and measure the voltage across terminal A5-21 and terminal A5-15. The voltage should read 20-32 VDC. When the start-run-stop switch S2 is placed in the run position. Also measure voltage across terminal A5-23 to terminal A5-15. The voltage should read 20-32 VDC. If voltage is measured at A5-21 but not at A5-23, disconnect wire from A5-21 and check for continuity between terminal A5-21 and terminal A5-23 with A5-21 positive. If there is no continuity, replace diode CR6.

5. Measure the voltage across terminal A5-12 to terminal A5-15. The voltage should read 20-32 VDC when the start-run-stop switch S2 is placed in the START position. Also measure voltage across terminal A5-9 to terminal A5-15. The voltage should read 20-32 VDC. If voltage is measured at terminal A5-12 and not at terminal A5-9, disconnect wire from terminal A5-12 and check for continuity across terminals A5-12 to terminal A5-9 with A5-12 positive. If there is no continuity, replace diode CR3.

6. Disconnect connector P33 from the float switch located in the day tank and install a jumper between pins C and D of P33 to simulate a low fuel fault condition. Place the battle short switch S7 in the on position. Place the start-run-stop switch S2 in the RUN position and measure the voltage from terminal A5-6 to terminal A5-15. The voltage should read 20-32 VDC. Disconnect the wire from terminal A5-17 and check continuity across terminal A5-5 to terminal A5-17 with voltage applied to terminal A5-6. If voltage is measured at terminal A5-6 and there is no continuity from terminal A5-5 to terminal A5-17, replace relay A5K8. Remove jumper from pins C and D of P33.

b. Removal. Refer to figure 6-22 and tag, then disconnect wiring to the DC relay terminal board. Remove the four nuts securing the relay in position.

6-88. TEST.

a. Connect the DC relay assembly to test equipment as illustrated in figure 6-23 and perform test specified in procedural analysis table 6-9.

#### NOTE

Figure 1-14 illustrates the DC relay assembly schematic. Refer to this schematic when checking individual components for required values.

b. Remove the DC relay from the test equipment.

6-89. DISASSEMBLY. Refer to figure 6-24 and disassemble the DC relay assembly to the extent necessary to accomplish repair. Pay particular attention to the following:

#### WARNING

Avoid breathing fumes generated by unsoldering /soldering. Eye protection is required.

a. Exercise care not to apply excessive heat when unsoldering components.

b. Remove relay socket (10) by removing nut (7), lock washer (8) and washer (9), spacer (11) will fall free.

6-90. CLEANING. Clean all components with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

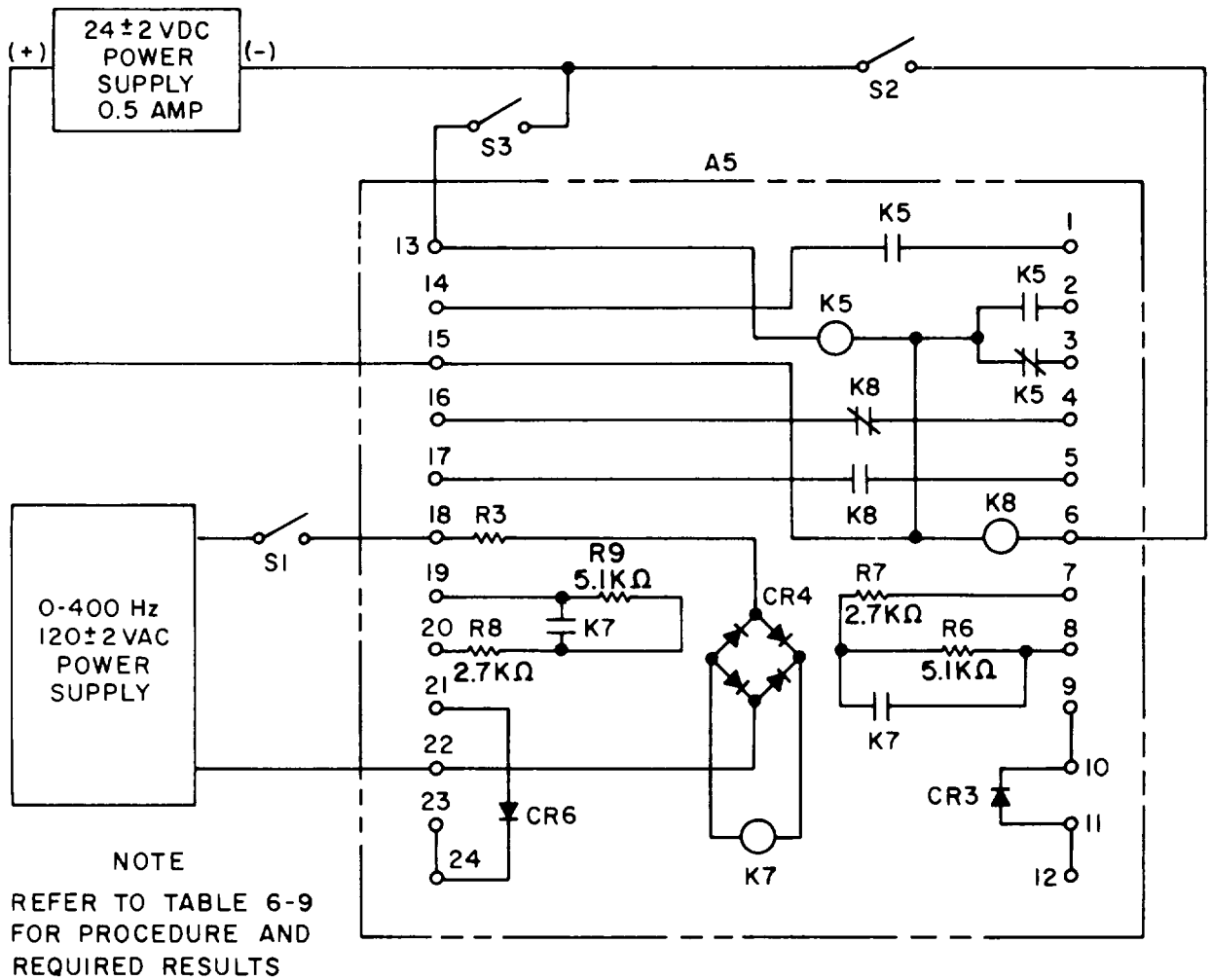


Figure 6-23. DC relay assembly (A5) test setup

6-91. INSPECTION.

- a. Inspect electrical components and printed circuit board in accordance with paragraph 6-53.
- b. Inspect relays in accordance with figure 6-5.
- c. Inspect relay sockets for damage, shorts to case and surrounding pins.

6-92. REPAIR. Repair printed circuit board in accordance with paragraph 6-54, step f.

6-93. REASSEMBLY. Refer to figure 6-24 and reassemble dc relay assembly in reverse order of index numbers assigned. Pay particular attention to the following:

**WARNING**

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- a. Exercise care not to apply excessive heat to components when soldering connections.
- b. Press relay (6) into relay socket (10) squarely and secure in position with screw (5).
- c. Test dc relay assembly as outlined in paragraph 6-88.



Table 6-9. DC Relay Assembly (A5) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
<p><u>WARNING</u></p> <p>Exercise extreme care when testing as high voltage present will cause injury to personnel upon contact.</p> <p><u>CAUTION</u></p> <p>When applying 120 VAC voltages for test to the dc relay assembly terminals, insure correct placement of power supply leads. Damage to other components on dc relay assembly could result if leads are inadvertently misplaced.</p>				
1.	Connect 120 VAC, 400 hertz supply across terminals 18 and 22 of dc relay assembly and close S1 switch. Measure resistance between terminal 7 and 8, and 19 and 20.	Measured resistance should be 2500 ohms for both measurements.	<p>Open or defective resistor R3.</p> <p>Defective full wave rectifier bridge CR4.</p> <p>Defective relay K7.</p> <p>Defective resistors R7 and R8.</p>	<p>Check resistor with ohmmeter.</p> <p>Check CR4 with ohmmeter.</p> <p>Remove relay K7 from board, and apply 24±2 vdc to pins 2 and 7 of relay. Check continuity across pins 5 and 3, and 6 and 4. If there is no continuity, relay is defective.</p> <p>Check resistors with ohmmeter.</p>

Table 6-9. DC Relay Assembly (A5) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
NOTE				
Remove 120 VAC, 0 to 400 hertz supply before this test.				
2.	Measure resistance between terminals 19 and 20, and 7 and 8 of dc relay assembly.	Measured resistance should be 7100-8200 for both measurements.	Defective resistors R6, R7, R8 or R9.  Defective relay K7.	Check resistors with ohmmeter.  Check continuity across pins 5 and 3, and 6 and 4 of relay K7. If there is continuity in either measurement; relay K7 is defective.
3.	3.a. Check continuity between terminals 11 and 10, and 21 and 23.	Measured resistance should be approximately 25 ohms.	Defective diode CR3 or CR6.	Check continuity with an ohmmeter (+ lead placed on terminals 11 and 21).
	3.b. Perform continuity checks in above except reverse lead of ohmmeter.	There should not be continuity.	Defective diode CR3 or CR6.	Check continuity with an ohmmeter (+ lead placed on terminals 10 and 23).

Table 6-9. DC Relay Assembly (A5) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
4.	Connect 24 vdc across terminals 6(-) and 15(+) and close S2 switch.	There shouldn't be continuity between terminals 4 and 16, and there should be continuity between terminals 5 and 17.	Defective relay K8.	Remove relay K8 from board, and apply 24±2 vdc to pins 2 and 7 of relay. Check continuity across pins 5 and 3, and 6 and 4. If there is no continuity, relay is defective.
<p>NOTE</p> <p>Remove 24 vdc once this test is completed.</p>				
5.	Connect 24 vdc across terminals 13 and 15 (terminal 15 positive) and close S3 switch.	Measured voltage between terminals 2 and 13 should be 24 vdc, while between terminals 3 and 13 there should be zero volts. Continuity should exist between terminals 1 and 14.	Defective relay K5.	Remove relay K5 from board, and apply 24±2 vdc to pins 2 and 7 of relay. Check continuity across pins 5 and 3, and 6 and 4. If there is no continuity, relay is defective.

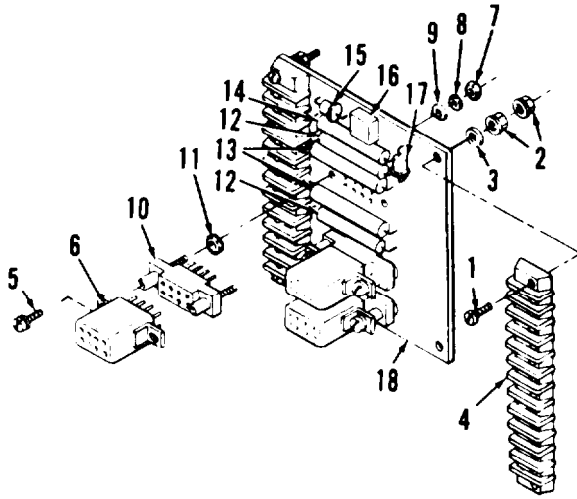


Figure 6-24. DC relay assembly (A5)  
 exploded view

Legend to figure 6-24:

1. Screw (4)
2. Nut assembly (8)
3. Washer (4)
4. Terminal board (2)
5. Screw assembly (6)
6. Relay (3)
7. Nut (6)
8. Lock washer (6)
9. Washer (6)
10. Relay socket (3)
11. Spacer
12. Resistor (2)
13. Resistor (2)
14. Resistor
15. Silicone junction rectifier
16. Silicone bridge rectifier
17. Silicone junction rectifier
18. Board

6-94. INSTALLATION. Refer to figure 6-22 and install the DC relay assembly. Secure the assembly in position with four nuts, then refer to figure 1-15 and reconnect wiring to the relay terminal board. Replace mode I relay box cover.

6-95. MODE I RELAY BOX ASSEMBLY (A27).

6-96. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the mode I relay box assembly is usually indicated by a failure of the DC relay assembly, failure of the engine to crank when the start-run-stop switch S2 is energized, and unequal reactive load sharing when the generator set is operated in parallel. To isolate the malfunction, refer to figure 1-14 and proceed as outlined in steps b. through d.

WARNING

Exercise extreme care not to touch electrical connections when working on the electrical components with the generator set operating.

b. To isolate a malfunction of the DC relay, refer to paragraph 6-87.

NOTE

Remove cover from mode I relay box to gain access to the test points, see figures 6-15 and 6-22.

c. To isolate a malfunction of the engine crank relay, place the start-run-stop switch S2 in the START position and measure the voltage across A27K3 relay terminals as follows:

1. Voltage across X1(-) and X2(+) should read 20-32 VDC.
2. Voltage across A1 or A2(+) to TB2-1(-) should read 20-32 VDC.

NOTE

If the voltage is measured at X1 and A2, but not at A1, replace the relay.

d. To isolate a malfunction in the reactive droop circuit, install a shorting plug on paralleling receptacle J45, J46 or J47 located below the manual speed control knob. Proceed as follows:

1. With the generator set operating at 100 percent 0.80 PF load, position the parallel switch S6 to the PARRALLE L position. Voltage measured across resistor R1 located in this Mode I relay box, as the reactive current rheostat R29, located on the Mode I relay box, is rotated counterclockwise should increase to approximately 9 VAC, then decrease to 0 VAC as R29 is rotated full clockwise.

2. If the voltage values (step 1 above) are not met, connect a 0-3 amp ammeter in series with current transformer CT7. Current measured should be approximately 1.5 amperes at 100 percent, 0.8PF load.

3. If the current value (step 2 above) is not met, check continuity of the circuit through current transformer CT7 and reactive current rheostat R29. If the circuitry is proper, check R29 for full resistance range 0-12 ohms.

4. If the current value (step 2 preceding) is met, measure voltage across terminals of transformer T1. Voltage across terminals 1-2, and 3-4 should be identical, if not transformer T1 is defective.

d. Removal. Refer to figure 6-15. Disconnect all electrical plug connectors at mode I relay box assembly receptacles, then remove the four screws and nuts securing the assembly in position. Remove the mode I relay box assembly.

6-97. BENCH TEST.

- a. Refer to table 6-10 and perform a continuity test of mode I relay box circuitry.

- b. Connect the mode I relay box assembly to test equipment as illustrated in figure 6-25 and perform test specified in procedural analysis table 6-11

6-98. DISASSEMBLY, Refer to figures 6-22 and 6-26, and disassemble the mode I relay box assembly in the order of index numbers assigned. Pay particular attention to the following.

NOTE

Disassemble the mode I relay box assembly to the extent necessary to accomplish repair.

- a. Remove ten screw assemblies (2, figure 6-26) and washers (3) and left cover (1) from chassis assembly (39).

- b. Tag, then disconnect harness wiring from components.

- c. Remove battery charging ammeter shunt (R13) engine cranking relay (K3),

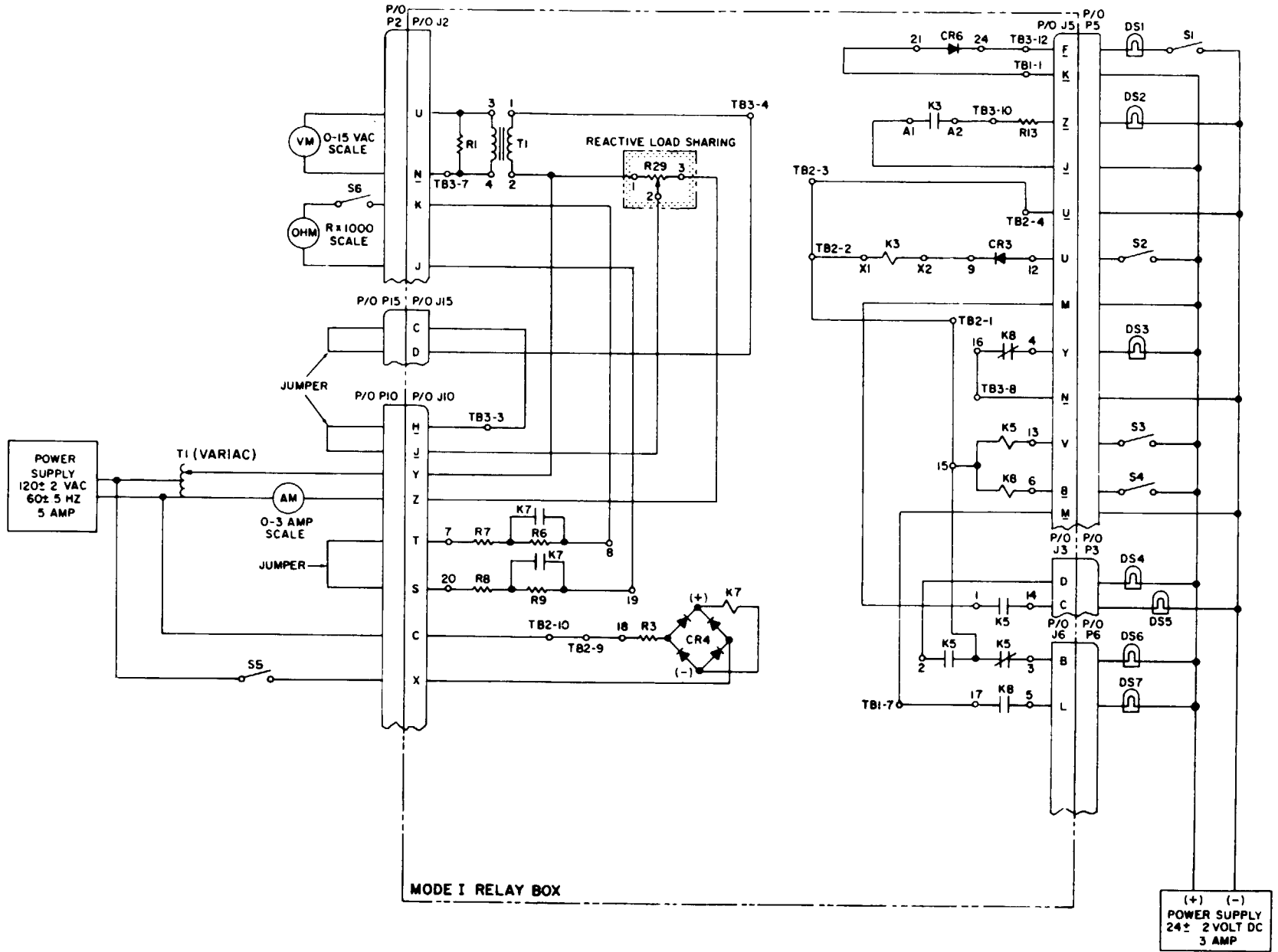


Figure 6-25. Mode I relay box assembly (A27) test setup

Table 6-10. Mode I Relay Box Assembly (A27) Continuity Test

FROM	TO	REQUIRED RESULT
J50-L	<u>J50-B</u>	Continuity
J50-L	<u>J2-W</u>	Continuity
J50-L	J31-E	Continuity
J50-L	J10-N	Continuity
J50-L	J10-E	Continuity
J50-L	<u>J5-K</u>	Continuity
J50-L	<u>J5-C</u>	Continuity
J50-L	<u>J5-E</u>	Continuity
J50-L	A5-21	Continuity
J50-P	J31-K	Continuity
J50-P	<u>J6-C</u>	Continuity
J50-P	<u>J5-M</u>	Continuity
J50-P	J5-Z	Continuity
J50-P	J5-W	Continuity
J50-P	A5-17	Continuity
J50-R	J2-F	Continuity
J50-R	J10-B	Continuity
J50-S	J2-E	Continuity
J50-S	J10-A	Continuity
J50-H	J50-B	Continuity
J50-H	J 2 - H	Continuity
J50-W	J 2 - P	Continuity
J50-W	J 2 - R	Continuity
J50-W	J50-M	Continuity
J50-W	J31-D	Continuity
J50-W	J31-Z	Continuity
J50-W	J7-A	Continuity
J50-W	J10-L	Continuity
J50-W	J29-E	Continuity
J50-W	J5-T	Continuity
J50-W	<u>J5-U</u>	Continuity
J50-W	J5-H	Continuity
J50-W	<u>J5-G</u>	Continuity
J50-W	J5-S	Continuity
J50-W	K3-X1	Continuity
J50-W	A5-15	Continuity

Table 6-10. Mode I Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J50-J	J31-A	Continuity
J50-J	<u>J2-Z</u>	Continuity
J50-J	<u>J10-C</u>	Continuity
J50-J	A5-18	Continuity
J50-K	J31-B	Continuity
J50-K	J10-W	Continuity
J50-K	J2-Y	Continuity
J50-D	J2-D	Continuity
J50-V	J10-D	Continuity
J50-U	J10-E	Continuity
J50-T	J10-F	Continuity
J50-A	J10-M	Continuity
J50-E	J31-L	Continuity
J50-X	J31-U	Continuity
J50-N	J31-S	Continuity
J2-T	J31-H	Continuity
J2-H	J31-R	Continuity
J2-H	<u>J10-B</u>	Continuity
J2-L	J3-A	Continuity
J2-M	J31-M	Continuity
J2-N	J31-N	Continuity
J2-T	J31-T	Continuity
<u>J2-B</u>	J31-P	Continuity
<u>J2-C</u>	J5-G	Continuity
J2-X	J5-H	Continuity
J2-V	J5-I	Continuity
J2-W	J5-J	Continuity
J2-X	J5-K	Continuity
J2-Y	J5-Z	Continuity
J2-Y	J7-E	Continuity
J2-Z	R13-3	Continuity
J2-P	T1-2	Continuity
J2-S	J29-B	Continuity
J2-U	R1-2	Continuity
J2-A	J10-J	Continuity
J2-B	J10-H	Continuity
J2-C	J10-G	Continuity



Table 6-10. Mode I Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRE D RESULT
J2-G	J10-A	Continuity
J2-1	J10-D	Continuity
J2-J	A5-19	Continuity
J2-K	A5-8	Continuity
J2-0	J29-C	Continuity
J2-A	J10-F	Continuity
J2-U	J29-A	Continuity
J2-V	A5-1	Continuity
J2-K	J29-H	Continuity
J2-K	J10-C	Continuity
J2-M	J5-P	Continuity
J2-M	J5-P	Continuity
J2-M	J5-R	Continuity
J2-N	J2-V	Continuity
J2-N	J3-B	Continuity
J2-E	J29-F	Continuity
J2-E	A5-16	Continuity
J2-E	J5-N	Continuity
J2-G	J5-D	Continuity
J2-G	J29-G	Continuity
J2-R	J6-A	Continuity
J2-R	J29-D	Continuity
J50-C	J6-I	Continuity
J50-D	J6-H	Continuity
J50-F	J6-F	Continuity
J50-G	J6-M	Continuity
J50-A	J5-E	Continuity
J5-F	J31-C	Continuity
J5-J	K3-A1	Continuity
J5-W	R13-4	Continuity
J5-W	K3-A2	Continuity
J5-W	J5-L	Continuity

Table 6-10. Mode I Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J5-D	J5 - F	Continuity
J5-D	A5-24	Continuity
J5-A	J6-K	Continuity
J5-B	J6-E	Continuity
J5-C	J6-D	Continuity
J5-Z	R13-1	Continuity
J5-M	A5-1	Continuity
J5-U	A5-12	Continuity
J5-V	A5-13	Continuity
J5-Y	A5-4	Continuity
J5-B	A5-6	Continuity
J15-J	J15-E	Continuity
J15-J	J15-A	Continuity
J15-J	J10-G	Continuity
J15-F	J31-J	Continuity
J15-F	J15-K	Continuity
J15-F	J15-B	Continuity
J15-L	J15-G	Continuity
J15-L	J15-C	Continuity
J15-L	J10-H	Continuity
J15-M	J15-H	Continuity
J15-M	J15-D	Continuity
J15-M	T1-1	Continuity
J10-K	J31-G	Continuity
J10-J	R29-2	Continuity
J10-X	A5-22	Continuity
J10-Y	R29-1	Continuity
J10-Z	R29-3	Continuity
J10-T	A5-7	Continuity
J10-S	A5-20	Continuity
J3-C	A5-14	Continuity
J3-D	A5-2	Continuity
J31-F	J6-G	Continuity
J6-B	A5-3	Continuity
J6-L	A5-5	Continuity
R1-1	T1-4	Continuity
R1-2	T1-3	Continuity

Table 6-11. Mode I Relay Assembly (A27) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
1.	Connect mode I relay box assembly to test equipment depicted in figure 6-25 and open all switches.			
2.	Energize the 24 VDC power source.	Indicator lights DS3 and DS6 should light.	Defective relays K5 and K8	Test relays as outlined in figure 6-5.
3.	Close switch S1.	Indicator light DS1 should light.	Defective diode CR6.	Check diode.
4.	Close switch S2.	Indicator light DS2 should light.	Defective relay K3, resistor R13, or diode CR3.	Test relay as outlined in figure 6-5. Check diode and resistor.
5.	Close switch S3.	Indicator light DS6 should extinguish and DS4 and DS5 should light.	Defective relay K5.	Test relay as outlined in figure 6-5.
6.	Close switch S4.	Indicator light DS3 should extinguish and DS7 should light.	Defective relay K8.	Test relay as outlined in figure 6-5.

Table 6-11. Mode I Relay Assembly (A27) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
7.	Turn on AC power supply and close switches S5 and S6.	Ohmmeter should read 5K ohms.	Defective relay K7. Open resistors R7 or R8.	Test relay as outlined in figure 6-5. Check resistors.
8.	With switch S6 closed, open S5.	Ohmmeter should read 15K ohms.	Defective relay K7. Open resistors R6 or R9.	Test relay as outlined in figure 6-5. Check resistors.
9.	Adjust transformer T1 so that ammeter reads 1.5 ± 0.1 amperes.	Voltmeter should indicate 0-9 VAC as reactive load sharing rheostat R29 is varied full range.	Defective resistor R1, transformer T1 or rheostat R29.	Check resistor, transformer and rheostat.
10.	Turn off AC and DC power supplies.			

transformer (T1) and resistor (R1) by removing their attaching screws and nuts (2 each). See figure 6-22.

d. Remove dc control relay assembly (A5) by removing the four nuts securing the assembly in position.

NOTE

Refer to paragraph 6-86 for dc relay assembly maintenance instructions.

e. Remove nut (4, figure 6-26) and washer (5) securing rheostat (6) to chassis assembly (39).

f. Remove wire harness (25) by removing the four screws and nuts securing each of the ten connectors to the chassis assembly (39).

NOTE

Electrical connector covers (7 and 8) will fall free.

6-99. CLEANING. Clean all components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

6-100. INSPECTION AND BENCH TEST.

a. Harness.

1. Inspect harness wiring for defective insulation and continuity.

2. Inspect harness connectors for damaged threads; bent, loose or missing pins and for shorts.

b. Test transformer T1 by applying 9 VAC, to terminals 1 and 2. (Excitation current shall be less than 0.1 ampere. )

Output measured at terminals 3 and 4 shall be 9 VAC.

c. Test engine cranking relay K3 by applying 24 VDC to terminals X1 and X2. Normally open contacts A 1 -A2 shall close.

6-101. REPAIR.

a. Repair or fabricate mode I relay box assembly wiring harness according to figure 6-27.

b. Straighten dented or distorted sheet metal parts using proper tools. Blend in repaired area with a suitable abrasive paper and touch up painted surfaces. Restencil panel markings as necessary.

6-102. REASSEMBLY. Refer to figure 6-26 and reassemble the mode I relay box assembly in reverse order of index numbers assigned. Pay particular attention to the following:

a. Assemble battery charging ammeter shunt (R13), engine cranking relay (K3), transformer (T1), and resistor (R1) in position using two each, screws and nuts. See figure 6-22.

b. Assemble DC control relay assembly (A5) in position using four nuts,

c. Install wire harness (25, figure 6-26) in chassis (39) and secure in position with four screws and nuts at each of the ten connectors.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

d. Connect wire harness leads to componentry using figure 1-15 as a guide.

NOTE

Solder connections shall be made using solder, Federal Specification QQ-S-571, Sn 60.

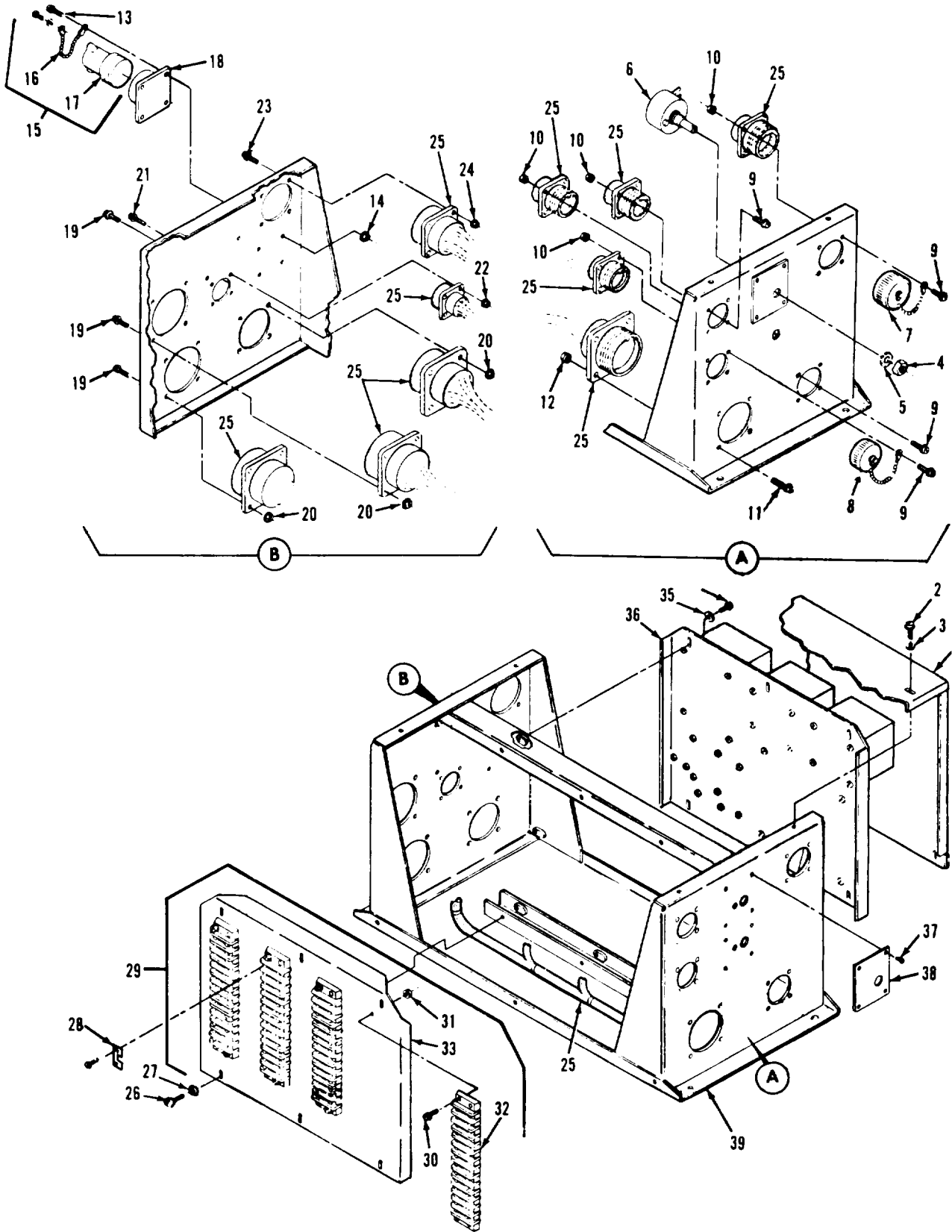


Figure 6-26. Mode I relay box assembly (A-27), exploded view

Legend to figure 6-26:

- |                               |                                   |
|-------------------------------|-----------------------------------|
| 1. Cover                      | 20. Nut assembly (8)              |
| 2. Screw assembly (10)        | 21. Screw assembly (8)            |
| 3. Washer (10)                | 22. Nut assembly (8)              |
| 4. Nut                        | 23. Screw assembly (8)            |
| 5. Washer                     | 24. Nut assembly (8)              |
| 6. Rheostat (R29)             | 25. Wire harness                  |
| 7. Electrical connector cover | 26. Screw assembly                |
| 8. Electrical connector cover | 27. Washer                        |
| 9. Screw assembly (16)        | 28. Jumper terminal board         |
| 10. Nut assembly (16)         | 29. Terminal board assembly       |
| 11. Screw assembly (4)        | 30. Screw assembly (8)            |
| 12. Nut assembly (4)          | 31. Nut assembly (8)              |
| 13. Screw assembly (4)        | 32. Terminal board (4)            |
| 14. Nut assembly (5)          | 33. Bracket                       |
| 15. Connector assembly        | 34. Screw assembly (6)            |
| 16. Chain assembly            | 35. Washer (6)                    |
| 17. Connector                 | 36. Electronic component assembly |
| 18. Dummy connector           | 37. Rivet (4)                     |
| 19. Screw assembly (8)        | 38. Identification plate          |
| 20. Nut assembly (8)          | 39. Chassis assembly              |
| 21. Screw assembly (8)        |                                   |

e. Test mode I relay box assembly as outlined in paragraph 6-97.

f. Secure cover (1, figure 6-26) to chassis assembly (39) using ten screw assemblies (2) and washers (3).

6-103. INSTALLATION. Refer to figure 6-15, and install the mode I relay box assembly. Secure the assembly in position using four screws and nuts. Refer to the Operator and Organizational Maintenance Manual and reconnect all electrical plug connectors to the assembly receptacles.

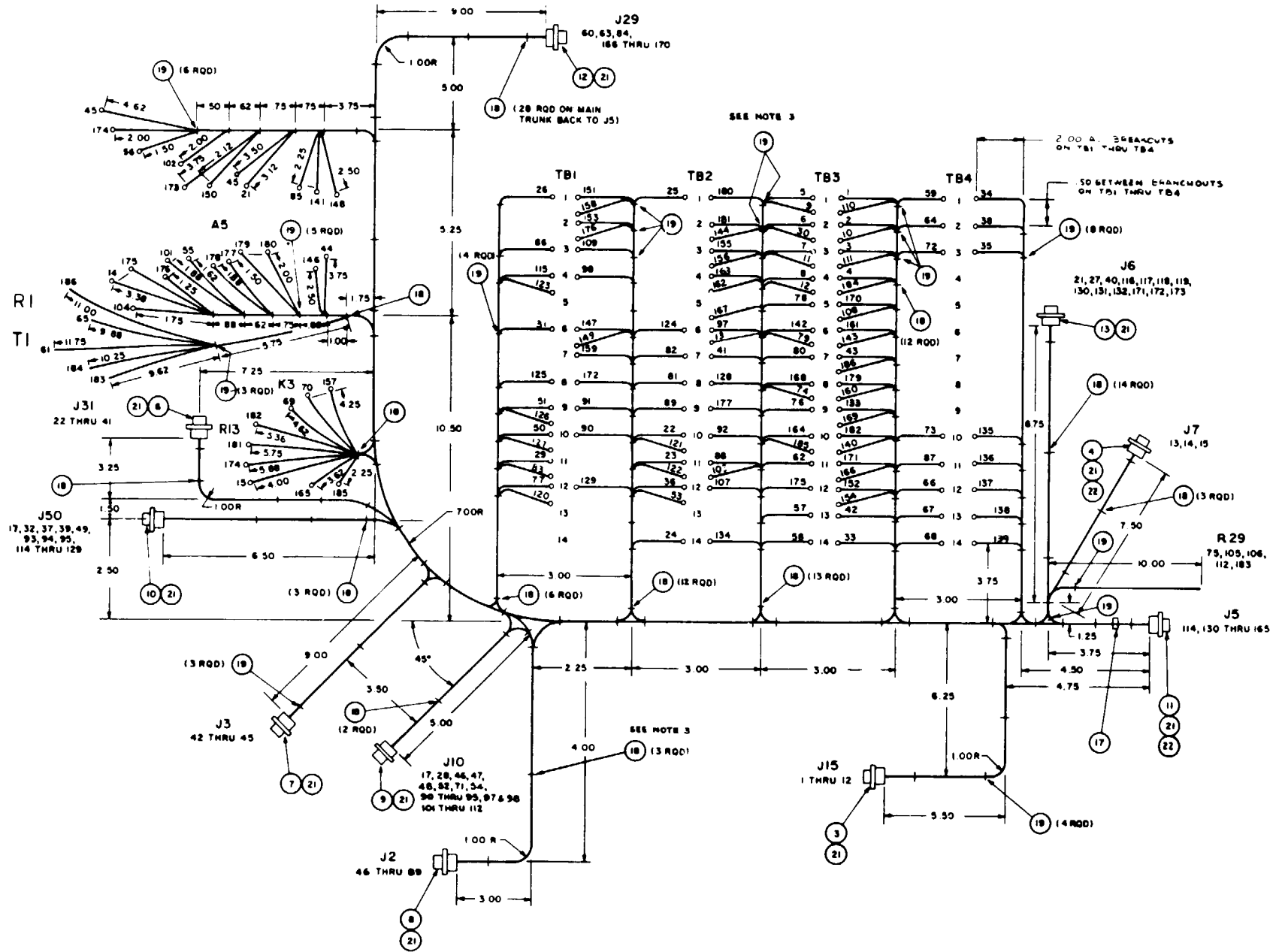


Figure 6-27. Mode I relay box wiring harness (Sheet 1 of 4)



23		MS25036-108	4	TERMINAL, LUG, CRIMP STYLE			
22		TYPE F, FORM UA GRADE A, CL I CATEGORY J	6	TUBING INSULATION .148 ID X .020 WALL X .62 LG	MIL-I-631		
21		TYPE F, FORM UA GRADE A, CL I CATEGORY J	199	TUBING INSULATION .106 X .016 WALL X .62 LG	MIL-I-631		
20		SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 3	
19		MS3367-4-9	43	STRAP, TIEDOWN		NYLON	
18		MS3367-1-9	92	STRAP, TIEDOWN		NYLON	
17		MS39020-2	1	BAND, MARKER		AL ALY	
16		MS25036-157	3	TERMINAL, LUG, CRIMP STYLE			
15		MS25036-111	8	TERMINAL, LUG, CRIMP STYLE			
14		MS25036-106	142	TERMINAL, LUG, CRIMP STYLE			
13		MS3102R20-27S	1	CONNECTOR, RECEPTACLE			
12		MS3102R22-19S	1	CONNECTOR, RECEPTACLE			
11		MS3102R36-7P	1	CONNECTOR, RECEPTACLE			
10		MS3102R28-12S	1	CONNECTOR, RECEPTACLE			
9		MS3102R32-7P	1	CONNECTOR, RECEPTACLE			
8		MS3102R36-7S	1	CONNECTOR, RECEPTACLE			
7		MS3102R14S-6S	1	CONNECTOR, RECEPTACLE			
6		MS3102R24-28S	1	CONNECTOR, RECEPTACLE			
5							
4		MS3102R18-11S	1	CONNECTOR, RECEPTACLE			
3		MS3102R20-29S	1	CONNECTOR, RECEPTACLE			
2		MS0862-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2		
1		MS0862-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2		
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 20. SOLDER CONNECTIONS PER MIL-STD-454, REQ 5
3. CABLE STRAPS, FIND NO. 18 AND 19, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. A. TRUNK BENDS TO BE 2.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
B. BREAKOUTS TO BE 1.00 RADIUS.
6. BRANCHOUTS TO FIND NO. 5(J52), FIND NO. 9(J10) AND FIND NO. 8(J2) SHALL BE LAID IN THAT RESPECTIVE ORDER.

Figure 6-27, Mode I relay box wiring harness (Sheet 2 of 4)

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	K112D16	J15-A	3	TB3-1	14	25.00
2	BLACK	K111F16	J15-B	3	TB3-2	14	24.50
3	BLACK	X98D16	J15-C		TB3-3	14	24.00
4	BLACK	X96B16	J15-D		TB3-4	14	23.50
5	BLACK	K112F16	J15-E		TB3-1	14	25.00
6	BLACK	K111H16	J15-F		TB3-2	14	24.50
7	BLACK	X94F16	J15-G		TB3-3	14	24.00
8	BLACK	X94D16	J15-H		TB3-4	14	23.50
9	BLACK	K112J16	J15-J		TB3-1	14	25.00
10	BLACK	K111K16	J15-K		TB3-2	14	24.50
11	BLACK	X98J16	J15-L	3	TB3-3	14	24.00
12	BLACK	X96F16	J15-M	3	TB3-4	14	23.50
13	BLACK	P55PP12	J7-A	4	TB2-6	15	22.00
14	BLACK	P51A12	J7-B	4	A5-23	15	41.00
15	BLACK	P141D12	J7-E	4	R13-1	16	34.00
16							
17	BLACK	P63C16		J50-a	J10-M	9	
18							
19							
20							
21	BLACK	P66B16	A5-3	14	J6-B	13	
22	BLACK	X9K16	J31-A	6	TB2-10	14	26.00
23	BLACK	K12A16	J31-B	6	TB2-11	14	26.00
24	BLACK	P81F16	J31-C		TB2-14	14	25.00
25	BLACK	P55AR16	J31-D		TB2-1	14	29.50
26	BLACK	P50L16	J31-E		TB1-1	14	25.00
27	BLACK	P204B16	J31-F		J6-G	13	40.00
28	BLACK	K110D16	J31-G		J10-K	9	23.50
29	BLACK	P57F16	J31-H		TB1-11	14	21.00
30	BLACK	K111D16	J31-I		TB3-2	14	32.50
31	BLACK	P200C16	J31-K		TB1-C	14	23.00
32	BLACK	P60C16	J31-L		J50-F	10	18.50
33	BLACK	K32H16	J31-M		TB3-14	14	30.00
34	BLACK	K33F16	J31-N		TB4-1	14	39.00
35	BLACK	L93H16	J31-P		TB4-3	14	39.00
36	BLACK	X15J16	J31-R		TB2-12	14	24.50
37	BLACK	K102F16	J31-S		J50-N	10	18.50
38	BLACK	K34F16	J31-T		TB4-2	14	39.00
39	BLACK	K101F16	J31-U		J50-X	10	18.50
40	BLACK	P210B16	J31-V	6	J6-N	13	40.00
41	BLACK	P55AS16	J31-Z	6	TB2-7	14	30.50
42	BLACK	X91F16	J3-A	7	TB3-13	14	24.00
43	BLACK	X137E16	J3-B	7	TB3-7	14	28.00
44	BLACK	P42A16	J3-C	7	A5-14	14	23.50
45	BLACK	P67A16	J3-D	7	A5-2	14	31.00
46	BLACK	D20D16	J2-A	8	J10-J	9	13.50
47	BLACK	D21D16	J2-B	8	J10-H	9	13.50

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
48	BLACK	D22D16	J2-C	8	J10-G	9	13.50
49	BLACK	D24G16	J2-D	8	J50-d	10	21.00
50	BLACK	X7B16	J2-E		TB1-10	14	14.50
51	BLACK	X8B16	J2-F		TB1-9	14	15.00
52	BLACK	X14816	J2-G		J10-a	9	13.50
53	BLACK	X15B16	J2-H		TB2-12	14	14.00
54	BLACK	X1F816	J2-I		J10-d	9	13.50
55	BLACK	L25C16	J2-I		A5-19	14	27.00
56	BLACK	L26C16	J2-K		A5-8	14	33.00
57	BLACK	X91C16	J2-L		TB3-13	14	17.00
58	BLACK	K32C16	J2-M		TB3-14	14	15.00
59	BLACK	K33C16	J2-N		TB4-1	14	25.50
60	BLACK	K31C16	J2-O		J29-C	12	41.00
61	BLACK	X194C16	J2-P		T1-2	14	38.50
62	BLACK	P45H16	J2-R		TB3-11	14	17.00
63	BLACK	X29C16	J2-S		J29-B	12	41.00
64	BLACK	X34C16	J2-T		TB4-2	14	24.75
65	BLACK	X90D16	J2-U		R1-2	—	37.00
66	BLACK	E39C16	J2-V		TB4-12	14	19.50
67	BLACK	E38C16	J2-W		TB4-13	14	19.00
68	BLACK	E37C16	J2-X		TB4-14	14	18.50
69	BLACK	E35C16	J2-Y		R13-2	23	21.00
70	BLACK	E36C16	J2-Z		R13-3	23	20.50
71	BLACK	P199C16	J2-a		J10-f	9	13.50
72	BLACK	L93D16	J2-b		TB4-3	14	24.00
73	BLACK	P198C16	J2-c		TB4-10	14	20.50
74	BLACK	P47B16	J2-e		TB3-8	14	17.50
75	BLACK	X195C16	J2-f		R29-3	—	28.50
76	BLACK	P44D16	J2-g		TB3-9	14	17.50
77	BLACK	P62B16	J2-h		TB1-12	14	13.50
78	BLACK	P56D16	J2-k		TB3-5	14	13.50
79	BLACK	P80F16	J2-m		TB3-6	14	18.50
80	BLACK	X197C16	J2-n		TB3-7	14	18.00
81	BLACK	P55Z16	J2-p		TB2-8	14	16.50
82	BLACK	P55416	J2-r		TB2-7	14	17.00
83	BLACK	P57E16	J2-t		TB1-11	14	14.00
84	BLACK	P40K16	J2-u		J29-A	12	41.00
85	BLACK	P40J16	J2-v		A5-1	14	31.50
86	BLACK	P50K16	J2-w		TB1-3	14	18.50
87	BLACK	P46C16	J2-x		TB4-11	14	20.00
88	BLACK	X12B16	J2-y		TB2-11	14	16.50
89	BLACK	X9B16	J2-z	8	TB2-9	14	16.00
90	BLACK	X7A16	J10-A	9	TB1-10	14	16.00
91	BLACK	X8A16	J10-B	9	TB1-9	14	16.50
92	BLACK	X9A16	J10-C	9	TB2-10	14	18.50
93	BLACK	X19C16	J10-D	9	J50-V	10	18.50
94	BLACK	X18C16	J10-E	9	J50-U	10	19.00

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 6-27. Mode I relay box wiring harness (Sheet 3 of 4)

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
95	BLACK	X17C16	J10-F	9	J50-T	10	19.00
96							
97	BLACK	P55J16	J10-L	9	TB2-6	14	20.00
98	BLACK	P50EE16	J10-N	9	TB1-4	14	18.50
99							
100							
101	BLACK	X21R16	J10-S	9	A5-20	14	25.50
102	BLACK	X22R16	J10-T	9	A5-7	14	33.50
103	BLACK	X12W16	J10-W		TB2-11	14	17.50
104	BLACK	X6C16	J10-X		A5-22	14	26.00
105	BLACK	X194E16	J10-Y		R29-1	—	29.00
106	BLACK	X195D16	J10-Z		R29-3	—	29.00
107	BLACK	X15A16	J10-b		TB2-12	14	18.00
108	BLACK	P56H16	J10-c		TB3-5	14	23.00
109	BLACK	P50MM16	J10-e		TB1-3	14	19.00
110	BLACK	K112C16	J10-g		TB3-1	14	25.00
111	BLACK	X98C16	J10-h	9	TB3-3	14	23.50
112	BLACK	X97A16	J10-j	9	R29-2	—	32.00
113							
114	BLACK	P58B16	J50-A	10	J5-E	11	28.00
115	BLACK	P50R16	J50-B	10	TB1-4	14	20.00
116	BLACK	P206B16	J50-C		J6-I	13	36.00
117	BLACK	P205B16	J50-D		J6-H	13	36.00
118	BLACK	P203B16	J50-F		J6-F	13	36.00
119	BLACK	P209B16	J50-G		J6-M	13	36.00
120	BLACK	P62H16	J50-H		TB1-12	14	16.50
121	BLACK	X9T16	J50-J		TB2-10	14	21.50
122	BLACK	X12AA16	J50-K		TB2-11	14	21.50
123	BLACK	P50Z16	J50-L		TB1-4	14	19.00
124	BLACK	P55Y16	J50-M		TB2-6	14	23.50
125	BLACK	P200S16	J50-P		TB1-8	14	18.00
126	BLACK	X8H16	J50-R		TB1-9	14	17.00
127	BLACK	X7H16	J50-S		TB1-10	14	16.50
128	BLACK	P55AR16	J50-W		TB2-8	14	25.00
129	BLACK	P62A16	J50-b	10	TB1-12	14	21.00
130	BLACK	P207B16	J5-A	11	J6-K	13	15.00
131	BLACK	P202B16	J5-B	11	J6-E	13	15.00
132	BLACK	P201B16	J5-C	11	J6-D	13	15.00
133	BLACK	P44H16	J5-D	11	TB3-9	14	14.00
134	BLACK	P81D16	J5-F	11	TB2-14	14	15.00
135	BLACK	P198E16	J5-G	11	TB4-10	14	10.50
136	BLACK	P46E16	J5-H	11	TB4-11	14	10.00
137	BLACK	E39E16	J5-I	11	TB4-12	14	9.50
138	BLACK	E38E16	J5-J	11	TB4-13	14	8.50
139	BLACK	E37E16	J5-K	11	TB4-14	14	7.50
140	BLACK	P140J16	J5-L	11	TB3-10	14	13.50
141	BLACK	P40H16	J5-M	11	A5-1	14	41.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
142	BLACK	P80B16	J5-P	11	TB3-6	14	17.50
143	BLACK	P80F16	J5-R	11	TB3-6	14	17.50
144	BLACK	P55F16	J5-S		TB2-2	14	18.50
145	BLACK	P48B16	J5-U		A5-12	14	43.00
146	BLACK	P54B16	J5-V		A5-13	14	33.00
147	BLACK	P200J16	J5-W		TB1-6	14	20.50
148	BLACK	P52B16	J5-Y		A5-4	14	40.00
149	BLACK	P200L16	J5-Z		TB1-6	14	21.00
150	BLACK	P68B16	J5-b		A5-6	14	42.00
151	BLACK	P50X16	J5-c		TB1-1	14	23.00
152	BLACK	P51D16	J5-d		TB3-12	14	13.00
153	BLACK	P50U16	J5-e		TB1-2	14	23.50
154	BLACK	P51F16	J5-f		TB3-12	14	13.00
155	BLACK	P55S16	J5-y		TB2-3	14	18.25
156	BLACK	P55P16	J5-h		TB2-3	14	18.50
157	BLACK	P41A16	J5-j		K3-A1	23	30.00
158	BLACK	P50KK16	J5-k		TB1-1	14	23.00
159	BLACK	P200P16	J5-m		TB1-7	14	20.50
160	BLACK	P47J16	J5-n		TB3-8	14	14.00
161	BLACK	P80A16	J5-p		TB3-6	14	15.00
162	BLACK	P55M12	J5-l		TB2-4	15	18.00
163	BLACK	P55E12	J5-u		TB2-4	15	18.00
164	BLACK	P140E12	J5-w		TB3-10	15	15.00
165	BLACK	P141C12	J5-z	11	R13-1	16	31.00
166	BLACK	P45L16	J29-D	12	TB3-11	14	47.00
167	BLACK	P55U16	J29-E	12	TB2-5	14	48.00
168	BLACK	P47F16	J29-F	12	TB3-8	14	47.00
169	BLACK	P44E16	J29-G	12	TB3-9	14	49.00
170	BLACK	P56E16	J29-H	12	TB3-5	14	51.00
171	BLACK	P45J16	J6-A	13	TB3-11	14	20.00
172	BLACK	P200B16	J6-C	13	TB1-8	14	27.00
173	BLACK	P208B16	J6-L	13	A5-5	14	48.50
174	BLACK	P49A16	A5-9	14	K3-X2	14	24.50
175	BLACK	P51C16	A5-24	14	TB3-12	14	30.00
176	BLACK	P50J12	A5-21	15	TB1-2	15	30.50
177	BLACK	X9J16	A5-18	14	TB2-9	14	29.50
178	BLACK	P200N16	A5-17	14	TB1-7	14	28.00
179	BLACK	P47E16	A5-16	14	TB3-8	14	32.00
180	BLACK	P55U16	A5-15	14	TB2-1	14	32.50
181	BLACK	P55YY16	K3-X1	14	TB2-2	14	30.00
182	BLACK	P140H16	K3-A2	23	TB3-10	14	29.00
183	BLACK	X194D16	T1-2	14	R29-1	—	53.00
184	BLACK	X96A16	T1-1	14	TB3-4	14	46.50
185	BLACK	P140F12	R13-4	16	TB3-10	15	23.00
186	BLACK	X197D16	TB3-7	14	R1-1	—	46.00

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
0	50	.12
.50	2	.19
2	6	.25
6	12	.38

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 6-27. Mode I relay box wiring harness (Sheet 4 of 4)

## Section VII. MODE II RELAY BOX ASSEMBLY

### 6-104. GENERAL.

The mode II relay box assembly (A27) is a junction box which is utilized to interconnect certain electronic componentry for 400 hertz precise generators sets. The relay box contains the dc relay assembly, the under frequency relay, under voltage relay, permissive paralleling relay, engine crank relay, governor paralleling control, voltage regulator paralleling control governor feedback capacitor, frequency adjust device fixed resistors, cross current transformer and burden resistor, and the battery charging ammeter shunt. Refer to schematic figure 1-16.

a. The dc relay assembly (A5) is a component mounted printed circuit board. It contains the field flash relay K5, figure 1-16, parallel operation voltage sensor rectifier bridge CR4 and relay K7, fuel level relay K8, start circuit diode CR3, fuel pumps diode CR6, and paralleling lights resistors R6 through R9. Resistor R3, rectifier bridge CR4, and relay K7 are connected in parallel with winding T6-T9 of the generator assembly. When the generator output is connected for 120/208 VAC output; T9 is reconnected to T3 and T6 is connected to T12. The voltage across this phase coil is rectified by CR4 and then applied to relay K7. This causes its contacts to short out resistors R9 and R6 in series with the synchronizing lights DS4 and DS5. When the generator output voltage is reconnected for 240/416 VAC; terminals T6 and T9 are connected together. This de-energized relay K7, and resistors R6 and R9 are connected in series with synchronizing lights DS4 and DS5.

b. The underfrequency relay (K12) is a solid state device which functions to protect the load in the event generator frequency decreases below preset limits. It actuates when generator frequency drops below  $370 \pm 5$  hertz. Upon actuation, contacts within the underfrequency relay close to signal the fault locator and open to de-energize the load contactor, resulting in display of fault condition and removal of load from generator.

c. The under voltage relay (K11) is a solid state device which functions to protect the load in the event generator voltage decreases below preset limits. It senses single phase 120 VAC. The time lag between an under voltage condition and activation of relay switching depends upon the magnitude of the voltage sensed. When the input voltage drops below 48 VAC, the device shall operate instantaneously. For voltages above 72 VAC, the device shall operate in  $6 \pm 2$  seconds. Upon actuation, contacts within the under voltage relay, close to signal the fault locator and open to de-energize the load contactor, resulting in display of the fault condition and removal of the load from the generator.

d. The permissive paralleling relay (K16) is utilized only on precise generator sets. Its function is to ensure that a generator set cannot be paralleled with other generator sets until synchronization is accomplished. It accomplishes this by sensing the voltage drop across one of the synchronization lights. When the voltage exceeds 9 VAC, the relay contacts are open. When the voltage is less than 7 VAC, its contacts close. Since its contacts are connected be-

tween the load contactor switch S3 and the load contactor relay coil CB2, it will allow or prevent the contactor from being energized. When this generator set is perfectly synchronized with the other sets, the voltage across the synchronizing lights will be minimum (less than 7 VAC). This causes the permissive paralleling relay to close its contacts and allow the generator set to be paralleled with other generator sets by closing of its load contactor switch S3. If the generator set is not perfectly synchronized, the voltage across the synchronizing lights will be above 9 VAC. This causes the permissive paralleling relay to have its contacts open and prevents the load contactor CB2 from closing.

e. The electronic components assembly (A6) consists of C1, R4, and R5. The assembly connects to the 'governor control unit and acts as a feedback circuit to provide the governor with greater frequency stabilization.

f. The variable resistor (R29) is a potentiometer which permits adjustment of the reactive KVA between sets operating in parallel. Its slotted shaft, when rotated clockwise, will cause the corresponding set to increase its share of the total reactive KVA.

g. The governor paralleling control is a rheostat (R28) which permits initial matching of the governor paralleling circuits for sets operating in parallel. Its function is to ensure proper real load sharing. It has a slotted shaft with locking device which when rotated counterclockwise will cause an increase in signal appearing at paralleling receptacles, causing the generator to assume a greater share of the load.

#### 6-105. DC RELAY ASSEMBLY (A5).

Refer to paragraph 6-86 through 6-94 for dc relay assembly (A5) maintenance instructions.

#### 6-106. 400 HERTZ UNDER FREQUENCY RELAY (K12).

#### 6-107. ON EQUIPMENT TEST

a. Symptom and Isolation of Malfunction. A malfunction of the underfrequency relay K12 is usually indicated by the illumination of the UNDERFREQUENCY fault light or by failure of the load contactor to close with the generator output frequency normal. To isolate the malfunction, proceed as follows:

#### WARNING

Exercise extreme care not to touch exposed electrical connections when working inside mode II relay box with generator set operating.

#### NOTE

Remove cover from mode II relay box to gain access to the test points, see figures 6-15 and 6-22.

1. With the generator set operating at rated speed and voltage, measure the voltage from terminal 1 to terminal 2 of the K12 relay. The nominal voltage is 120 VAC.

2. If the voltage at terminals 1 and 2 is normal and fault light is still illuminated, remove the wire from terminal 6 of K12 relay and reset fault lamp. If fault lamp can be reset, relay K12 is defective.

3. If the voltage at terminals 1 and 2 is normal and the contactor CB2 will not close, measure the voltage from terminal 3 of K12 to TB2-1. The voltage should read 20-32 VDC when the contactor switch S3 is placed in the closed position. Measure the voltage from terminal 4 of K12 to TB2-1. The voltage should read 20-32 V DC with the contactor switch in the closed position. If no voltage is present, K12 relay is defective. The under frequency relay should trip when the frequency is below  $370 \pm 5$  Hz.

b. Removal. Refer to figure 6-22 and tag, then disconnect wiring to the under-frequency relay. Remove the four screw assemblies securing the relay in position.

6-108. BENCH TEST.

a. Connect the underfrequency relay to the test equipment as illustrated in figure 6-28.

WARNING

Exercise extreme care when making tests as high voltages present will cause injury to personnel upon contact.

b. With switches S1 and S2 open, energize variable frequency supply and adjust output to 120 VAC, 400 hertz. Close switch S1 then S2. Indicator DS1 should energize and DS2 should de-energize.

c. Lower frequency of variable frequency supply until indicator DS1 de-energizes and DS2 energizes. This should occur at  $370 \pm 5.0$  hertz.

d. If the underfrequency relay does not meet the requirements of the above tests replace the relay.

e. Remove the underfrequency relay from the test equipment.

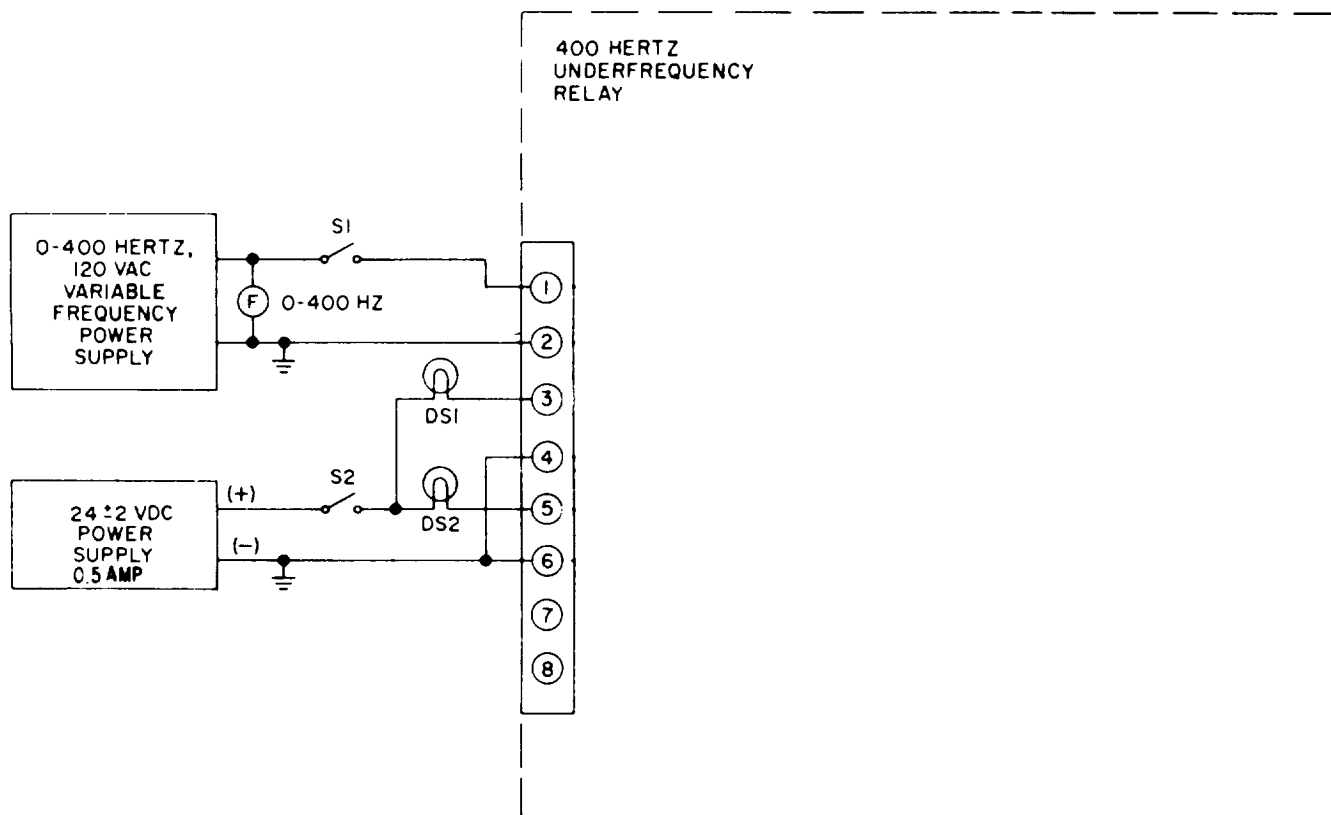


Figure 6-28. 400 hertz underfrequency relay (K12) test setup

6-109. INSTALLATION. Refer to figure 6-22 and install the underfrequency relay in the mode II relay box. Secure the relay in position with four screw assemblies, then refer to figure 1-17 and reconnect wiring. Replace mode II relay box cover.

6-110. 400 HERTZ UNDERVOLTAGE RELAY (K11).

6-111. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the undervoltage relay K11 is usually indicated by the illumination of the UNDERVOLTAGE fault light, or by failure of the load contactor to close with the generator output voltage normal. To isolate the malfunction, proceed as follows:

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside mode II relay box with generator set operating.

NOTE

Remove cover from mode II relay box to gain access to the test points, see figures 6-15 and 6-22.

1. With the generator set operating at rated speed and voltage, measure the voltage from terminal 1 to terminal 2 of the K11 relay. The nominal voltage is 120 VAC. Remove the wire from terminal 3 of K11 and reset fault light. If fault light can now be reset, relay K11 is defective.

2. If the voltage at terminals 1 and 2 is normal and the contactor CB2 won't close, measure the voltage from terminal 7 of K11 to TB2-1. The voltage should

read 20-32 VDC when the contactor switch S3 is placed to the close position.

3. Measure the voltage from terminal 8 of K11 to terminal board TB2-1. The voltage should read 20-32 VDC with contactor switch to the close position; if no voltage replace K11 relay. The undervoltage relay should trip when the voltage is lowered below  $99 \pm 4$  volts in  $6 \pm 2$  seconds.

b. Removal. Refer to figure 6-22 and tag, then disconnect wiring to the undervoltage relay. Remove the four screws securing the relay in position.

6-112. BENCH TEST.

a. Connect the undervoltage relay to the test equipment as illustrated in figure 6-29.

WARNING

Exercise extreme care when making tests as high voltages will cause injury to personnel upon contact.

b. Energize variable voltage AC supply and adjust to 120 VAC, 400 hertz. Energize 24VDC supply and close switches S2 and S1. Indicator DS2 should energize and DS1 should deenergize.

c. Adjust the variable voltage supply to 99 VAC. Indicator DS2 should deenergize and DS1 should energize after  $6 \pm 2$  seconds.

d. If the undervoltage relay does not meet the requirements of the above test, replace the relay.

e. Remove the under voltage relay from the test equipment.

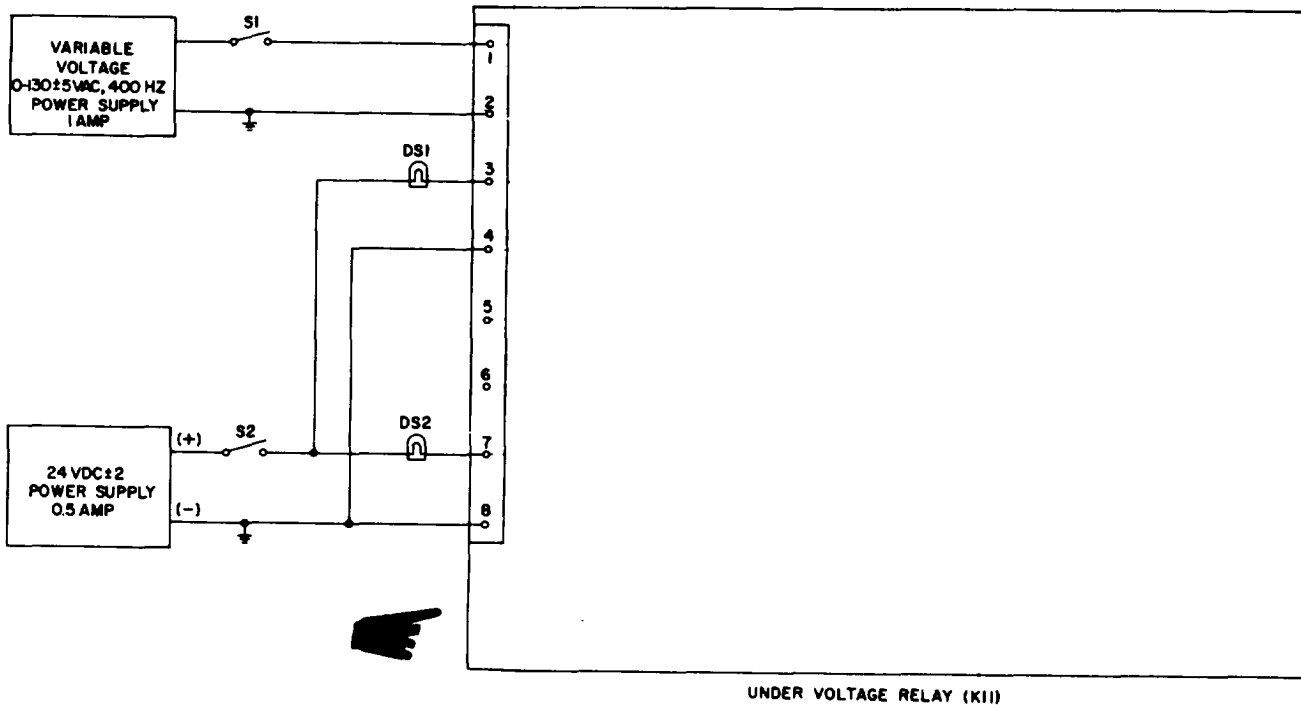


Figure 6-29. Undervoltage relay (K11), test setup

6-113. **INSTALLATION.** Refer to figure 6-22 and install the undervoltage relay in the mode II relay box. Secure the relay in position with four screw assemblies, then refer to figure 1-17 and reconnect wiring. Replace mode II relay box cover.

**NOTE**

Remove cover from mode II relay box to gain access to the test points, see figures 6-15 and 6-22.

6-114. PERMISSIVE PARALLELING RELAY (K16), 400 HERTZ.

6-115. **ON EQUIPMENT TEST.**

**a. Symptom and Isolation of Malfunction.** A malfunction of the permissive paralleling relay K16 is usually indicated by the load contactor CB2 closing when the set voltage is out of phase with the buss voltage. To isolate the malfunction, proceed as follows:

**WARNING**

Exercise extreme care not to touch exposed electrical connections when working inside mode II relay box with generating set operating.

1. Remove wire from terminal 7 of the K16 relay to prevent the contacts from closing. With the generator set operating at rated speed and voltage and the-load buss energized by a second set, measure the voltage from terminal 3 to terminal 4 of the K16 relay. The voltage should read 20-32 VDC.

2. Measure the voltage from terminal 1 to terminal 2 of K16 with the contactor switch (S3) in the close position. Connect an ohmmeter across terminal 7 and 8 of K12. Observe that the ohmmeter does not read continuity when the voltage across terminals 1 and 2 is above 10 VAC; if the contacts close with a higher voltage the K16 relay is defective.



b. Removal. Refer to figure 6-22 and tag, then disconnect wiring to the permissive paralleling relay. Remove the four screws securing the relay in position.

6-116. BENCH TEST.

a. Connect the permissive paralleling relay to the test equipment as illustrated in figure 6-30.

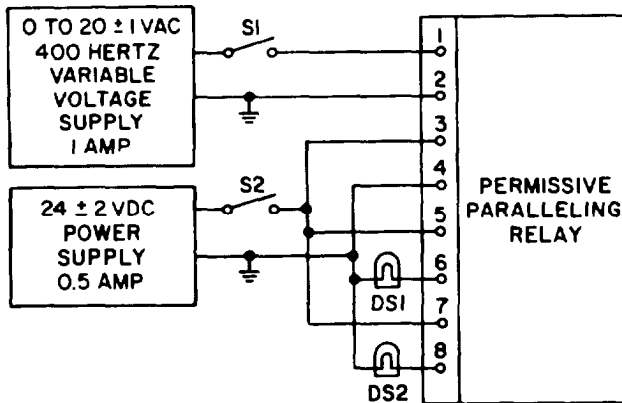


Figure 6-30. Permissive Paralleling relay (K16) test set up

b. With switches S1 and S2 open, energize variable voltage supply and adjust to 15 VAC. Close switches S1 and S2. Indicator DS1 should energize and DS2 should de-energize.

c. Decrease voltage of variable voltage supply until indicator DS1 de-energizes. The voltage should be  $8 \pm 1$  VAC.

d. If the permissive paralleling relay does not meet the requirements of the above tests, replace the relay.

e. Remove the permissive paralleling relay from the test equipment.

6-117. INSTALLATION. Refer to figure 6-22 and install the permissive paralleling relay in the mode II relay box. Secure the relay in position with four screw assemblies, then refer to figure 1-17 and reconnect wiring. Replace mode II relay box cover.

6-118. 400 HERTZ ELECTRONIC COMPONENTS ASSEMBLY (A6).

6-119. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the electronic component assembly (A6) usually is indicated by an unstable generator frequency or by loss of frequency control. To isolate this malfunction, refer to figure 1-16 and proceed as follows :

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside mode II relay box with generator set operating.

NOTE

Remove cover from mode II relay box to gain access to the test points, see figures 6-15 and 6-22.

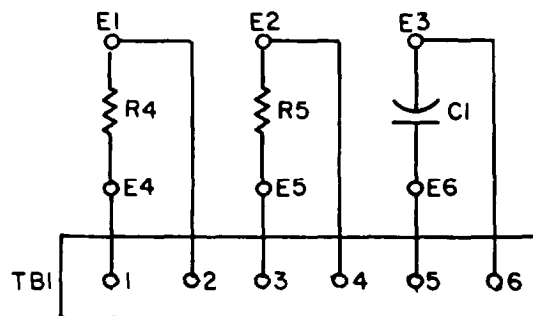
1. To check for cause of unstable generator frequency, connect an ohmmeter, set to the R x 10,000 scale, to capacitor C1. The meter should indicate 0 resistance and slowly rise to infinite resistance. If capacitor C1 does not meet the above requirements, the capacitor is defective.

2. To check for lack of frequency control, measure the resistance of resistors R4 and R5. The resistance should be  $249 \text{ ohms} \pm 1$  percent, if not, the resistors are defective.

b. Removal. Refer to figure 6-22 and tag, then disconnect wiring to the electronic components assembly. Remove the three screw assemblies securing the assembly in position.

6-120. BENCH TEST.

Using an ohmmeter test the electronic components assembly for values as noted in figure 6-31.



STEP	PROCEDURE	TEST POINT	REQUIRED RESULT
1	USE OHMMETER (R X 10K SCALE)	TB1-5 to TB1-6	METER SHOULD READ 0 OHMS INITIALLY, THEN SLOWLY RISE TO INFINITY.
2	USE OHMMETER (R X 10 SCALE)	TB1-1 to TB1-2 TB1-3 to TB1-4	249 ± 1 PERCENT OHMS.

Figure 6-31. Electronic components assembly (A6) test data

NOTE

Figure 6-31 illustrates the electronic components assembly schematic and includes required values. If the required value is not obtained, replace the faulty component.

6-121. DISASSEMBLY. Refer to figure 6-32 and disassemble the electronic components assembly to the extent necessary to accomplish repair. Pay particular attention to the following.

- a. Tag, then disconnect hook-up wire.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- b. Exercise care not to apply excessive heat to components when unsoldering components.

6-122. CLEANING. Clean all components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

6-123. INSPECTION.

- a. Check electrical components for opens, shorts, continuity and proper valves.
- b. Inspect components for security.
- c. Inspect wiring for defective insulation and continuity.
- d. Inspect terminal board for cracks, warping, burned or discolored areas and illegible stenciling.

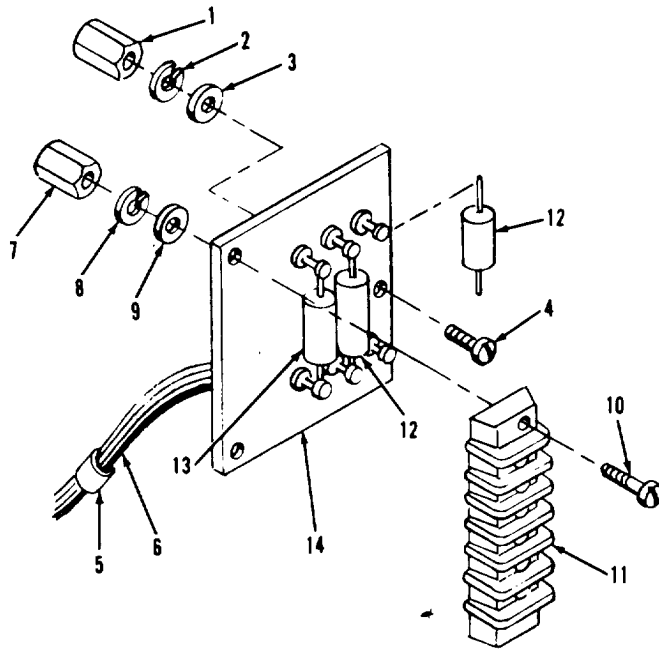


Figure 6-32. Electronic component assembly (A6), exploded view

Legend to figure 6-32:

1. Standoff
2. Lockwasher
3. Washer
4. Screw
5. Cable strap
6. Wire
7. Standoff (2)
8. Lock washer (2)
9. Washer (2)
10. Screw (2)
11. Terminal board
12. Resistors, R4 and R5
13. Capacitor, C1
14. Terminal board assembly

6-124. REPAIR.

a. Repair or fabricate electronics components assembly hookup wire in accordance with table 6-12.

b. Restencil all illegible reference designations.

c. Replace all defective components.

WARNING

Insulating Compound, MIL-I-46058 is flammable and slightly toxic to eyes, skin and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

d. After replacement of components, coat the terminal board with protective coating, conforming to Military Specification MIL-I-46058, grade S, type PUR, 0.005 minimum thickness. Air bubbles should be prevented during coating, so that legibility of identification or information markings are not impaired. The coating shall be applied so that it anchors the components to the board. Terminals utilized for connection to external circuits shall not be coated.

6-125. REASSEMBLY. Refer to figure 6-32 and reassemble the electronic components assembly in reverse order of index numbers assigned. Pay particular attention to the following.

a. Exercise care not to apply excessive heat to components when soldering connections.

b. Connect wires from components to terminal board according to table 6-12, and figure 1-17.

c. Test electronics components assembly in accordance with figure 6-31.

6-126. INSTALLATION. Refer to figure 6-22 and install the electronic components assembly in the mode II relay box. Secure the relay in position with three screw assemblies, then refer to figure 1-17 and reconnect wiring. Replace mode H relay box cover.

Table 6-12. Electronics Components Assembly (A6) Hook Up Wire Data

WIRE	WIRE LENGTH (INCHES)	FROM	TO
1	3.50	E4	TB1-1
2	4.50	E1	TB1-2
3	3.50	E5	TB1-3
4	3.00	E2	TB1-4
5	2.00	E3	TB1-5
6	5.00	E6	TB1-6

Notes

1. Solder using Federal Specification Q-Q-S-571, Sn 60
2. Wire is in accordance with MIL-STD-454, requirement 20

6-127. MODE II RELAY BOX ASSEMBLY (A27), 400 HERTZ.

1. To isolate a malfunction of the dc relay, refer to paragraph 6-87.

6-128. ON EQUIPMENT TEST.

2. To isolate a malfunction of the uncler frequency relay, refer to paragraph 6-107.

a. Symptom and Isolation of Malfunction. A malfunction of the mode II relay box assembly is usually indicated by a failure of the dc relay assembly, under-frequency relay, undervoltage relay, permissive paralleling relay, electronic components assembly, failure of the engine to crank when the start-run-stop switch S2 is energized, and unequal reactive and real load sharing when the generator set is operated in parallel. To isolate the malfunction, refer to figure 1-16 and proceed as outlined in steps 1. through 8.

3. To isolate a malfunction of the undervoltage relay, refer to paragraph 6-111.

4. To isolate a malfunction of the permissive paralleling relay, refer to paragraph 6-115.

5. To isolate a malfunction of the electronic components assembly, refer to paragraph 6-119.

WARNING

6. To isolate a malfunction of the engine crank relay, refer to paragraph 6-96, step c.

Exercise extreme care not to touch electrical connections when working on the electrical components with the generator set operating.

7. To isolate a malfunction in the reactive droop circuit, refer to paragraph 6-96, step d.

NOTE

Remove cover from the mode II relay box to gain access to the test points, see figures 6-15 and 6-22.

8. To isolate a malfunction in the real load sharing circuit, measure resistance of rheostat R28. Resistance shall

readjustable in the range of 0-15K ohms ± 10 percent. Refer figure 1-16 and 1-17.

b. Removal. Refer to figure 6-15, disconnect all electrical plug connectors at mode II relay box assembly receptacles, then remove the four screws and nuts securing the assembly in position. Remove the mode II relay box assembly.

6-129. BENCH TEST.

a. Refer to table 6-13 and perform a continuity test of mode II relay box circuitry.

b. Connect the mode H relay box assembly to test equipment as illustrated in figure 6-33 and perform test specified in procedural analysis table 6-14.

6-130. DISASSEMBLY. Refer to figures 6-22 and 6-34 and disassemble the mode II relay box in the order of index numbers assigned. Pay particular attention to the following.

NOTE

Disassemble the mode II relay box to the extent necessary to accomplish repair.

Table 6-13. Mode II Relay Box Assembly (A27) Continuity Test

FROM	TO	REQUIRED RESULT
J50-S	J2-E	Continuity
J50-S	J10-A	Continuity
J2- <u>T</u>	K11-7	Continuity
J50-M	J50-W	Continuity
J50-M	J2- <u>P</u>	Continuity
J50-M	J2- <u>R</u>	Continuity
J50-M	J10-L	Continuity
J50-M	J29-E	Continuity
J50-M	J7-A	Continuity
J50-M	J5- <u>T</u>	Continuity
J50-M	J5- <u>U</u>	Continuity
J50-M	J5- <u>H</u>	Continuity
J50-M	J5- <u>G</u>	Continuity
J50-M	J5-S	Continuity
J50-M	A5-15	Continuity
J50-M	K3-X1	Continuity
J50-M	K16-4	Continuity
J50-M	J8-D	Continuity

Table 6-13. Mode II Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J50-J	J2- <u>Z</u>	Continuity
J50-J	J10-C	Continuity
J50-J	J8-A	Continuity
J50-J	A5-18	Continuity
J50-J	K11-1	Continuity
J50-J	K12-1	Continuity
J50-K	J2- <u>Y</u>	Continuity
J50-K	J10-W	Continuity
J50-K	J8-B	Continuity
J50-K	K12-2	Continuity
J50-K	K11-2	Continuity
J2-H	J10- <u>B</u>	Continuity
J2-H	K16-1	Continuity
J8-C	J5-F	Continuity
J15-J	J15-E	Continuity
J15-J	J15-A	Continuity
J15-J	J10- <u>G</u>	Continuity
J15-F	J15-B	Continuity
J15-F	J15-K	Continuity
J15-F	J8-J	Continuity
J15-L	J15-G	Continuity
J15-L	J15-C	Continuity
J15-L	J10- <u>H</u>	Continuity
J50-L	J50-B	Continuity
J50-L	J2- <u>W</u>	Continuity
J50-L	J5- <u>K</u>	Continuity
J50-L	J5- <u>C</u>	Continuity
J50-L	J5- <u>E</u>	Continuity
J50-L	J10- <u>E</u>	Continuity
J50-L	J10-N	Continuity
J50-L	A5-21	Continuity
J50-L	K16-3	Continuity
J50-H	J50- <u>B</u>	Continuity
J50-H	J2- <u>H</u>	Continuity

Table 6-13. Mode II Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J50-P	J5-W	Continuity
J50-P	J5-Z	Continuity
J50-P	J5-M	Continuity
J50-P	J6-C	Continuity
J50-P	A5-17	Continuity
J50-P	K12-6	Continuity
J50-P	K11-4	Continuity
J50-R	J2-F	Continuity
J50-R	J10-B	Continuity
J15-M	J15-H	Continuity
J15-M	J15-D	Continuity
J15-M	T1-1	Continuity
J2-K	J29-H	Continuity
J2-K	J10-C	Continuity
J2-M	J5-P	Continuity
J2-M	J5-P	Continuity
J2-M	J5-R	Continuity
J2-N	J3-B	Continuity
J2-E	J29-F	Continuity
J2-E	J5-N	Continuity
J2-E	A5-16	Continuity
J2-G	J5-D	Continuity
J2-G	J29-G	Continuity
J5-W	J5-L	Continuity
J5-W	K3-A2	Continuity
J5-W	TB 3-10	Continuity
J2-R	J6-A	Continuity
J2-R	J29-D	Continuity
J5-D	J5-F	Continuity
J5-D	A5-24	Continuity
J2-L	J3-A	Continuity
J2-M	J8-M	Continuity
J2-C	J5-G	Continuity
J2-X	J5-H	Continuity
J2-V	J5-I	Continuity

Table 6-13. Mode II Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J2-W	J5-J	Continuity
J2-X	J5-K	Continuity
J2-A	J10-J	Continuity
J2-B	J10-H	Continuity
J2-C	J10-G	Continuity
J2-D	J50-D	Continuity
J2-G	J10-A	Continuity
J2-I	J10-D	Continuity
J2-J	A5-19	Continuity
J2-K	A5-8	Continuity
J2-N	A26-TB1-2	Continuity
J2-O	J29-C	Continuity
J2-P	T1-2	Continuity
J2-S	J29-B	Continuity
J2-T	A26-TB1-4	Continuity
J2-U	R1-2	Continuity
J2-Y	R13-2	Continuity
J2-Z	R13-3	Continuity
J2-A	J10-F	Continuity
J2-B	K16-2	Continuity
J2-F	J50-R	Continuity
J2-U	J29-A	Continuity
J2-V	A5-1	Continuity
J3-D	A5-2	Continuity
J10-D	J50-V	Continuity
J10-E	J50-U	Continuity
J10-F	J50-T	Continuity
J10-K	J8-G	Continuity
J10-M	J50-A	Continuity
J10-J	R29-A	Continuity
J10-X	A5-22	Continuity
J10-Y	R29-1	Continuity
J10-Z	R29-3	Continuity
J10-T	A5-7	Continuity
J10-S	A5-20	Continuity
J10-I	J29-K	Continuity
J10-K	J29-J	Continuity
J10-P	J29-N	Continuity
J10-R	J29-M	Continuity
J10-V	TB4-9	Continuity
J50-A	J5-E	Continuity
J50-C	J6-I	Continuity



Table 6-13. Mode II Relay Box Assembly (A27) Continuity Test (Continued)

FROM	TO	REQUIRED RESULT
J50-D	J6-H	Continuity
J50-E	K16-8	Continuity
J50-F	J6-F	Continuity
J50-G	J6-M	Continuity
J50-N	J8-S	Continuity
J50-X	J8-U	Continuity
J5-O	TB2-2	Continuity
J5-A	J6-K	Continuity
J5-B	J6-E	Continuity
J5-C	J6-D	Continuity
J5-Z	R13-1	Continuity
J5-M	A5-1	Continuity
J5-U	A5-12	Continuity
J5-V	A5-13	Continuity
J5-Y	A5-4	Continuity
J5-B	A5-6	Continuity
J5-J	K3-A1	Continuity
J6-G	K11-3	Continuity
J6-L	A5-5	Continuity
J6-N	K12-5	Continuity
J6-B	A5-3	Continuity
J7-B	A5-23	Continuity
J7-E	R13-1	Continuity
R29-1	T1-2	Continuity
K12-4	K16-7	Continuity
K11-8	K12-3	Continuity
K16-7	K12-4	Continuity
K11-8	K12-3	Continuity
K3-X2	A5-9	Continuity

a. Remove ten screw assemblies (2, figure 6-40) and washers (3) and lift cover (1) from chassis assembly (39).

b. Tag, then disconnect harness wiring from components.

c. Remove battery charging ammeter shunt (R13), engine crank ing relay (K3), transformer (T1) and resistor (R1), by removing their attaching screws and nuts (2 each). See figure 6-22.

d. Remove underfrequency relay (K12), undervoltage relay (K11) and permissive paralleling relay (K16) by removing their attaching screws (4 each).

#### NOTE

Refer to paragraphs 6-106, 6-110, and 6-114 respectively for relay maintenance instructions.

e. Remove dc control relay assembly (A5) by removing the four nuts securing the assembly in position.

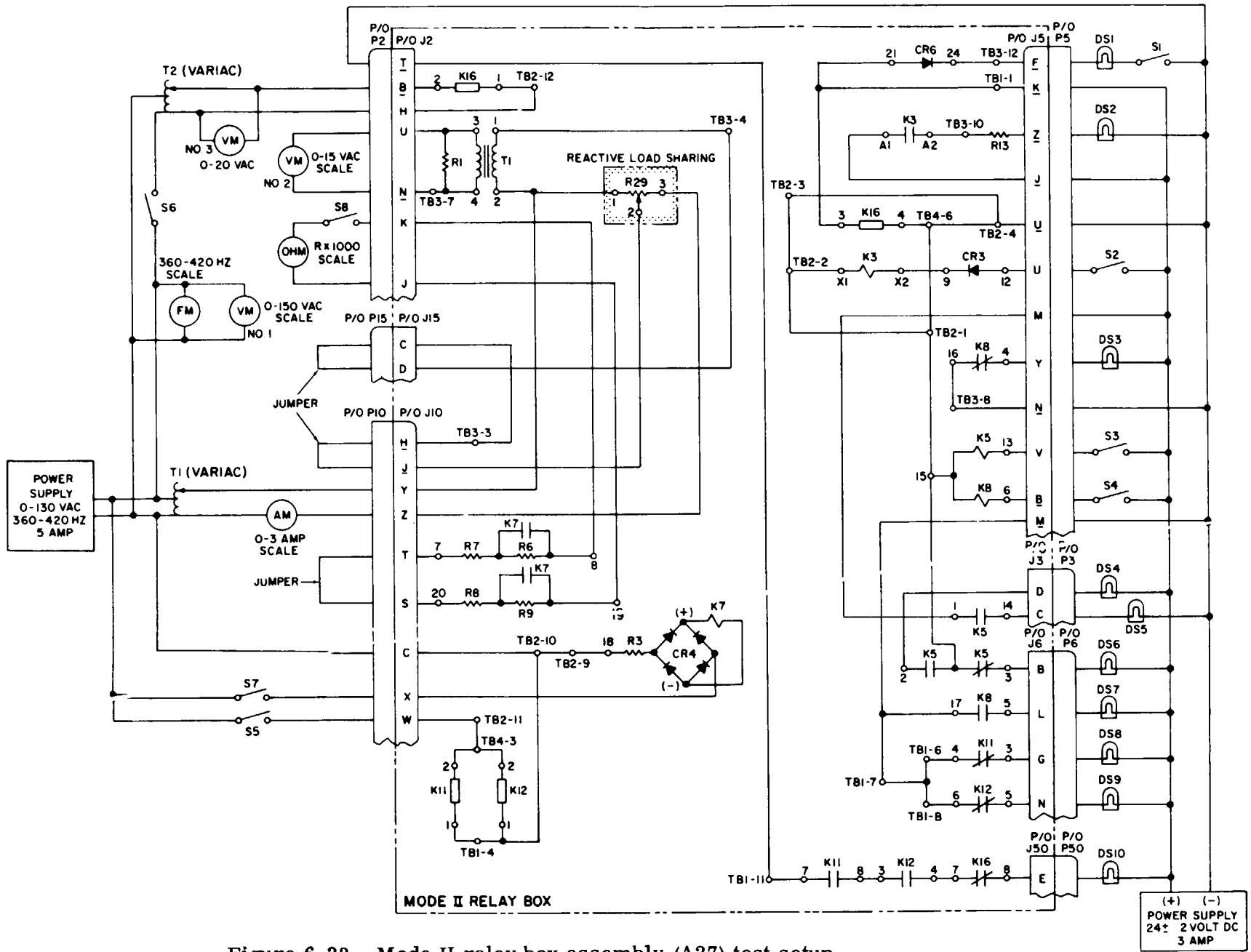


Figure 6-33. Mode II relay box assembly (A27) test setup

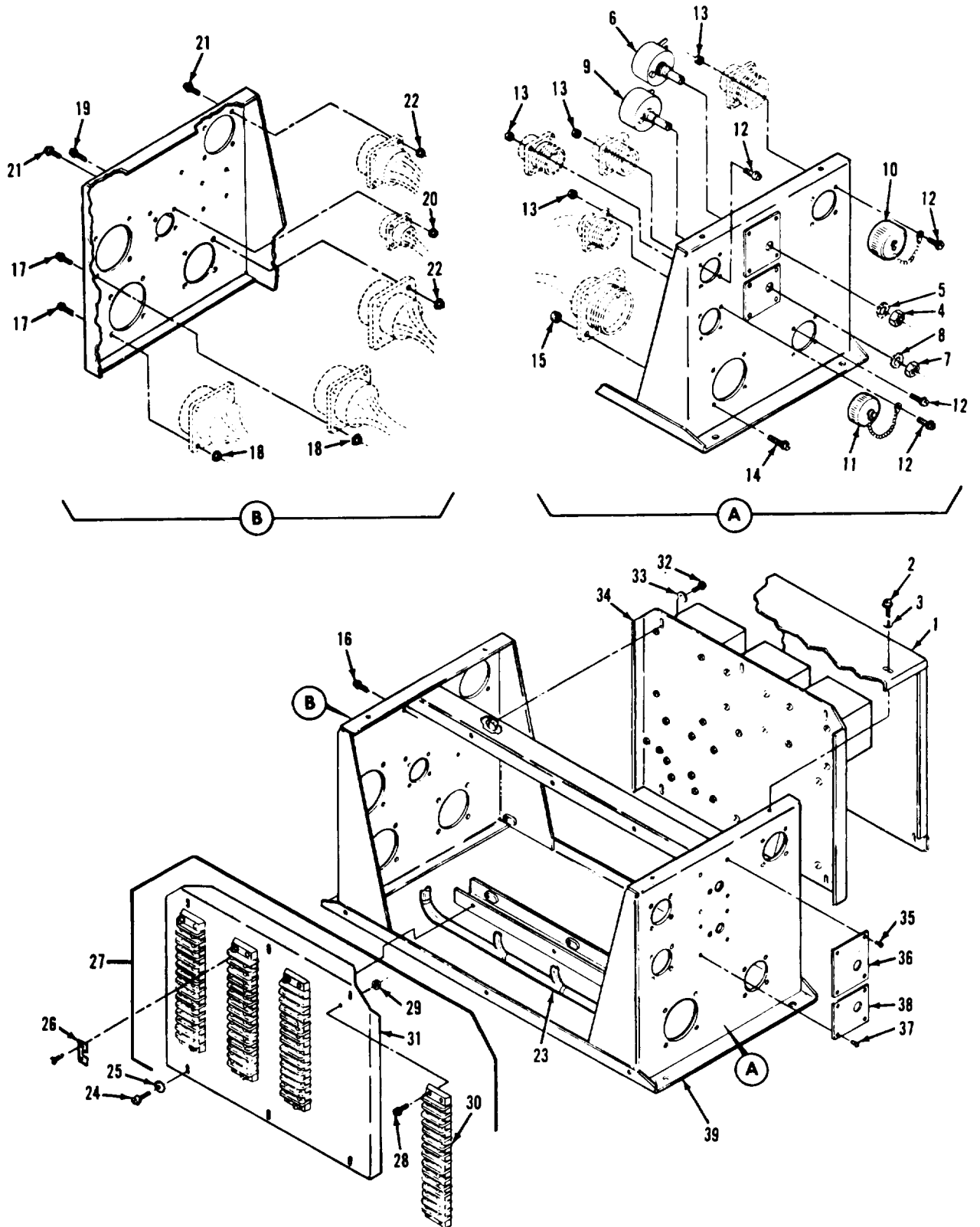


Figure 6-34. Mode II relay box assembly (A27), exploded view

**Legend to figure 6-34:**

- |                                |                                   |
|--------------------------------|-----------------------------------|
| 1. Cover                       | 21. Screw assembly (8)            |
| 2. Screw assembly (10)         | 22. Nut assembly (8)              |
| 3. Washer (10)                 | 23. Wiring harness                |
| 4. Nut                         | 24. Screw assembly (6)            |
| 5. Washer                      | 25. Washer (6)                    |
| 6. Rheostat (R29)              | 26. Terminal board jumper (13)    |
| 7. Nut                         | 27. Terminal board assembly       |
| 8. Washer                      | 28. Screw assembly (8)            |
| 9. Rheostat (R28)              | 29. Nut assembly (8)              |
| 10. Electrical connector cover | 30. Terminal board (4)            |
| 11. Electrical connector cover | 31. Bracket                       |
| 12. Screw assembly (16)        | 32. Screw assembly (6)            |
| 13. Nut assembly (16)          | 33. Washer (6)                    |
| 14. Screw assembly (4)         | 34. Electronic component assembly |
| 15. Nut assembly (4)           | 35. Rivet                         |
| 16. Screw assembly (3)         | 36. Identification plate          |
| 17. Screw assembly (8)         | 37. Rivet                         |
| 18. Nut assembly (8)           | 38. Identification plate          |
| 19. Screw assembly (8)         | 39. Chassis assembly              |
| 20. Nut assembly (8)           |                                   |

**NOTE**

Refer to paragraph 6-86 for dc relay assembly maintenance instructions.

f. Remove electronic components assembly (A6) by removing the three screw assemblies securing the assembly in position.

**NOTE**

Refer to paragraph 6-118 for electronic component assembly maintenance instructions.

g. Remove nuts (4 and 7, figure 6-34) and washers (5 and 8) securing rheostats (6 and 9) to chassis assembly (39).

h. Remove wire harness (23) by removing the four screws and nuts securing each of the ten connectors to the chassis assembly (39).

**NOTE**

Electrical connector covers (10 and 11) will fall free.

6-131. **CLEANING.** Clean all components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

6-132. **INSPECTION.**

a. **Harness.**

1. Inspect harness wiring for defective insulation and continuity.

Table 6-14. Mode II Relay Assembly (A27) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
1.	Connect mode II relay box assembly to test equipment depicted in figure 6-33 and open all switches.			
2.	Energize the 24 VDC power source.	Indicator lights DS8, DS3, DS6, and DS9 should light.	Defective relays K5, K8, K11 and K12.	Test relays K5 and K8 as outlined in figure 6-5.  Test K11 and K12 as outlined in paragraph 6-108 and 6-112.
3.	Close switch S1.	Indicator light DS1 should light.	Defective diode CR6.	Check diode.
4.	Close switch S2.	Indicator light DS2 should light.	Defective relay K3 or or diode CR3.	Test relays as outlined in Figure 6-5. Check diode.
5.	Close switch S3.	Indicator light DS6 should extinguish and DS4 and DS5 should light.	Defective relay K5.	Test relay as outlined in Figure 6-5.
6.	Close switch S4.	Indicator light DS3 should extinguish and DS7 should light.	Deflective relay K8.	Test relay as outlined in figure 6-5.

Change 3 6-99

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-074641-35 TM 5-6115-457-34

Table 6-14. Mode II Relay Box Assembly (A27) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
7.	Turn on AC power supply and adjust voltage for $120 \pm 1$ volt, at 400 Hz.			
8.	Close switch S5.	After 2 seconds indicator lights DS8 and DS9 should extinguish and DS10 should light.	Defective relays K11, K12, or K16	Test relays as outlined in paragraphs 6-108, 6-112 and 6-116.
9.	Adjust voltage to 99 volts.  Note  Repeat test lowering voltage to less than 48 volts. Action should be instantaneous.	In $6 \pm 3$ seconds Indicator light DS10 should extinguish and DS8 should light.	Defective relay K11.	Test relay as outlined in paragraph 6-112.
10.	Reset voltage to $120 \pm 1$ volt AC.	Indicator light DS8 should extinguish and DS10 should light.	Same as step 9.	Same as step 9.
11.	Adjust frequency to $370 \pm 0.8$ Hz.	Indicator light DS10 should extinguish and DS9 should light.	Defective relay K12.	Test relay as outlined in paragraph 6-108.

Table 6-14. Mode II Relay Box Assembly (A27) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
12.	Reset frequency to 400 Hz.	Indicator light DS9 should extinguish and DS10 should light.	Same as step 11.	Same as step 11.
13.	Close switch S6 and adjust T2 for 11-15 volts AC as measured by voltmeter (VM3).	Indicator light DS10 should extinguish.	Defective relay K16.	Test relay as outlined in paragraph 6-116.
14.	Lower voltage (step 13 preceding) below 10 VAC.	Indicator light DS10 should light.	Same as step 13.	Same as step 13.
15.	Close switches S7 and S8.	Ohmmeter should read 5K ohms.	Defective relay K7. Open resistors R7 and R8.	Test relay as outlined in Figure 6-5, check resistors.
16.	With switch S8 closed, open S7.	Ohmmeter should read 15K ohms.	Defective relay K7. Open resistors R6 or R9.	Test relay as outlined in Figure 6-5, check resistors.
17.	Adjust transformer T1 so that ammeter reads $1.5 \pm 0.1$ amperes.	Voltmeter (VM2) should indicate 0-9 VAC as reactive load sharing rheostat R29 is varied full range.	Defective resistor R1, transformer T1, or rheostat R29.	Check resistor, transformer and rheostat.
18.	Turn off AC and DC power supplies.			

Change 8  
6-101

P-8-627-34 T O 35C2-3-442-2  
TM-074644-35 TM 5-6115-457-34

2. Inspect harness connectors for damaged threads; bent, loose or missing pins and for shorts.

#### 6-133. REPAIR.

a. Repair or fabricate mode II relay box assembly wiring harness according to figure 6-35.

6. Straighten dented or distorted sheet metal parts using proper tools. Blend in repaired area with a suitable abrasive paper and touch up painted surfaces. Restencil panel markings as necessary.

6-134. REASSEMBLY. Refer to figure 6-34 and reassemble the mode II relay box assembly in reverse order of index numbers assigned. Pay particular attention to the following:

a. Install wire harness (23) in chassis (39) and secure in position with four screws and nuts at each of the ten connectors.

b. Assemble electronic components assembly (A6) in position using three screw assemblies. See figure 6-22.

c. Assemble dc control relay assembly (A5) in position using four nuts.

d. Assemble underfrequency relay (K12), undervoltage relay (K11) and per-

missive paralleling relay (K16), in position using four each, screws.

e. Assemble battery charging ammeter shunt (R13), engine cranking relay (K3), transformer (T1) and resistor (R1) into position using two each, screws and nuts.

#### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

f. Connect wire harness loads to componentry using figure 1-17 as a guide.

#### NOTE

Solder connections shall be made using solder, Federal Specification QQ-S-571, Sn 60.

g. Test mode II relay box assembly as outlined in paragraph 6-129.

h. Secure cover (1, figure 6-34) to chassis assembly (39) using ten screw assemblies (2) and washers (3).

6-135. INSTALLATION. Refer to figure 6-15, and install the mode II relay box assembly. Secure the assembly in position using four screws and nuts. Refer to the Operator and Organizational Maintenance Manual and reconnect all electrical plug connections to the assembly receptacles.



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	K112D16	J15-A	3	TB3-1	14	24.00
2	BLACK	K111E16	J15-B	↑	TB3-2	14	23.50
3	BLACK	X98D16	J15-C		TB3-3	14	23.00
4	BLACK	X96B16	J15-D		TB3-4	14	22.50
5	BLACK	K112F16	J15-E		TB3-1	14	25.00
6	BLACK	K111H16	J15-F		TB3-2	14	24.50
7	BLACK	X98F16	J15-G		TB3-3	14	24.00
8	BLACK	X96D16	J15-H		TB3-4	14	23.50
9	BLACK	K112J16	J15-J		TB3-1	14	25.00
10	BLACK	K111K16	J15-K		TB3-2	14	23.50
11	BLACK	X98J16	J15-L	↓	TB3-3	14	24.00
12	BLACK	X96F16	J15-M	3	TB3-4	14	23.50
13	BLACK	P55PP12	J7-A	4	TB2-6	74	22.00
14	BLACK	P51A12	J7-B	4	A5-23	24	41.00
15	BLACK	P141D12	J7-E	4	R13-1	16	34.00
16							
17	BLACK	P63C16	J50-a	10	J10-M	9	19.00
18							
19							
20							
21	BLACK	P66B16	A5-3	14	J6-B	13	48.50
22	BLACK	X9M16	J8-A	6	TB4-1	14	37.25
23	BLACK	X12P16	J8-B	↑	TB4-3	14	36.25
24	BLACK	P81F16	J8-C		TB2-14	14	25.00
25	BLACK	P55AD16	J8-D		TB4-6	14	36.75
26	BLACK	K105B16	J8-E		R28-1	—	29.00
27	BLACK	K107B16	J8-F		R28-3	—	29.00
28	BLACK	K110D16	J8-G		J10-K	9	25.00
29	BLACK	K106B16	J8-H		R28-2	—	29.00
30	BLACK	K111D16	J8-J		TB3-2	14	32.50
31	BLACK	K32H16	J8-M		TB3-14	14	30.00
32	BLACK	K103B16	J8-N		A6-TB1-1	14	24.25
33	BLACK	K108B16	J8-P		A6-TB1-5	14	24.25
34	BLACK	K109B16	J8-R		A6-TB1-6	14	24.25
35	BLACK	K102F16	J8-S		J50-M	10	18.50
36	BLACK	K104B16	J8-T	↓	A6-TB1-3	14	24.25
37	BLACK	K101F16	J8-U	6	J50-X	10	13.50
38	BLACK	X91F16	J3-A	7	TB3-13	14	25.00
39	BLACK	X197E16	J3-B	↑	TB3-7	14	28.00
40	BLACK	P42A16	J3-C	↓	A5-14	14	22.50
41	BLACK	P67A16	J3-D	7	A5-2	14	30.00
42	BLACK	D20D16	J2-A	8	J10-J	9	13.50
43	BLACK	D21D16	J2-B	↑	J10-H	9	13.50
44	BLACK	D22D16	J2-C		J10-G	9	13.50
45	BLACK	D24D16	J2-D		A5-d	10	21.00
46	BLACK	X7B16	J2-E	↓	TB1-10	14	14.50
47	BLACK	X8B16	J2-F	8	TB1-9	14	15.00



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
48	BLACK	X14B16	J2-G	8	J10-a	9	13.50
49	BLACK	X15B16	J2-H	↑	TB2-12	14	14.00
50	BLACK	X16B16	J2-I		J10-d	9	13.50
51	BLACK	L25C16	J2-J		A5-19	14	27.00
52	BLACK	L26C16	J2-K		A5-8	14	33.00
53	BLACK	K33C16	J2-N		A, TB1-2	14	20.00
54	BLACK	X31C16	J2-O		J29-C	12	41.00
55	BLACK	X194C16	J2-P		T1-2	14	38.50
56	BLACK	P45H16	J2-R		TB3-11	14	17.00
57	BLACK	X29C16	J2-S		J29-B	12	41.00
58	BLACK	K34C16	J2-T		A6-T51-4	14	20.00
59	BLACK	X90D16	J2-U		R1-2	—	37.00
60	BLACK	E39C16	J2-V		TB4-12	14	19.50
61	BLACK	E38C16	J2-W		TB4-13	14	19.00
62	BLACK	E37C16	J2-X		TB4-14	14	18.50
63	BLACK	E35C16	J2-Y		R13-2	23	21.00
64	BLACK	E36C16	J2-Z		R13-3	23	20.50
65	BLACK	P199C16	J2-a		J10-f	9	13.50
66	BLACK	L93D16	J2-b		K16-2	14	41.25
67	BLACK	P198C16	J2-c		TB4-10	14	20.50
68	BLACK	P47D16	J2-e		TB3-8	14	16.50
69	BLACK	X195C16	J2-f		R29-3	—	29.50
70	BLACK	P44D16	J2-g		TB3-9	14	17.50
71	BLACK	P62B16	J2-h		TB1-5	14	18.00
72	BLACK	P56D16	J2-k		TB3-5	14	19.00
73	BLACK	P80C16	J2-m		TB3-6	14	18.50
74	BLACK	X197C16	J2-n		TB3-7	14	18.00
75	BLACK	P55Z16	J2-p		TB2-8	14	16.50
76	BLACK	P55W16	J2-r		TB2-7	14	17.00
77	BLACK	P57E16	J2-l		TB1-11	14	14.00
78	BLACK	P40K16	J2-v		J29-A	12	41.00
79	BLACK	P40J16	J2-v		TB4-9	14	24.00
80	BLACK	P50K16	J2-w		TB1-3	14	18.50
81	BLACK	P46C16	J2-y		TB4-11	14	20.00
82	BLACK	X12B16	J2-z	↓	TB2-11	14	17.00
83	BLACK	X9B16	J2-z	8	TB2-9	14	16.00
84	BLACK	X7A16	J10-A	9	TB1-10	14	16.00
85	BLACK	X8A16	J10-B	↑	TB1-9	14	16.50
86	BLACK	X9A16	J10-C		TB2-10	14	18.50
87	BLACK	X19C16	J10-D		J50-v	10	19.00
88	BLACK	X18C16	J10-E		J50-u	10	19.00
89	BLACK	X17C16	J10-F		J50-t	10	19.00
90	BLACK	P55J16	J10-L		TB2-6	14	20.00
91	BLACK	P50EE16	J10-N		TB1-4	14	18.50
92	BLACK	P151C16	J10-P		J29-N	12	42.00
93	BLACK	P150C16	J10-R	↓	J29-M	12	42.00
94	BLACK	X21R16	J10-S	9	A5-20	14	25.50

Figure 6-35. Mode II relay box assembly (A27) wiring diagram (Sheet 2 of 4)

WIRE NO.	WIRE MARKING		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	IDENTIFICATION COLOR	NUMBER					
95	BLACK	X22R16	J10-T	9	A5-7	14	33.50
96	BLACK	X12W16	J10-W	↑	TB2-11	14	17.50
97	BLACK	X6C16	J10-X		A5-22	14	26.00
98	BLACK	X194E16	J10-Y		R29-1	-	30.00
99	BLACK	X195D16	J10-Z		R29-3	-	30.00
100	BLACK	X15A16	J10-b		TB2-12	14	18.00
101	BLACK	P56H16	J10-c		TB3-5	14	23.00
102	BLACK	P50MM16	J10-e		TB1-3	14	13.00
103	BLACK	K112C16	J10-f		TB3-1	14	25.00
104	BLACK	X98C16	J10-g	↑	TB3-3	14	23.50
105	BLACK	X97A16	J10-h	9	R29-2	-	31.00
106	BLACK	P58B16	J50-A	10	J5-E	11	29.50
107	BLACK	P50R16	J50-B	↑	TB1-4	14	20.00
108	BLACK	P206B16	J50-C		J6-1	13	36.00
109	BLACK	P205B16	J50-D		J6-H	13	36.00
110	BLACK	P60C16	J50-E		K16-8	14	38.00
111	BLACK	P203B16	J50-F		J6-F	13	36.00
112	BLACK	P209B16	J50-G		J6-M	13	36.00
113	BLACK	P62H16	J50-H		TB1-5	14	21.00
114	BLACK	X9T16	J50-J		TB2-10	14	21.50
115	BLACK	X12AA16	J50-K		TB2-11	14	21.50
116	BLACK	P50Z16	J50-L		TB1-4	14	19.00
117	BLACK	P55Y16	J50-M		TB2-6	14	23.50
118	BLACK	P200S16	J50-P		TB1-8	14	18.00
119	BLACK	X8H16	J50-R		TB1-9	14	17.00
120	BLACK	X7H16	J50-S		TB1-10	14	16.50
121	BLACK	P55AR16	J50-W	↓	TB2-7	14	27.00
122	BLACK	P62A16	J50-U	10	TB1-5	14	25.00
123	BLACK	P207B16	J5-A	11	J6-K	13	15.00
124	BLACK	P202B16	J5-B	↑	J6-E	13	15.00
125	BLACK	P201B16	J5-C		J6-D	13	15.00
126	BLACK	P44H16	J5-D		TB3-9	14	14.00
127	BLACK	P198E16	J5-G		TB4-10	14	10.50
128	BLACK	P46E16	J5-H		TB4-11	14	10.00
129	BLACK	E39E16	J5-I		TB4-12	14	9.50
130	BLACK	E38E16	J5-J		TB4-13	14	8.50
131	BLACK	E37E16	J5-K		TB4-14	14	8.50
132	BLACK	P140J16	J5-L		TB3-10	14	13.50
133	BLACK	P40H16	J5-M		TB3-9	14	11.50
134	BLACK	P80B16	J5-P		TB3-6	14	17.50
135	BLACK	P80F16	J5-R		TB3-6	14	15.00
136	BLACK	P55F16	J5-S		TB2-2	14	18.50
137	BLACK	P48B16	J5-U		A5-12	14	43.00
138	BLACK	P54B16	J5-V		A5-13	14	31.00
139	BLACK	P200J16	J5-W		TB1-6	14	20.50
140	BLACK	P52B16	J5-Y	↓	A5-4	14	40.50
141	BLACK	P200L16	J5-Z	11	TB1-6	14	21.00

WIRE NO.	WIRE MARKING		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	IDENTIFICATION COLOR	NUMBER					
142	BLACK	P68B16	J5-b	11	A5-6	14	42.00
143	BLACK	P50X16	J5-c	↑	TB1-1	14	23.00
144	BLACK	P51D16	J5-d		TB3-12	14	13.00
145	BLACK	P50U16	J5-e		TB1-2	14	23.50
146	BLACK	P51F16	J5-f		TB3-12	14	13.00
147	BLACK	P55S16	J5-g		TB2-3	14	18.25
148	BLACK	P55P16	J5-h		TB2-3	14	18.50
149	BLACK	P41A16	J5-i		K3-A1	23	30.00
150	BLACK	P50KK16	J5-k		TB1-1	14	23.00
151	BLACK	P200P16	J5-m		TB1-7	14	20.50
152	BLACK	P47J16	J5-n		TB3-8	14	14.00
153	BLACK	P80A16	J5-p		TB3-6	14	15.00
154	BLACK	P55M12	J5-t		TB2-4	14	18.00
155	BLACK	P55E12	J5-u		TB2-4	24	18.00
156	BLACK	P140E12	J5-w	↓	TB3-10	24	15.00
157	BLACK	P141C12	J5-z	11	R13-1	16	31.00
158	BLACK	P45L16	J29-D	12	TB3-11	14	47.00
159	BLACK	P55U16	J29-E	↑	TB2-5	14	48.00
160	BLACK	P47F16	J29-F		TB3-8	14	47.00
161	BLACK	P44E16	J29-G		TB3-9	14	49.00
162	BLACK	P56E16	J29-H		TB3-5	14	51.00
163	BLACK	P149C16	J29-J	↓	J10-k	9	42.00
164	BLACK	P148C16	J29-K	12	J10-l	9	42.00
165	BLACK	P45J16	J6-A	13	TB3-11	14	20.00
166	BLACK	P200B16	J6-C	↓	TB1-8	14	27.00
167	BLACK	P204B16	J6-G		K11-3	14	53.00
168	BLACK	P208B16	J6-L	↓	A5-5	14	48.50
169	BLACK	P210B16	J6-M	13	K12-5	14	53.25
170	BLACK	P50JJ12	TB1-2	24	A5-21	15	30.50
171	BLACK	P200N16	TB1-7	14	A5-17	14	28.00
172	BLACK	P57F16	TB1-11	↑	K11-7	14	32.25
173	BLACK	P55AB16	TB2-1		TB4-6	14	24.00
174	BLACK	P55U16	TB2-1		A5-15	14	32.50
175	BLACK	P55YY16	TB2-2		K3-X1	14	30.00
176	BLACK	X9J16	TB2-9		A5-18	14	29.50
177	BLACK	X9K16	TB2-10		TB4-2	14	29.00
178	BLACK	X12A16	TB2-11		TB4-4	14	20.75
179	BLACK	X15J16	TB2-12		K16-1	14	42.00
180	BLACK	X96A16	TB3-4		T1-1	14	46.50
181	BLACK	X197D16	TB3-7	↑	R1-1	-	46.00
182	BLACK	P47E16	TB3-8	14	A5-16	14	32.00
183	BLACK	P140F12	TB3-10	24	R13-4	16	23.00
184	BLACK	P140H16	TB3-10	14	K3-A2	23	29.00
185	BLACK	P51C16	TB3-12	↑	A5-24	14	30.00
186	BLACK	X9R16	TB4-1		K11-1	14	52.75
187	BLACK	X9S16	TB4-1	↓	K12-1	14	50.00
188	BLACK	X12T16	TB4-3	14	K12-2	14	49.00

Figure 6-35. Mode II relay box assembly (A27) wiring diagram (Sheet 3 of 4)

24		B	71-4924	6	TERMINAL, LUG, CRIMP STYLE		
23			MS25036-108	4	TERMINAL, LUG, CRIMP STYLE		
22			TYPE F, FORM Ua GRADE a, Cl I CATEGORY 1	5	TUBING, INSULATION, 148 IDX. 020 WALL X .62 LG	MIL-I-631	
21			TYPE F, FORM Ua GRADE a, Cl I CATEGORY 1	227	TUBING, INSULATION .106 IDX. 016 WALL X .62 LG	MIL-I-631	
20			SN66WRAP 2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 3
19			MS3367-4-9	17	STRAP, TIEDOWN		NYLON
18			MS3367-1-9	82	STRAP, TIEDOWN		NYLON
17			MS39020-2	1	BAND, MARKER		AL ALY
16			MS25036-157	3	TERMINAL, LUG, CRIMP STYLE		
15			MS25036-111	6	TERMINAL, LUG, CRIMP STYLE		
14			MS25036-106	174	TERMINAL, LUG, CRIMP STYLE		
13			MS3102R20-27S	1	CONNECTOR, RECEPTACLE		
12			MS3102R22-19S	1	CONNECTOR, RECEPTACLE		
11			MS3102R36-7P	1	CONNECTOR, RECEPTACLE		
10			MS3102R28-12S	1	CONNECTOR, RECEPTACLE		
9			MS3102R32-7P	1	CONNECTOR, RECEPTACLE		
8			MS3102R36-7S	1	CONNECTOR, RECEPTACLE		
7			MS3102R145-6S	1	CONNECTOR, RECEPTACLE		
6			MS3102R24-28S	1	CONNECTOR, RECEPTACLE		
5							
4			MS3102R18-11S	1	CONNECTOR, RECEPTACLE		
3			MS3102R20-29S	1	CONNECTOR, RECEPTACLE		
2			MS0867-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
1			MS0867-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
FIND NO	CODE IDENT	QTY	PART OR IDENTIFYING NO	QTY REQD	NONENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

WIRE NO.	WIRE MARKING		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG REF
	COLOR	NUMBER					
189	BLACK	X12U16	TB4-3	14	K11-2	14	49.25
190	BLACK	P50P16	TB1-1	14	K16-3	14	42.50
191	BLACK	P55AE16	TB4-6	14	K16-4	14	53.50
192	BLACK	P200F16	TB1-6	14	K11-4	14	47.00
193	BLACK	P200H16	TB1-8	14	K12-6	14	38.50
194	BLACK	P49A16	A5-9	14	K3-X2	14	24.50
195	BLACK	P59A16	K12-4	14	K16-7	14	2.50
196	BLACK	P71A16	K12-3	14	K11-8	14	10.00
197	BLACK	X194D16	T1-2	14	R29-1	—	54.00
198	BLACK	P81D16	J5-F	11	TB2-14	14	15.00
199	BLACK	X91C16	J2-L	8	TB3-13	14	17.00
200	BLACK	K32C16	J2-M	8	TB3-14	14	16.00
201	BLACK	P40AA16	TB4-9	14	A5-1	14	44.00
202	BLACK	P40AB16	J10-V	9	TB4-9	14	30.00
203	RED	P55BK16	J5-0	11	TB2-2	14	26.00

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 20.
3. CABLE STRAPS, FIND NO. 18 AND 19. SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. A. TRUNK BENDS TO BE 2.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
 B. BREAKOUTS TO BE 1.00 RADIUS.

Figure 6-35. Mode II relay box assembly (A27) wiring diagram (Sheet 4 of 4)

Section VIII. RECONNECTION BOARD ASSEMBLY, LOAD CONTACTOR, MOTOR OPERATED CIRCUIT BREAKER ASSEMBLY, LOAD BOARD ASSEMBLY, AND TRANSFORMER ASSEMBLY

6-136. GENERAL.

The reconnection board assembly, load contactor, load bus bars, load board assembly, and transformer assembly are located on the right side of the generator. The motor operated circuit breaker assembly, used in place of the load contactor on 400 hertz generator sets, is located on the left side of the generator.

a. The voltage reconnection system permits reconnection of the generator phase windings to provide 120/208 or 240/460 output voltages. One end of each coil of each phase winding runs from the generator through an instrumentation and a static exciter current transformer to the reconnection panel. This assures current sensing in each phase regardless of voltage connection at the reconnection board assembly. The reconnection board assembly is equipped with a voltage change board to permit easy conversion to 120/208 or 240/416 generator output voltage. Positioning of the voltage change board connects two coils of each phase in series or parallel. In parallel the output is 120/208, in series the output is 240/416 VAC. The terminals on the reconnection board assembly for connection to the generator loads are numbered according to the particular coil end of each phase of the generator to ensure proper connections.

b. The output terminals at the reconnection board assembly are connected to the load contactor through bus bars or to the circuit breaker with cable assemblies. The load contactor and circuit breaker have three main contacts within it which serve to connect or disconnect the load from the generator 3 phase, 4 wire, Y connected output. Three cables from the load contactor

or circuit breaker assembly are connected to the load terminal board where the load is electrically connected. The load terminal board has four terminals which are marked L1, L2, L3, and LO, respectively. Terminals L1, L2, and L3 are connected through cable, bus bars, and the load contactor or circuit breaker assembly to generator output leads T1, T2, and T3, respectively. The load contactor also contains auxiliary dc contacts and a connector for connection of these auxiliary contacts in the generator set electrical system.

6-137. RECONNECTION BOARD ASSEMBLY.

6-138. REMOVAL. Refer to figure 6-36 and remove reconnection board assembly as follows:

- a. Remove protective cover (3) by removing loosening studs (1).
- b. Remove brackets (6 and 7) by removing screws (4) and nuts (5).
- c. Remove support bracket (8) by removing screws (28), lock washers (29), and washers (30).

NOTE

Tag electrical leads with location to insure proper installation.

d. Remove nuts (9), washers (10), electrical leads (11), and bus bars (12) from reconnection board assembly (13).

6-139. DISASSEMBLY. Refer to figure 6-37 and disassemble reconnection board assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Each stud is numbered, note numbering sequence prior to removal to insure proper reassembly.

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

6-140. CLEANING. Clean parts in an approved cleaning solvent and dry thoroughly.

6-14i. INSPECTION.

- a. Inspect threads for damage.
- b. Inspect terminal board and bus bars for cracks, warping, and burnt spots.
- c. Inspect for broken electrical leads (due to missing flat washers). Caused by lock washers cutting into leads without flat washers.

6-142. REASSEMBLY. Refer to figure 6-37 and reassemble reconnection board assembly in the reverse order of index numbers assigned. Pay particular attention to the following.

- a. Make sure studs are installed in proper numbering sequence.

6-143. INSTALLATION. Refer to figure 6-36 and install reconnection board assembly as follows:

- a. Connect bus bars (12), electrical leads (11), washers (10) and nuts (9) to reconnection board assembly (13) studs.
- b. Position reconnection board assembly (13), support bracket (8) and brackets (7 and 6) into mounting position on generator, and secure with screws (4 and 28), nuts (5), lock washers (29) and washers (30).
- c. Install protective cover (3) and secure by tightening studs.

6-144. LOAD CONTACTOR.

6-145. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the load contactor is usually indicated by the load contactor opening when the generator is operating within normal parameters or the contactor will not close to apply power to the load.

NOTE

Test should be accomplished with generator not operating and load cables disconnected.

1. Remove protective cover (3, figure 6-36) by loosening stud (1).
2. Disconnect electrical connector from load contactor connector J41. Connect a suitable voltmeter across pins A and B of connector P41. Refer 1-2 or 1-3.
3. Energize DC control circuit breaker, position start-run-stop switch to RUN, and position battle short switch to ON.
4. Position ac load contactor switch to CLOSE, voltmeter should indicate approximately 24 VDC. If voltage is present, check resistance of contactor coil between contactor connector J41 pins A and B, resistance should be 6.7 ohms. Replace defective contactor. If voltage is not present, check wiring back to its source and correct malfunction.

NOTE  
APPLICATIONS REQUIRING HB200A (50603) WILL  
REQUIRE MODIFICATION TO BRACKET 71-4642.

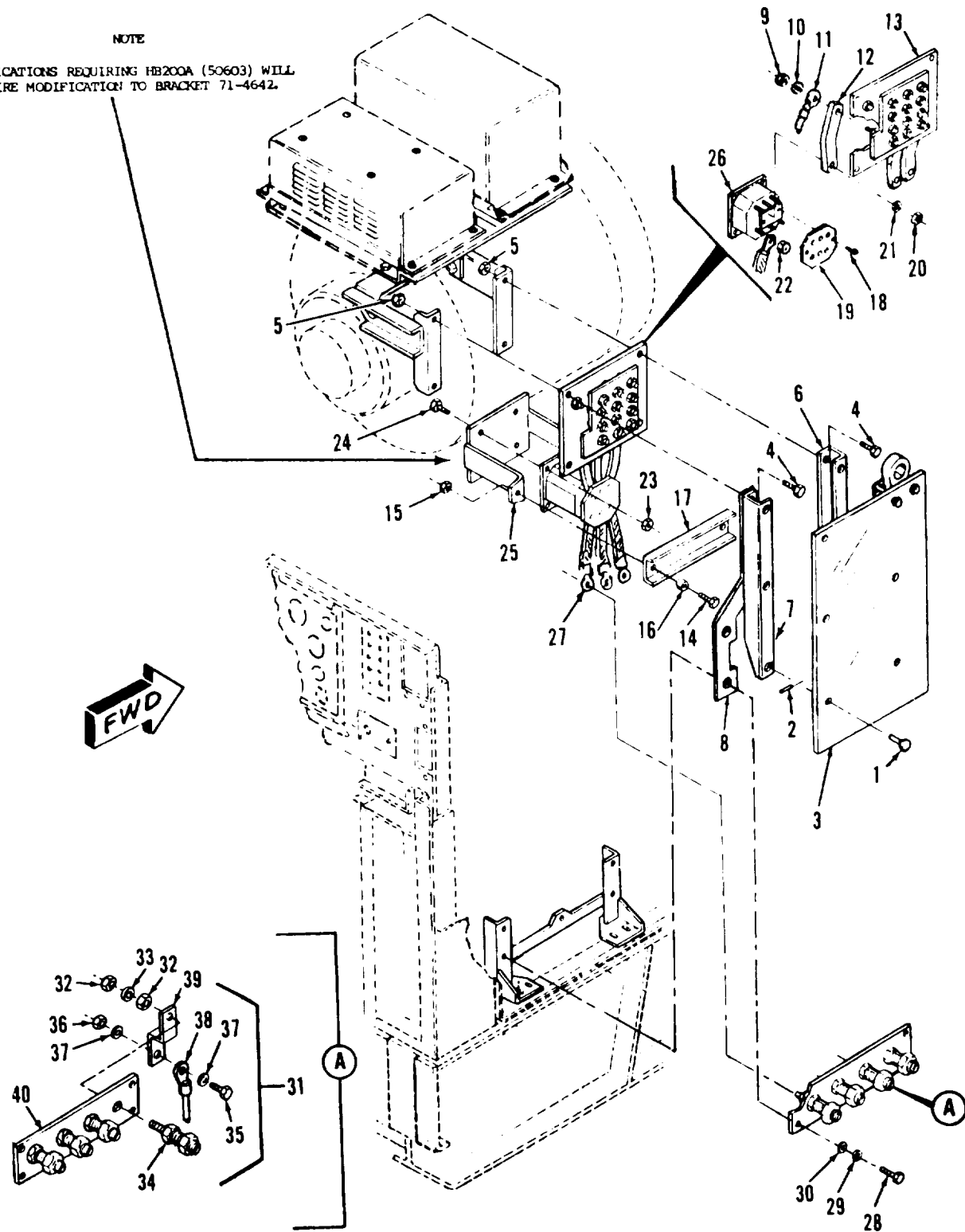


Figure 6-36. Reconnection board assembly, load contactor, and load board assembly, removal and installation

Legend to figure 6-36:

1. Stud (6)
2. Cross pin (6)
3. Protective cover
4. Screw (4)
5. Nut (4)
6. Bracket
7. Bracket
8. Support bracket
9. Nut (3)
10. Washer (3)
11. Electrical lead
12. Bus bar (3)
13. Reconnection board assembly
14. Screw (2)
15. Nut (2)
16. Spacer (2)
17. Strap
18. Screw (2)
19. Cover
20. Nut (3)
21. Washer (3)
22. Nut (3)
23. Nut and washer (4)
24. Screw and washer assembly
25. Mounting bracket
26. Contactor
27. Contactor cable (3)
28. Screw (4)
29. Lock washer (4)
30. Washer (4)
31. Load board assembly
32. Nut (8)
33. Lock washer (4)
34. Load terminal (4)
35. Screw
36. Nut
37. Washer (2)
38. Lead
39. Neutral bus bar
40. Terminal board

Legend to figure 6-36A:

- |                                    |  |
|------------------------------------|--|
| 1. Identification Plate            | 37. Grommet                              |
| 2. Wiring diagram Plate            | 38. Nut                                  |
| 3. Screw                           | 39. Lock washer                          |
| 4. Lock washer                     | 40. Washer                               |
| 5. Washer                          | 41. Contact assembly                     |
| 6. Terminal cover                  | 42. Main base                            |
| 7. Screw                           | 43. Screw                                |
| 8. Washer                          | 44. Washer                               |
| 9. Screw                           | 45. Actuator assembly                    |
| 10. Lock washer                    | 46. Auxiliary contact assembly connector |
| 11. Washer                         | 47. Screw                                |
| 12. Gasket                         | 48. Washer                               |
| 13. Gasket                         | 49. Screw                                |
| 14. Cover assembly                 | 50. Washer                               |
| 15. Primary contactor              | 51. Auxiliary contact assembly           |
| 16. Screw                          | 52. Nut                                  |
| 17. Lock washer                    | 53. Lock washer                          |
| 18. Washer                         | 54. Spring                               |
| 19. Chamber base                   | 55. Guide rod                            |
| 20. Gasket                         | 56. Nut                                  |
| 21. Main contact operator assembly | 57. Lock washer                          |
| 22. Nut                            | 58. Spacer                               |
| 23. Lock washer                    | 59. Core and rod assembly                |
| 24. Adjusting bushing              | 60. Post and operator                    |
| 25. Retainer                       | 61. Screw                                |
| 26. Locating bushing               | 62. Lock washer                          |
| 27. Spring                         | 63. Washer                               |
| 28. Shim                           | 64. Screw                                |
| 29. Main contact bridge assembly   | 65. Lock washer                          |
| 30. Main contact                   | 66. Washer                               |
| 31. Nut                            | 67. Screw                                |
| 32. Lock washer                    | 68. Lock washer                          |
| 33. Terminal washer                | 69. Switch bracket                       |
| 34. Base assembly                  | 70. Licon switch                         |
| 35. Arc chute                      | 71. End plate                            |
| 36. Arc chute spacer               | 72. Coil                                 |
|                                    | 73. Coil washer                          |
|                                    | 74. Core frame                           |



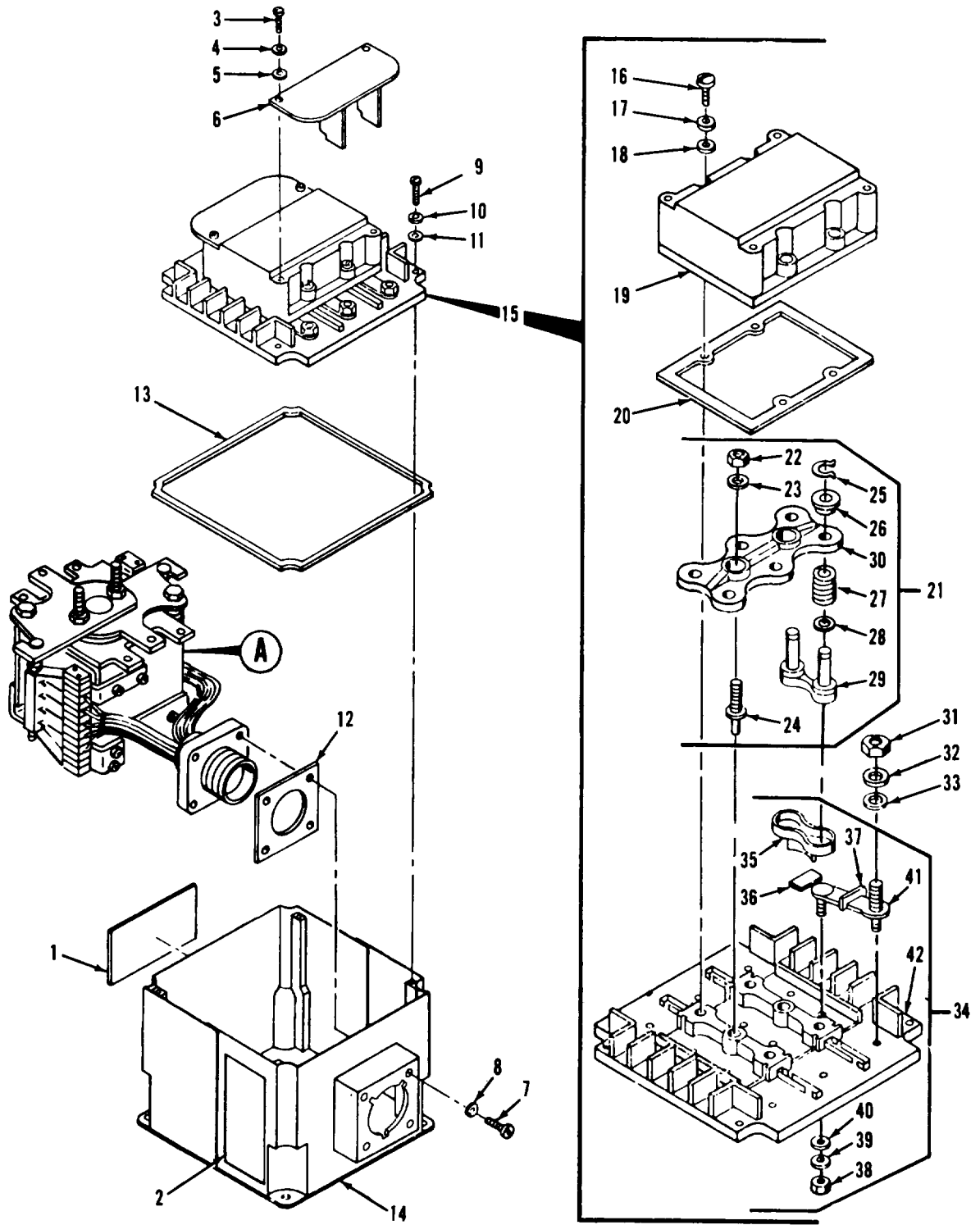


Figure 6-36A. Main load contactor (sheet 1 of 2)

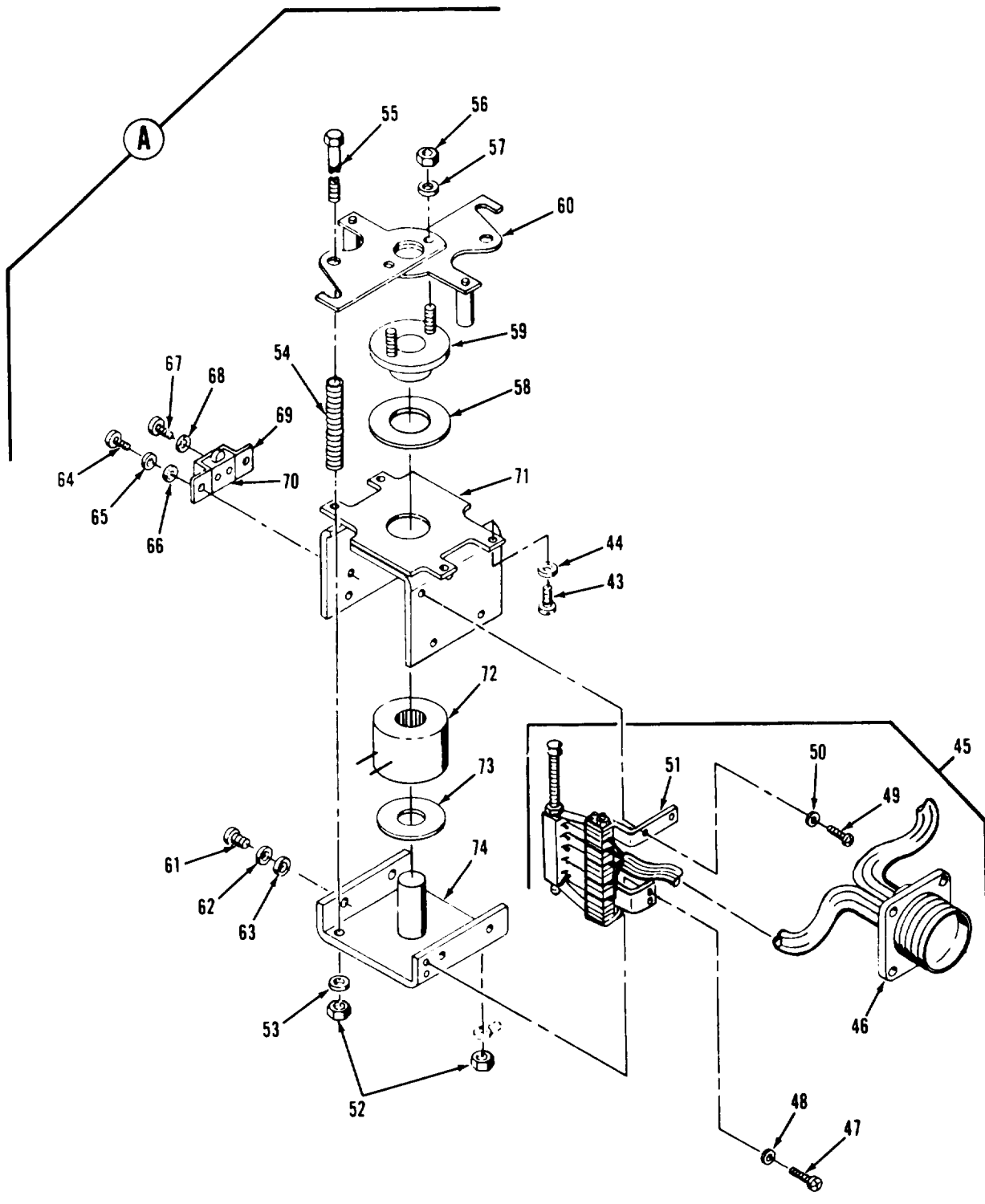


Figure 6-36A. Main load contactor (sheet 2 of 2)

5. Position load contactor switch to OPEN, battle short switch to OFF, and start-run-stop switch to STOP. De-energize circuit breaker,

6. Connect connector to load contactor and install protective cover.

■ b. Removal. Refer to figure 6-36 and remove load contactor as follows:

1. Remove protective cover (3) by loosening studs (1).

2. Disconnect bracket (17) by removing screws (14), spacers (16), and nuts (15).

3. Disconnect cover (19) from load contactor by removing screws (18). Disconnect bus bar (12) and contactor cables (27) from load contactor by removing nuts and washers.

4. Loosen nuts (9) securing bus bars (12) to reconnection board studs, to remove bus bars from contractors.

5. Disconnect electrical connector from connector J41 of load contactor.

6. Disconnect load contactor (26) from mounting bracket (25) by removing nuts (23) and screws (24).

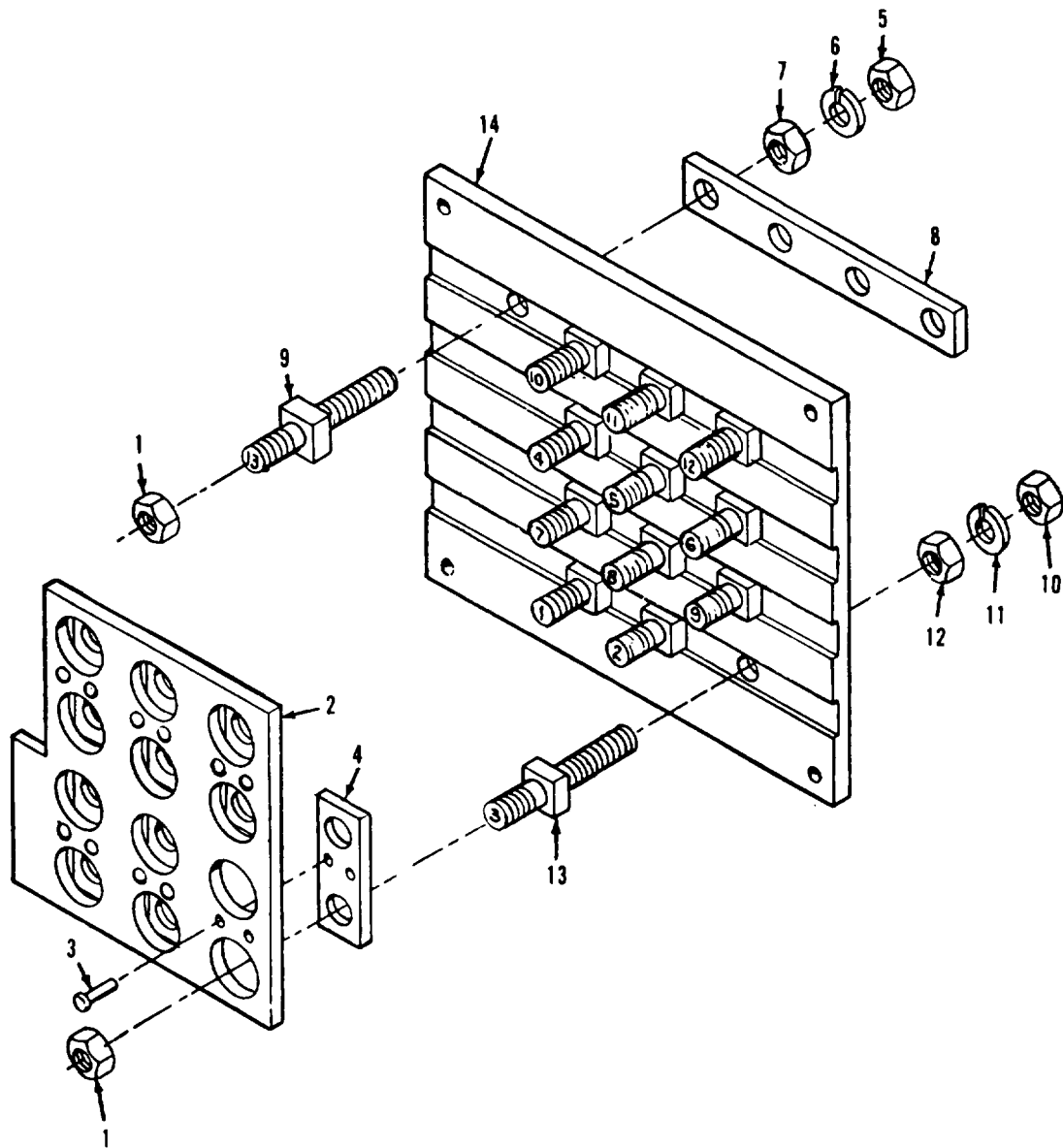


Figure 6-37. Reconnection board assembly, exploded view

Legend to figure 6-37:

- |                                       |                     |
|---------------------------------------|---------------------|
| 1. Nut (13)                           | 8. Bus bar          |
| 2. Voltage change board               | 9. Stud (4)         |
| 3. Rivet (12)                         | 10. Stud Nut (9)    |
| 4. Bus bar (6)                        | 11. Stud Washer (9) |
| 5. Nut (4)                            | 12. Stud Nut (9)    |
| 6. Terminal board assembly washer (4) | 13. Stud (9)        |
| 7. Nut (4)                            | 14. Terminal board  |

6-145A. REMOVAL. Refer to figure 6-36 and remove the load contactor as follows:

- a. Remove protective cover (3) by loosening studs (1). Disconnect strap (17) by removing screws (14), spacers (16), and nuts (15),
- b. Disconnect cover (19) from load contactor by removing screws (18). Disconnect bus bar (12) and contactor cables (27) from load contactor by removing nuts and washers.
- c. Loosen nuts (9) securing bus bars (12) to reconnection board studs, to remove bus bars from contactors. Disconnect electrical connector from connector J41 of load contactor.
- d. Disconnect load contactor (26) from mounting bracket (25) by removing nuts (23) and screws (24).

6-146. BENCH TEST.

- a. Apply 24 Vdc at pins A and B of main load contactor (3) connector. When main load contactor operates, it should create a distinctive noise.
- b. With an ohmmeter, check for continuity between terminal A1 and A2, B1 to B2, and C1 to C2 on top of the main load contactor.
- c. At the connector, check for continuity between pins C to D, E to F, G to H, J to K, and R to T.
- d. At the connector, check for an open circuit between pins L to M, N to P, and R to S.
- e. Remove the 24 Vdc and check for the opposite of the conditions (continuity or open circuit) listed in steps (2), (3), and (4).

6-146A. DISASSEMBLY. Refer to figure 6-36A and disassemble the main load contactor as follows:

- a. Remove screws (3), lock washers (4), washers (5) and two terminal covers (6) from the primary contactor assembly (15). Remove screws (7) and washers (8) holding the auxiliary contact connector (46) to the cover assembly (14).
- b. Remove screws (9), lock washer (10) and washers (11) from the primary contactor assembly (15). Push in on the auxiliary contact connector (46) freeing it and the gasket (12) from the cover assembly (14). Remove the primary contactor assembly (15) and gasket (13) from the cover assembly (14).
- c. Remove screws (16), lock washers (17) and washers (18) from the chamber base (19). Remove the chamber base (19) and gasket (20) from the main base (42),
- d. Disassemble the main contact operator assembly (21) in the following manner. Remove nut (22) and lock washer (23) from adjusting bushing (24). Remove retainer (25) and locating bushing (26) from the main contact bridge assembly (29). Remove the main contact (30), spring (27) and shim (28) from the main contact bridge assembly (29).
- e. Remove the arc chute (35), arc chute spacer (36) and grommet from the main base (42). Remove nuts (31 and 38), lock washers (32 and 39), terminal washers (33) and washers (40) from contact assembly (41). Remove contact assembly (41) from main base (42).

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

I

- f. Remove screws (43) and washers (44) from the end plate (71) and remove same from the main base (42). Remove screws (47 and 49) and washers (48 and 50) and remove the actuator assembly (45). Tag and

unsolder the leads from the connector (46) to the auxiliary contact assembly (51).

g. Remove nuts (52) and washer (53) from guide rod (55); carefully remove spring (55). Remove nuts (56) and washers (57) and remove the post and operator (60), core and rod assembly (59) and spacer (58) from end plate (71).

h. Remove screws (61), lock washers (62) and washers (63) from the core frame (74). Carefully slide the core frame (74) containing the coil (72) and coil washer (73) out from the end plate (71). Remove screws (64 and 67), lock washers (65 and 68) and washers (66) and remove the switch bracket (69) and licon switch (70) from the end plate (71).

6-146B. CLEANING. Clean all components with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly .

6-146C. INSPECTION.

a. Inspect harness wiring for defective insulation and continuity.

b. Inspect harness connector for damaged threads; bent, loose or missing pins and for shorts.

c. Check electrical components for opens, shorts, continuity, and proper values.

6-146D. REPAIR,

a. Replace contactor coil (72, figure 6-36A) if defective.

b. Replace contacts if badly pitted or burned.

c. Repair damaged threads with a die or by filing with a fine mill file.

6-146E. REASSEMBLY. Refer to figure 6-36A and reassemble the main load contactor as follows:

a. Install switch bracket (69) and licon switch (70) to end plate (71) using screws (64 and 67), lock washers (65 and 68) and washers (66).

b. Insert coil washer (73) and coil (72) over center pin on coil frame (74). Carefully align end plate (71) over the coil (72) and coil frame (74). Place spacer (58), core and rod assembly (59) and post and operator (60) onto end plate (71). Fasten post and operator (60) to end plate (71) utilizing guide rod (55), spring (74), nuts (52) and washers (53). Install screws (61), lock washers (62) and washers (63) and tighten snug. Install nuts (56) and lock washers (57) to the core and rod assembly (59).

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

c. Connect and solder electrical leads from connector (46) to auxiliary contact assembly (51). Install actuator assembly (45) to end plate (71) and core frame (74) using screws (47 and 49) and washers (48 and 50). Carefully clamp post and operator (60) and the core frame (74), so that no air space exists between the coil (72) and the core and rod assembly (59). Also check that no air space exists between the spacer (58) and end plate (71). Tighten screws (47 and 61). Remove the clamp and insert a  $.150 \pm .010$ , feeler gage, between the coil (72) and core and rod assembly (59). Adjust the guide rods (55) until the gage is snug. Secure after adjustment by tightening nuts (52).

d. Assemble the base assembly (34) by installing contact assembly (41) to main base (42). Secure with nut (38), lock washer (39) and washer (40). Install nut (31), lock washer (32) and washer (33) to contact assembly (41). Place the arc chute (35), arc chute spacer (36) and grommet (37) atop the contact assembly (41).

e. Assemble the main contact operator assembly (21) by placing shim (28) and spring (27) onto the main contact bridge assembly (29). Assemble three contact bridge assemblies and carefully insert into the main contact (30). Press down on the main contact (30) and place the locating bushings (26) and retainers (25) over the main contact bridge assembly (29). After reassembly of the main contact operator assembly (21), check each individual contact at its edge with a suitable force gage, Preload shall be 1 1/2 - 2 1/2 lbs. Preload is checked by the initial breakaway of the retainer (25).

f. Fasten adjusting bushing (24) to the main base (42). Carefully seat the main contact operator assembly (21) onto the adjusting bushings (24) and arc chutes (35). Install nuts (22) and lock washers (23). Place gasket (20) and chamber base (19) onto base assembly (34) and fasten with screws (16), lock washers (17) and washers (18).

#### NOTE

Before proceeding with the final phase of reassembly, it is mandatory that adjustment of the contactor be performed, Refer to paragraph 6-146E.

g. Seat gasket (13) into groove on main base (42). Place gasket (12) over the aux-

iliary contact connector (46). Insert the primary contactor assembly (15) into the cover assembly (14), Insert and seat the connector in the receptical opening of the cover assembly (14). Attach with screws (7) and washers (8). Carefully seat the main base (42) of the primary contactor assembly (15) onto the cover assembly (14); check that the gasket (13) forms an airtight seal. Install screws (9), lock washers (10) and washers (11). Place terminal cover (6) onto the primary contactor assembly (15). Secure with screws (3), lock washers (4) washers (5). Do not overly tighten screws (3) as the terminal cover (6) may crack.

#### 6-146F. ADJUSTMENT.

a. Contact Overtravel. Adjust the main load contactor for contact overtravel as follows:

1. Attach a suitable ohmmeter to terminals A1-A2 and C1-C2 on main base (42).
2. Insert .035 feeler gage between the coil (72) and core and rod assembly (59),
3. Apply 24VDC to the coil.
4. Adjust bushing (24) until continuity is made at A1-A2 and C1-C2. Secure adjustment by tightening screw (22).
5. Check that continuity is attained at .035 and no continuity at .040. Readjust if necessary,

b. Licon Switch. Adjust the main load licon switch (70) as follows:

1. Adjust switch bracket (69) to licon switch (70). Check that white button is fully depressed, and allow .010 clearance between white button and tap operator.

Secure with screws (64 and 67).

2. Insert .010 feeler gage between coil (72) and core and rod assembly (59).
3. Apply 24VDC to the coil.
4. Adjust lower tab by bending to licon switch.
5. Check that switch transfer is attained at .010 and that no switch transfer is attained at .018, Readjust if necessary,

6-147. INSTALLATION. Refer to figure 6-36 and install load contactor as follows:

**NOTE**

Application requiring HB200A (50603) will require modification to Bracket 714642. Those using alternate PN B301EA (74063) will not.

- a. Position load contactor (26) on mounting bracket (25) and secure with screws (24) and nuts (23).
- b. Connect electrical connector to load contactor connector J41.

c. Position bus bars (12) and contactor cables (27) on contactor studs and secure with nuts and washers. Tighten nuts (9) to secure bus bars (12) to reconnection board studs. Connect cover (19) to load contactor and secure with screws (18).

d. Connect bracket (17) and secure with screws (14), spacers (16), and nuts (15).

e. Install protective cover (3) and secure by tightening studs (1).

6-147A. CIRCUIT BREAKER ASSEMBLY.

6-147B. TEST ON EQUIPMENT.

a. Symptom and Isolation of Malfunction. A malfunction of the circuit breaker is usually indicated by the circuit breaker opening when the generator is operating within normal parameters or the circuit breaker will not close to apply power to the load.

**NOTE**

Test should be accomplished with generator not operating and load cables disconnected.

Table 6-15. Load Contactor (CB2), Test

OHMMETER CONNECTION POINTS	OHMMETER INDICATION
A1 to A2	CONTINUITY
B1 to B2	CONTINUITY
C1 to C2	CONTINUITY
J41C to J41D	CONTINUITY
J41E to J41F	CONTINUITY
J41G to J41H	CONTINUITY
J41J to J41K	CONTINUITY
J41L to J41M	NO CONTINUITY
J41N to J41P	NO CONTINUITY
J41R to J41T	CONTINUITY
J41R to J41S	NO CONTINUITY



1. Disconnect electrical connector from circuit breaker relay box connector J41. Connect a suitable voltmeter across pins M and B with B negative. Energize DC control circuit breaker. There should be approximately 24 volts.

2. Connect a suitable voltmeter across pins A and B of J41. Position start-run-stop switch to RUN, and position battle short switch to ON.

3. Position circuit breaker switch to CLOSE; voltmeter should indicate approximately 24 volts.

4. If voltage is not present in either step 2 or 3, check wiring back to its source and correct malfunctions.

5. If voltage is present but the contactor still will not close, check K26 Relay, OFF-ON Limit Switch, and Motor B1, and correct malfunction.

6. If the contactor closes and will not stay in the closed position, check under-voltage relay inside the circuit breaker.

7. Position load contactor switch to OPEN, battle short switch to OFF, and start-run-stop switch to STOP. De-energize circuit breaker.

8. Install connector plug P41 to circuit breaker relay box.

b. Removal. Refer to figure 6-37A and remove circuit breaker assembly as follows:

**NOTE**

Tag electrical leads with location to insure proper installation.

1. Tag and disconnect three top electrical leads and electrical connector P41 from circuit breaker assembly (7).

2. Disconnect three circuit breaker electrical leads from load board; loosen clamp at base of generator.

3. Remove screws (1 and 4), lock washers (2 and 5) and washers (3 and 6).

4. Remove clamps (7B) by removing screws (7B) and remove circuit breaker and three electrical leads.

6-147C. TEST.

a. Connect circuit breaker assembly to test equipment as illustrated in figure 6-37B and perform test specified in procedural analysis table 6-15A.

b. Remove test equipment.

6-147D. DISASSEMBLY. Refer to figure 6-37C and disassemble circuit breaker assembly in the sequence of index numbers assigned. Pay particular attention to the following:

a. Remove screws (1), lock washers (2) and washers (3). Remove bracket (4) from bracket (29).

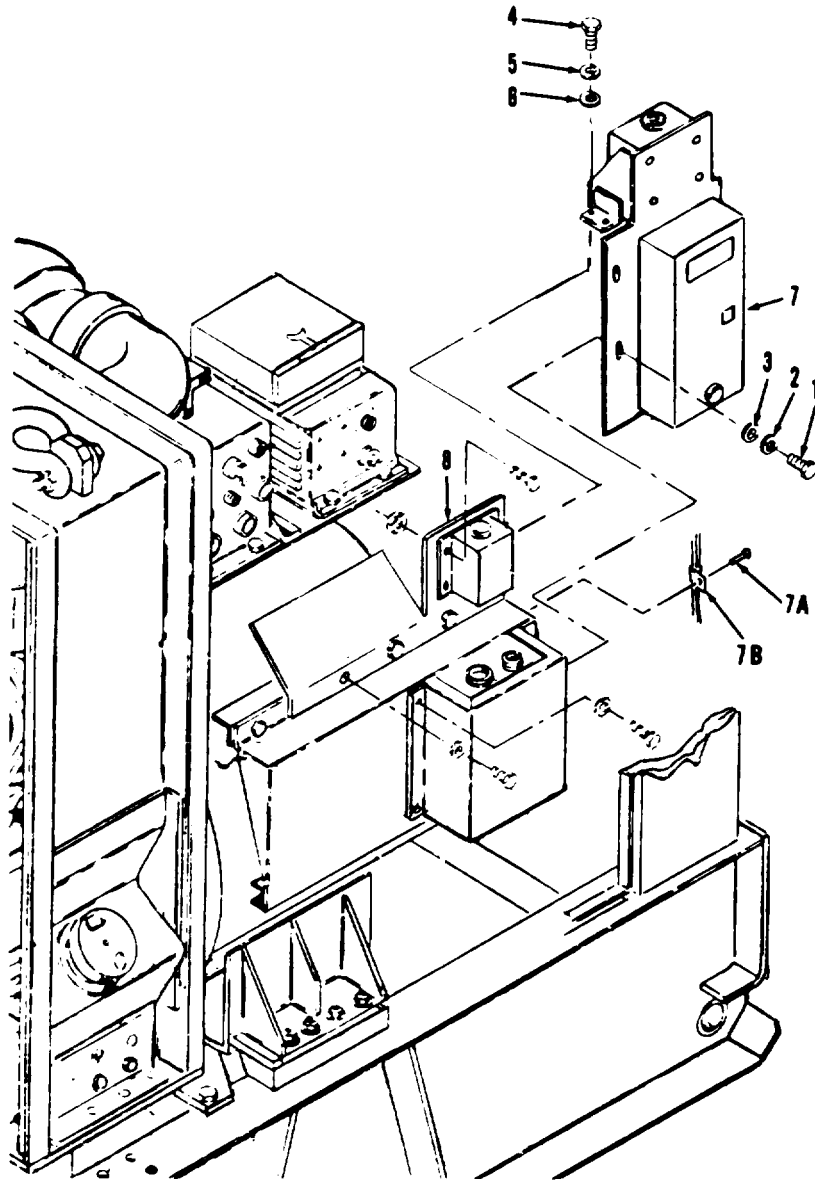
b. Remove clamp (7) from bracket (29) by removing nut and washer assembly (5) and screw and washer (6).

c. Remove screw and washer assembly (8) securing relay box (9) to top of bracket (29).

d. Remove relay (11) from relay socket (14) by removing screw and washer assemblies (10).

**NOTE**

Do not disconnect electrical leads from relay socket (14) unless replacement is required.



- |                    |  |
|--------------------|--|
| 1. SCREW (2)       | 7. MOTOR OPERATED<br>CIRCUIT BREAKER<br>ASSEMBLY |
| 2. LOCK WASHER (2) | 7A. SCREW (2)                                    |
| 3. WASHER (2)      | 7B. CLAMP (2)                                    |
| 4. SCREW (2)       | 8. BRACKET                                       |
| 5. LOCK WASHER (2) |  |
| 6. LOCK WASHER (2) |  |

Figure 6-37A. Motor operated circuit breaker assembly (CB2), removal and installation

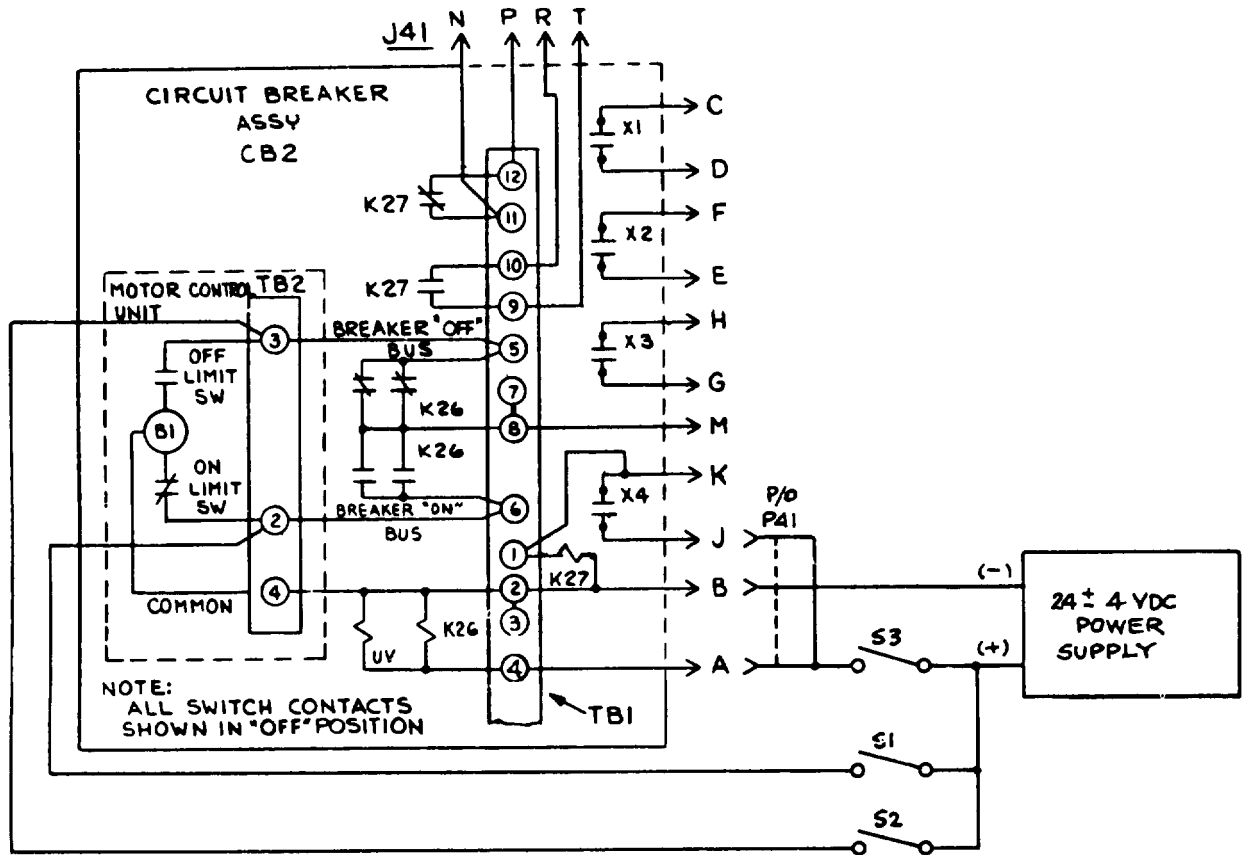


Figure 6-37B. Circuit breaker assembly (CB2), test setup

Table 6-15A. Circuit Breaker Assembly (CB2), Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
NOTE				
Motor control unit is removed from circuit breaker assembly during the following tests.				
1	With all switches open, and motor control indicator in the green "OFF" position, close switch S1 and S3.	Motor B1 should energize, and indicator should position to red "ON".	Motor B1 open.  Limit switch open.	Check continuity of motor.  Check continuity of switch.
2	Open switch S1 and close switch S2.	Motor B1 should energize and indicator should position to green "OFF".	Motor B1 open.  Limit switch open.	Check continuity of motor.  Check continuity.
3	With all switches open, close switch S3 and manually close the circuit breaker to the "ON" position.	Circuit breaker should stay closed.  There should be continuity between J41 pins: C to D E to F G to H	Under voltage trip relay open.  Open auxiliary switch.	Check continuity.  Replace switch.

6-120D

Change 3

P-9-TM-457-35  
TM-07464A-35

T.O. 35C2-3-442-2  
TM 5-6115-457-34

Table 6-15A. Circuit Breaker Assembly (CB2), Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
3 (cont)		There should be continuity between TB1-8 and -6, and no continuity between TB1-8 and -5.	Defective K-26 relay.	Check relay continuity.
		There should be continuity between J41 pins: R to T	Defective K-27 relay. Defective auxiliary switch X4.	Check relay continuity. Replace switch.
		There should be no continuity between J41 pins: N to P	Defective K-27 relay. Defective auxiliary switch X4.	Check relay continuity. Replace switch.
4	Open switch S3.	Circuit breaker should move to trip position.	Defective under voltage trip relay.	Check relay continuity.
		There should be no continuity between J41 pins: C to D E to F G to H J to K	Defective auxiliary switch.	Replace switch.

Change 3

6-120E

P-9-TM-457-35  
TM-07464A-35

T.O. 35C2-3-442-2  
TM 5-6115-457-34

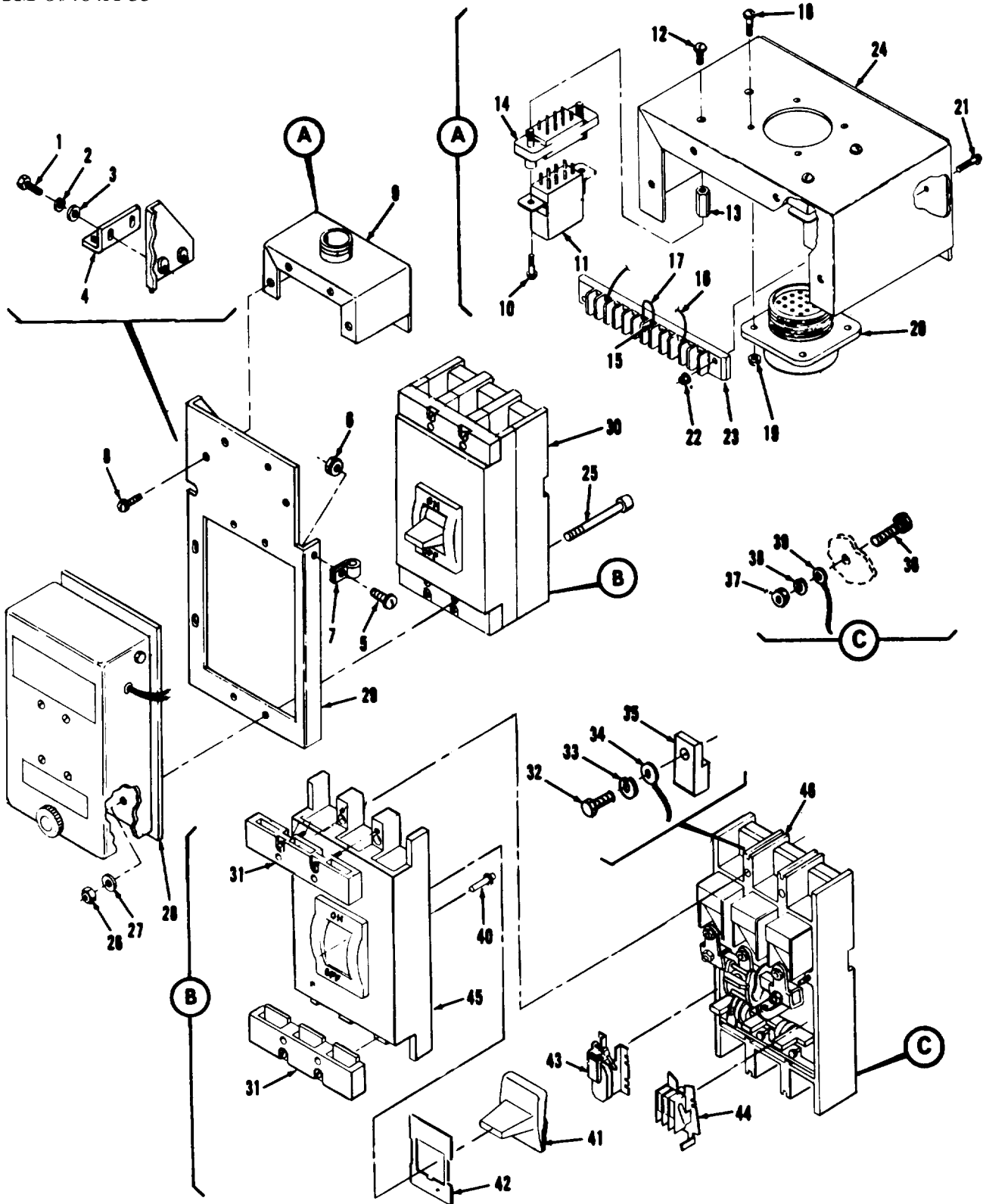


Figure 6-37C. Motor operated circuit breaker assembly (CB2), exploded view

Legend to figure 6-37C:

- |                                   |   |
|-----------------------------------|---|
| 1. Screw (2)                      | 24. Relay box cover                       |
| 2. Lock washer (2)                | 25. Screw (4)                             |
| 3. Washer (2)                     | 26. Nut (4)                               |
| 4. Bracket                        | 27. Washer (4)                            |
| 5. Nut and washer assembly        | 28. Motor control                         |
| 6. Screw and washer assembly      | 29. Bracket                               |
| 7. Clamp                          | 30. Circuit breaker                       |
| 8. Screw and washer assembly (4)  | 31. Terminal shield (2)                   |
| 9. Relay box                      | 32. Screw (3)                             |
| 10. Screw and washer assembly (4) | 33. Lock washer (3)                       |
| 11. Relay (2)                     | 34. Cable assembly                        |
| 12. Screw and washer assembly (4) | 35. Circuit breaker terminal extender (3) |
| 13. Standoff                      | 36. Screw (3)                             |
| 14. Relay socket (2)              | 37. Nut (3)                               |
| 15. Terminal lug                  | 38. Washer (3)                            |
| 16. Wire                          | 39. Cable assembly                        |
| 17. Jumper wire (2)               | 40. Trip rod assembly                     |
| 18. Screw and washer assembly (4) | 41. Handle                                |
| 19. Nut and washer assembly (4)   | 42. Handle shield                         |
| 20. Connector                     | 43. Undervoltage relay                    |
| 21. Screw and washer assembly (2) | 44. Auxiliary switch assembly             |
| 22. Nut and washer assembly (2)   | 45. Cover                                 |
| 23. Terminal board                | 46. Circuit breaker base                  |





e. Tag and disconnect leads from terminal board (23), and remove socket (14) with attaching leads from relay box (9) by removing screw and washer assemblies (12) and standoff (13).

**NOTE**

Do not disconnect electrical leads from connector J41 (20) unless replacement is required.

f. Tag and disconnect leads from terminal board (23), and remove connector J41 (20) with attaching leads from relay box (9) by removing screw and washer assemblies (18) and nut and washer assemblies (19).

g. Tag and disconnect remaining electrical leads from terminal board (23).

h. Remove terminal board (23 ) from relay box cover (24 ) by removing screw and washer assemblies (21) and nut and washer assemblies (22).

i. Remove screws (25), nuts (26) and washers (27). Separate motor control (28), bracket (29) and circuit breaker (30).

**WARNING**

The circuit breaker must be in the tripped position before removing cover (45).

- Drilling operations create metal chips which may enter the eye. Eye protection is required.

j. Drill out circuit breaker case securement rivets and separate cover (45) from circuit breaker base (46).

**WARNING**

Keep hands clear of mechanism at all times.

k. Remove undervoltage relay (43) and auxiliary switch assembly (44) from circuit breaker base (46).

6-147E. **CLEANING.**

a. Clean all components with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

6-147F. **INSPECTION.**

a. Inspect wiring for evidence of damaged insulation and continuity.

b. Inspect terminal block for cracked insulation and stripped threads.

c. Inspect relay socket for cracked insulation and broken pin receptacles.

d. Inspect electrical connector for cracked housing, broken or loose pins, and stripped threads.

e. Inspect circuit breaker contact points for signs of corrosion or excessive pitting and arcing. Minor pitting and arcing is normal to breaker operation.

6-147G. **REPAIR.**

a. Repair cracked sheet metal parts by welding. Straighten distorted parts using suitable tools.

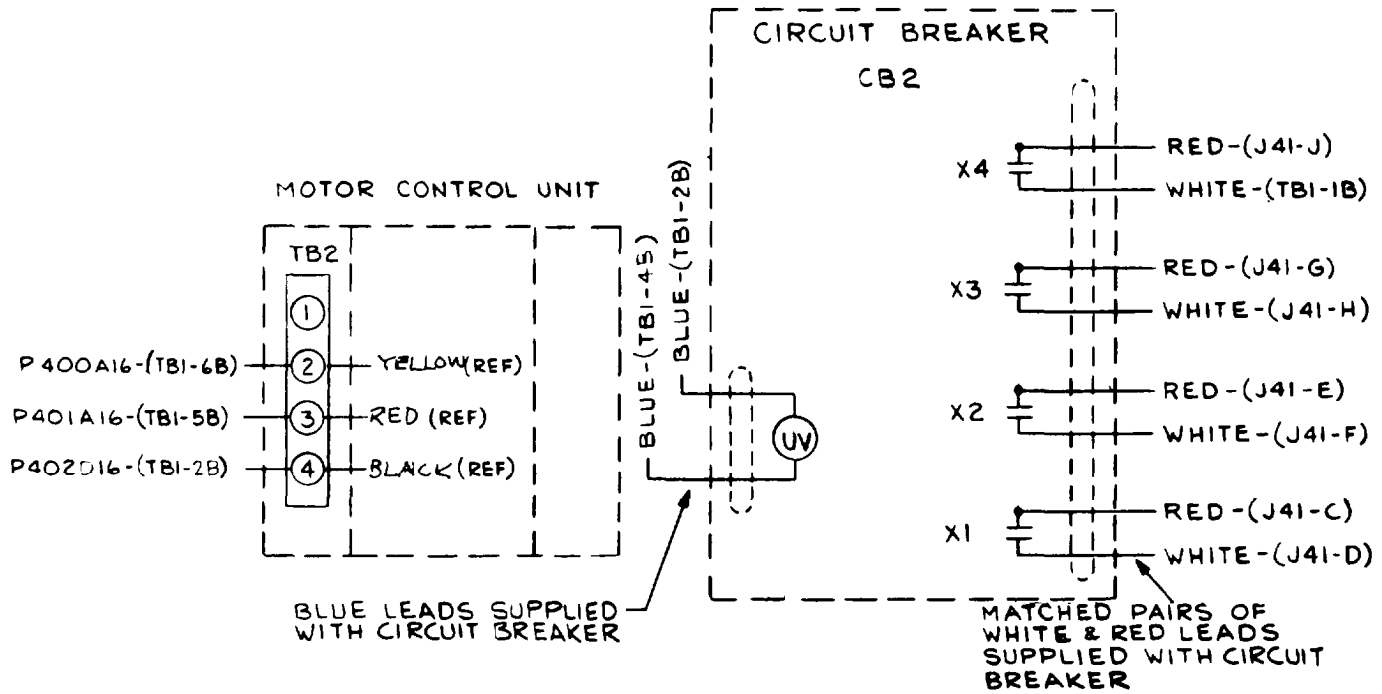
b. Chase damaged threads in mount.

c. Remove damaged paint. Blend in edge, prime, and paint damaged areas.

d. Repair or fabricate circuit breaker wiring in accordance with figure 6-37D and 6-37F.

e. Replace damaged or defective componentry.

6-147H. **REASSEMBLY.** Refer to figure 6-37C. and reassemble circuit breaker



WIRE TABULATION						
IDENTIFICATION		FROM	TERM. NOTE	TO	TERM. NOTE	LG (IN.)
COLOR	NUMBER					
RED	P402D16	TBI-2B	2	TB2-4	2	25.00
BLK	P401A16	TBI-5B	2	TB2-3	2	25.00
BLK	P400A16	TBI-6B	2	TB2-2	2	25.00
RED	—	J41-C	1, 4, 5	CB2-X1	1, 4, 5, 6	NOTE 5
WHITE	—	J41-D	↑	CB2-X1	↑	↑
RED	—	J41-E	↑	CB2-X2	↑	↑
WHITE	—	J41-F	↑	CB2-X2	↑	↑
RED	—	J41-G	↑	CB2-X3	↑	↑
WHITE	—	J41-H	↑	CB2-X3	↑	↑
RED	—	J41-I	↓	CB2-X4	1, 4, 5, 6	↑
WHITE	—	J41-K	1, 4, 5	TBI-1B	2, 6	↑
BLUE	—	CB2-W	1, 4, 5	TBI-2B	2, 6	↑
BLUE	—	CB2-UV	1, 4, 5	TBI-4B	2, 6	NOTE 5

NOTES

1. Solder, use Federal Specification QQ-S-571, Sn 60.
2. Secure end with terminal lug, MS25036-106.
3. Wire is M5086/2-16-9 per MIL-W-5086/2.
4. Use 5/8 inch long insulation tubing, TYPE F, FORM Ua, GRADE A, CLASS 1, CATEGORY 1, over each contact after soldering.
5. Wire marking to be in accordance with MIL-W-5088, intervals shall not exceed 6.00 inches.
6. Wire lengths for wires supplied with circuit breaker to be determined at time of assembly.

Figure 6-37D. Motor operated circuit breaker assembly (CB2), wiring diagram

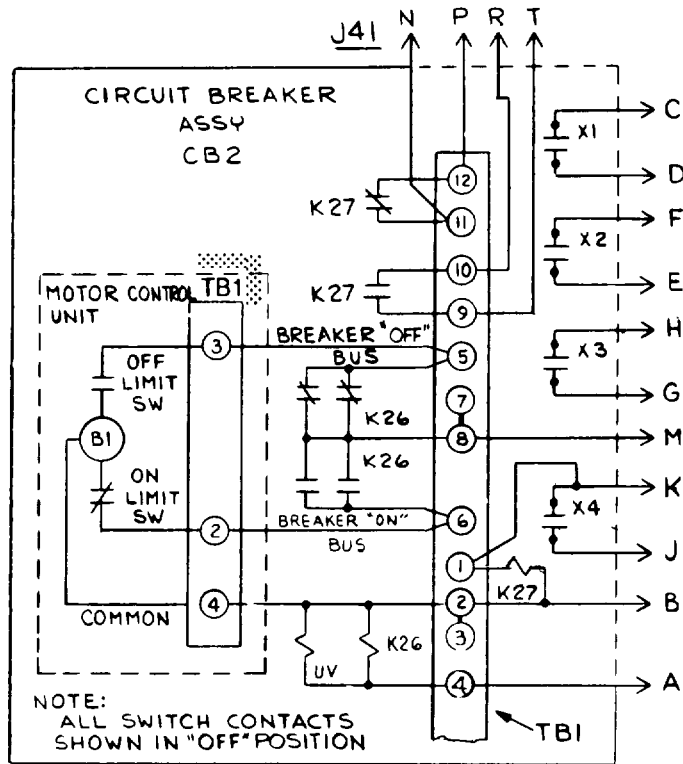


Figure 6-37E. Motor operated circuit breaker assembly (CB2), schematic



assembly in the reverse sequence of index numbers assigned. Pay particular attention to the following:

WARNING

Keep hands clear of mechanism at all times.

a. Carefully install the auxiliary switch assembly (44) and undervoltage relay (43) into circuit breaker base (46). Be sure insulative material surrounds both the auxiliary switch assembly (44) and undervoltage relay (43) so as not to cause any shorting.

NOTE

Insure that when circuit breaker is in the OPEN position, auxiliary switch actuator does not depress auxiliary buttons. Auxiliary switch buttons are depressed only when the circuit breaker is in the ONE position.

b. Place handle shield (42) over handle (41) then install onto circuit breaker actuator assembly.

c. Apply a suitable grease to trip rod assembly (40) so as to retain it captive in the circuit breaker cover (45) during assembly.

d. Install cover (45) onto circuit breaker base (46).

e. Install motor control unit (28) on circuit breaker (30) with cover open and circuit breaker handle in the OFF position. Adjust the motor control unit, sliding carriage, until it engages the circuit breaker handle. Adjustment is accomplished by turning slot at end of worm gear with a screw driver. Secure with washers (27), nuts (26) and screws (25). Secure knurled locking knob on motor control.

f. Install terminal board (23) in relay box cover (24) and secure with nut and washer assemblies (22) and screw and washer assemblies (21).

g. Install connector (20) onto relay box cover (24) and secure with nut and washer assemblies (19) and screw and washer assemblies (18).

h. Thread standoffs (13) onto relay sockets (14) and secure to relay box cover (24) using screw and washer assemblies (12)

i. Connect all tagged electrical leads to existing terminals.

j. Install relays (11) into relay sockets (14) and secure with screw and washer assemblies (10).

k. Install relay box (9) onto bracket (29) and secure with screw and washer assemblies (8).

l. Secure clamp (7) to bracket (29) with nut and washer assembly (6) and screw and washer assembly (5).

m. Fasten bracket (4) to side of bracket (29) with washers (3), lock washers (2) and screws (1).

6-1471. INSTALLATION. Refer to figure 6-37A, and install circuit breaker assembly in the reverse sequence of index numbers assigned. Pay particular attention to the following:

a. Place circuit breaker assembly (7) onto bracket (8) and install washers (7 and 6) lock washers (5 and 3) and screws (4 and 1).

b. Route three lower electrical leads through clamp at base of generator and connect to load board terminals. Tighten clamp. Secure clamps (7B) using screws (7A).

c. Connect electrical connector J41 and three top electrical leads to circuit breaker assembly (7).



6-148. LOAD BOARD ASSEMBLY.

6-149. REMOVAL AND DISASSEMBLY.

Refer to figure 6-36 and remove and disassemble load board assembly as follows:

- a. Remove protective cover (3) by loosening studs (1).
- b. Disconnect lead (38) from bus bar (39). Tag and disconnect contactor cables (27) from load terminals (34) by removing nuts (32) and washers (33).
- c. Disconnect load board assembly (21) by removing screws (28), lock washers (28), and washer (30).
- d. Remove load terminals (34) and bus bar (39) from terminal board (40) by removing nuts (32).

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

NOTE

Note position of terminals prior to removal to insure proper installation.

6-150. CLEANING. Clean parts in an approved cleaning solvent and dry thoroughly.

6-151. INSPECTION .

- a. Inspect threads for damage.
- b. Inspect terminal board for cracks, warping, and burnt areas.

6-152. REASSEMBLY AND INSTALLATION.

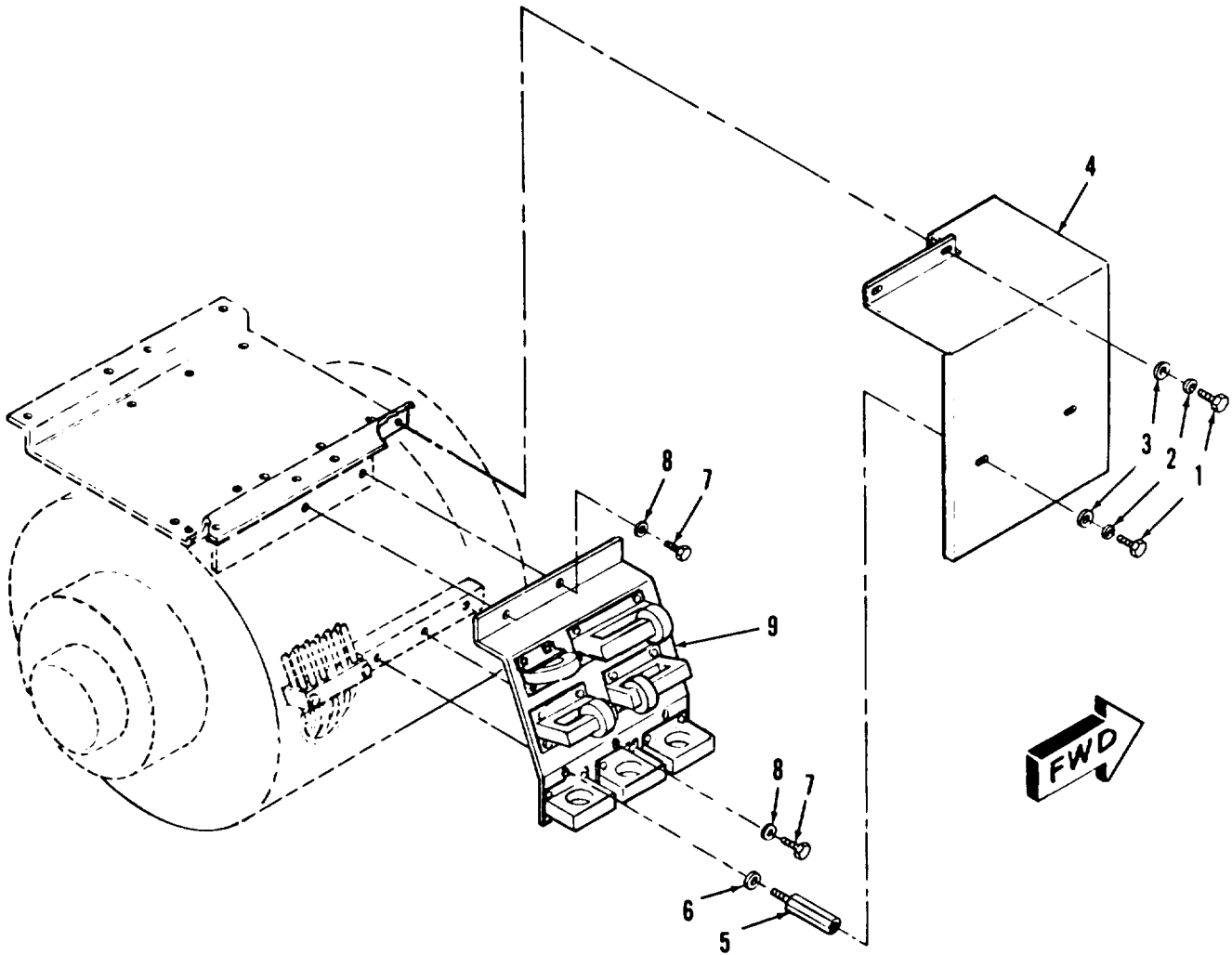
Refer to figure 6-36 and reassemble and install load board assembly as follows:

- a. Position load terminals (34) and bus bar (39) on terminal board (40) and secure with nuts (32).
- b. Position load board assembly (31) on bracket and secure with screws (28), lock washers (29), and washers (30).
- c. Connect lead (38) to bus bar (39) and secure with screw (35), nuts (36), and washers (37). Connect contactor cables (27) to load terminals (34) and secure with nuts (32) and washers (33).
- d. Install protective cover (3) and secure by tightening studs (1).

6-153. TRANSFORMER ASSEMBLY.

6-154. REMOVAL. Refer to figure 6-38 and remove transformer assembly as follows:

- a. Remove shield cover (4) by removing screws (1), lock washers (2) and washers (3).
- b. Tag and disconnect electrical wiring from transformers and terminal board.
- c. Cut tiedown straps connecting generator leads together. Tag and disconnect six generator leads that pass through transformer from reconnection board studs. Remove leads from transformer.
- d. Disconnect transformer assembly (9) from generator by removing spacers (2), screws (7), and lock washers (6 and 8).



- |                     |                         |
|---------------------|-------------------------|
| 1. SCREW (4)        | 6. LOCK WASHER (2)      |
| 2. LOCK WASHERS (4) | 7. SCREW (3)            |
| 3. WASHERS (4)      | 8. LOCK WASHER (3)      |
| 4. SHIELD           | 9. TRANSFORMER ASSEMBLY |
| 5. SPACER (2)       |                         |

Figure 6-38. Transformer assembly, removal and installation



6-155. DISASSEMBLY. Refer to figure 6-39 and disassemble transformer assembly in the order of index numbers assigned. Pay particular attention to the following.

a. Tag and disconnect transformer leads prior to transformer removal.

6-156. CLEANING.

a. Clean transformers with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean remaining parts in an approved cleaning solvent and dry thoroughly.

6-157. INSPECTION.

a. Inspect transformer leads for defective insulation. Inspect terminal lugs for condition and security.

b. Inspect terminal block for cracked insulation, stripped threads and missing jumper strips.

c. Inspect sheet metal parts for distortion and cracks.

Legend to figure 6-39:

1. Jumper (2)
2. Screw (2)
3. Terminal block TB2
4. Screw assembly (4)
5. Washer (4)
6. Exciter transformer (CT4)
7. Screw (4)
8. Washer (4)
9. Cross current transformer assembly
10. Nut (2)

d. Inspect threads for damage.

e. Test transformers for proper operation; refer to figure 6-40.

f. Inspect paint for damage.

6-158. REPAIR.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

a. Repair cracked sheet metal parts by welding. Straightened distorted parts using suitable tools.

b. Chase damaged threads in bracket.

c. Remove damaged paint. Blend in edge, prime, and paint damaged areas.

6-159. REASSEMBLY.

Refer to figure 6-39 and reassemble current transformer assembly in the reverse order of index numbers assigned, Connect transformer leads.

6-160. INSTALLATION. Refer to figure 6-38 and install transformer assembly as follows.

11. Screw (2)
12. Current transformer CT7
13. Bracket
14. Screw (8)
15. Washer (8)
16. Exciter transformer (CT5, CT6)
17. Screw (12)
18. Washer (12)
19. Instrument transformer (CT1, CT2, CT3)
20. Bracket

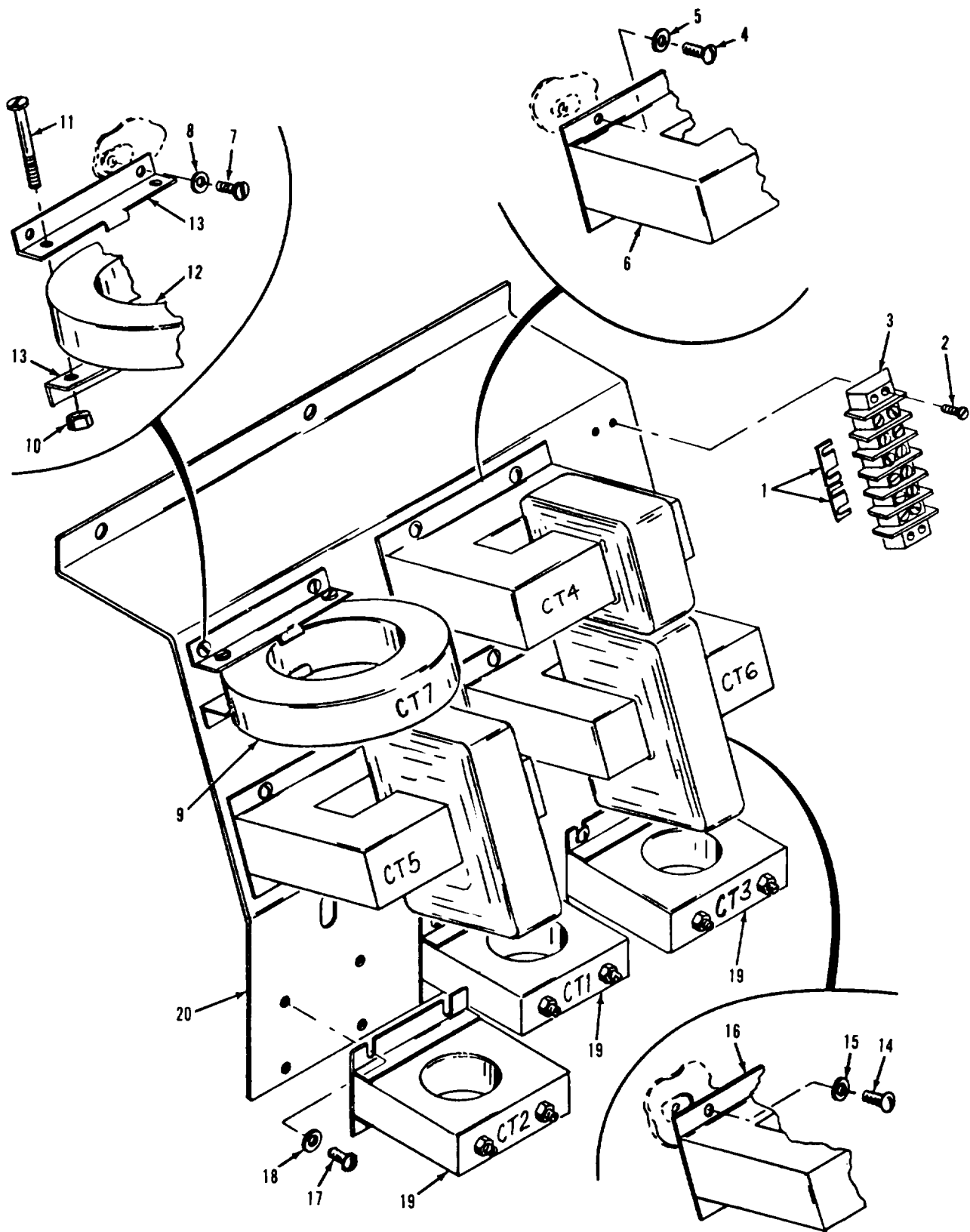
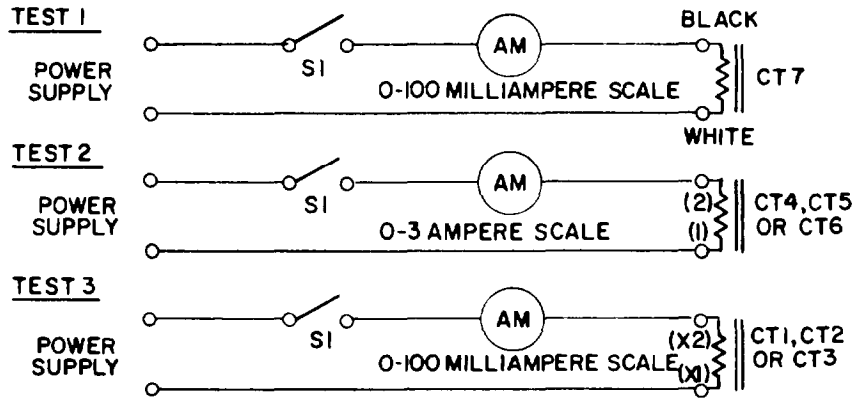


Figure 6-39. Transformer assembly, exploded view



TRANSFORMER	INPUT	MAXIMUM	RESISTANCE	TEST SETUP
		EXCITATION CURRENT	VALUE ± 20 PERCENT	
CROSSCURRENT TRANSFORMER CT7	10 VAC @ 60 HZ	0.05 AMPERES	2.5 OHMS	1
EXCITER CURRENT TRANSFORMER CT5 AND CT6	60 VAC @ 60 HZ	0.90 AMPERES	0.22 OHMS	2
	35 VAC @ 400 HZ	1.0 AMPERES	0.05 OHMS	2
EXCITER CURRENT TRANSFORMER CT4	60 VAC @ 60 HZ	0.30 AMPERES	0.83 OHMS	2
	40 VAC @ 400 HZ	0.50 AMPERES	0.15 OHMS	2
INSTRUMENT CURRENT TRANSFORMERS CT1, CT2, AND CT3	12.5 VAC @ 60 HZ	0.05 AMPERES	1.35 OHMS	3

Figure 6-40. Transformer inspection

a. Connect transformer assembly (9) to generator and secure with spacers (2), screws (7), and lock washers (6 and 8).

b. Refer to Operator and Organizational Maintenance Manual and route six generator leads through transformers. Leads passing through transformers CT4, CT5, and CT6 make two turns around transformers.

c. Connect generator leads to reconnection board studs. Secure leads together with tie straps.

NOTE

Interconnecting wiring diagram is contained in Operator and Organizational Maintenance Manual.

d. Connect electrical wiring to transformers and terminal board.

e. Position shield over transformer assembly and secure with screws (1), lock washers (2) and washers (3).

## Section IX. TACTICAL RELAY BOX

### 6-161. GENERAL.

The tactical relay box (A29) is used on both 50/60 and 400 hertz generator sets. It contains the over voltage relay, reverse power relay, short circuit relay, overload relay, and the three current transformer load resistors. Refer to schematic diagram figure 1-18.

a. The over voltage relay (K2) is a solid state device which functions to protect the load in the event that generator voltage exceeds preset limits. It actuates after a time delay from 180 to 800 milliseconds when generator voltage rises above 156 VAC (both 50/60 and 400 hertz sets). Upon actuation, contacts within the over voltage relay, close to signal the fault locator and open to shut-down the generator set.

b. The reverse power relay (K15) is a solid state device which functions to protect the generator in the event of a reverse power operating state during parallel operation. It operates in conjunction with the load measurement unit which produces a dc output voltage whose polarity and magnitude is a function of the total load on the generator set, regardless of phase or power factor. When the reverse power flow into the generator exceeds twenty percent of rated load; the load measurement unit output has sufficient magnitude and correct polarity to cause the reverse power relay to actuate. For 50/60 hertz sets this reverse power rating pertains to the 60 hertz rating. Upon actuation, contacts with the reverse power relay; close to signal the fault locator and open to de-energize the load contactor, result in display of the fault condition and removal of the load from the generator.

c. The short circuit relay (K13) is a solid state device which functions to protect the load in the event generator output current in any phase exceeds  $425 \pm 25$  percent of rated current for 50/60 hertz sets and  $180 \pm$

percent for 400 hertz sets. For 50/60 hertz sets this current rating pertains to the 60 hertz rating. When the above fault occurs, the short circuit relay will actuate. Upon actuation, contacts within the short circuit relay; close to signal the fault locator and open to de-energize the load contactor, resulting in display of the fault condition and removal of the load from the generator.

d. The overload relay (K14) is a solid state device whose function is to protect the load in the event of an overload condition. An overload condition is defined as the state when generator output current in any phase exceeds 110 percent of rated value. The overload relay is a current sensing device and operates on an inverse time principle as the current in any phase exceeds the overload state. At the point just above 130 percent of rated current the overload relay will actuate within  $8 \pm 2$  minutes. For 50/60 hertz sets this current rating pertains to the 60 hertz rating. Upon actuation, contacts within the overload relay; close to signal the fault locator and open to de-energize the load contactor, resulting in display of the fault condition and removal of the load from the generator.

### 6-162. OVER VOLTAGE RELAY (K2).

### 6-163. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the overvoltage relay K2 is usually indicated by failure of the generator fault monitoring system to detect and react to a voltage rise beyond preset limits. To isolate the malfunction, proceed as follows:

### WARNING

Exercise extreme care not to touch exposed electrical connections when working inside tactical relay box with generator set operating.

### NOTE

Remove cover from tactical relay box to gain access to test points, see figures 6-15 and 6-47.

1. With the generator set operating at the rated speed and voltage, and with the contactor closed, measure the voltage from terminal 1 to terminal 2 of the K2 relay. Nominal voltage is 120 VAC. Voltage from TB2-5 to K2 terminals 3 and 6 should measure 20-32 VDC. Shutdown generator set.

2. Install a 250 ohm, 25 watt resistor in series with voltage adjustment rheostat R2 between wire number X9F10 and TB1-7 located in the control cubicle. With the generator set operating at the rated speed and voltage, increase output voltage such that the voltage across terminals 1 and 2 of K2 relay measures  $153 \pm 3$  volts. When the K2 relay actuates there should be a momentary dc voltage measured from terminal 7 of K2 to TB2-5 and there should be no dc voltage measured from terminal 3 of K2 to TB2-5. If the above conditions are not met, replace the K2 relay.

b. Removal. Refer to figure 6-47 and tag, then disconnect wiring at the overvoltage relay terminals. Remove the four screw assemblies securing the relay in position.

### 6-164. BENCH TEST.

a. Connect the overvoltage relay to the test equipment as illustrated in figure 6-42.

### WARNING

Exercise extreme care when making tests as high voltages present will cause injury to personnel upon contact.

b. With all switches open, energize the 60 hertz variable voltage supply and adjust voltage to 120 VAC. Close switch S2 then S3. Indicator DS1 should be energized and DS2 should be de-energized.

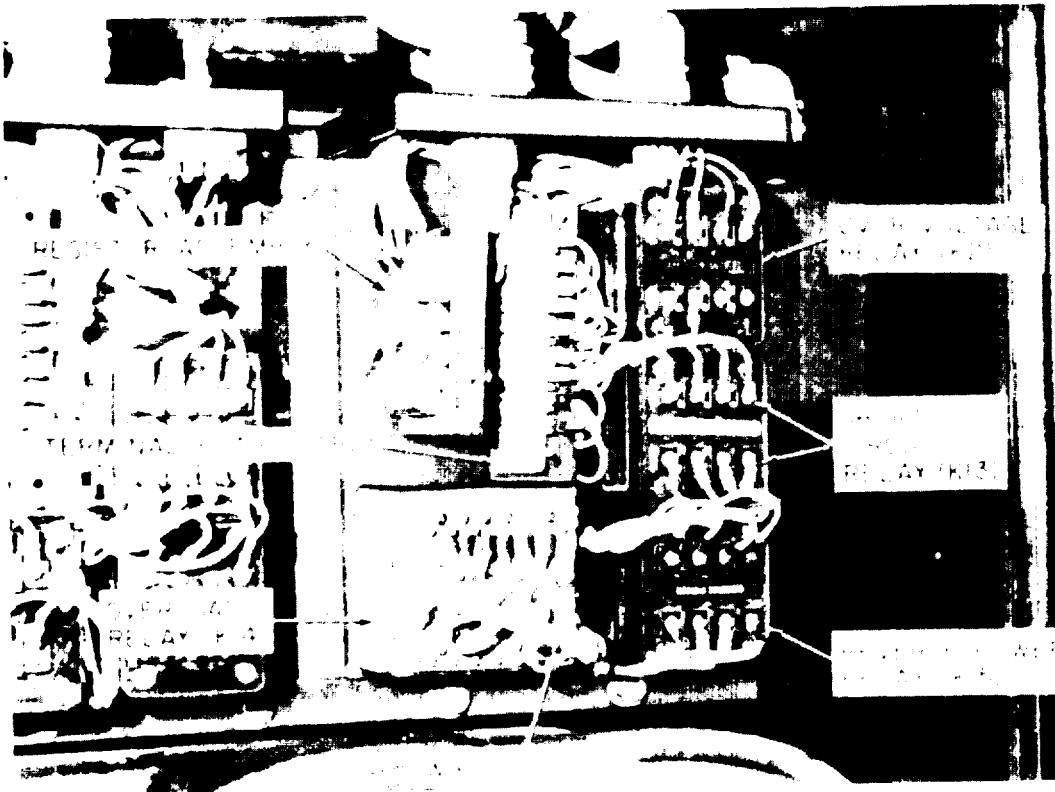
c. Adjust 60 hertz variable voltage supply to 157 VAC. Indicator DS1 should de-energize and DS2 should energize.

d. Open switches S2 and S3 and energize the 400 hertz variable voltage supply. Adjust the voltage to 120 VAC. Close switch S1 then S3. Indicator DS1 should be energized and DS2 de-energized.

e. Adjust 400 hertz variable voltage supply to 151 VAC. Indicator DS1 should de-energize and DS2 should energize.

f. If the overvoltage relay does not meet the requirements of the above tests, replace the relay.

g. Remove the overvoltage relay from the test equipment.



NOTES:

1. REMOVE THE FOUR SCREWS AND WASHERS SECURING THE COVER TO THE CHASSIS TO GAIN ACCESS TO THE TEST POINTS.
2. TACTICAL RELAY BOX MUST BE REMOVED FROM GENERATOR SET TO ACCOMMODATE REPLACEMENT OF RELAYS. TO REMOVE THE BOX ASSEMBLY, TAG AND DISCONNECT THE TWO ELECTRICAL PLUG CONNECTORS AT J4 AND J51, THEN REMOVE TWO SCREWS AND WASHERS SECURING THE BOX IN POSITION.
3. REPLACE ASSEMBLY BY REVERSING ABOVE PROCEDURES.

Figure 6-41. Tactical relay box (A29), cover removed

6-165. **INSTALLATION.** Refer to figure 6-41 and install the over voltage relay in position using four screw assemblies. Refer to figure 1-19 and reconnect wiring. Replace the tactical relay box and cover.

6-166. **REVERSE POWER RELAY (K15).**

6-167. **ON EQUIPMENT TEST.**

a. **Symptom and Isolation of Malfunction.** A malfunction of the reverse power relay K15 is usually indicated by failure of the generator fault monitoring system to detect and react to a reverse power condition when operating two or more generator sets in parallel. To isolate the malfunction, proceed as follows.

**WARNING**

Exercise extreme care not to touch exposed electrical connections when working inside tactical relay box with generator set operating.

**NOTE**

Remove cover from tactical relay box to gain access to test points, see figures 6-15, 6-41, 6-43 and paragraph 6-87.

1. Operate the generator set in parallel with another like unit.

2. Adjust voltage and frequency to rated value and measure the voltage across terminals 3 and 4 of relay K15. In addition, measure the voltage from TB2-5 to K 15 relay terminals 5 and 8. Voltage should be 20-32 VDC at all points.

3. Slowly reduce the generator set (unit under test) speed while monitoring the voltage across terminals 1 and 2 of relay K 15 (approximately 9.8 VDC, terminal 2 positive, at 100 percent load). When the voltage is zero, reverse the

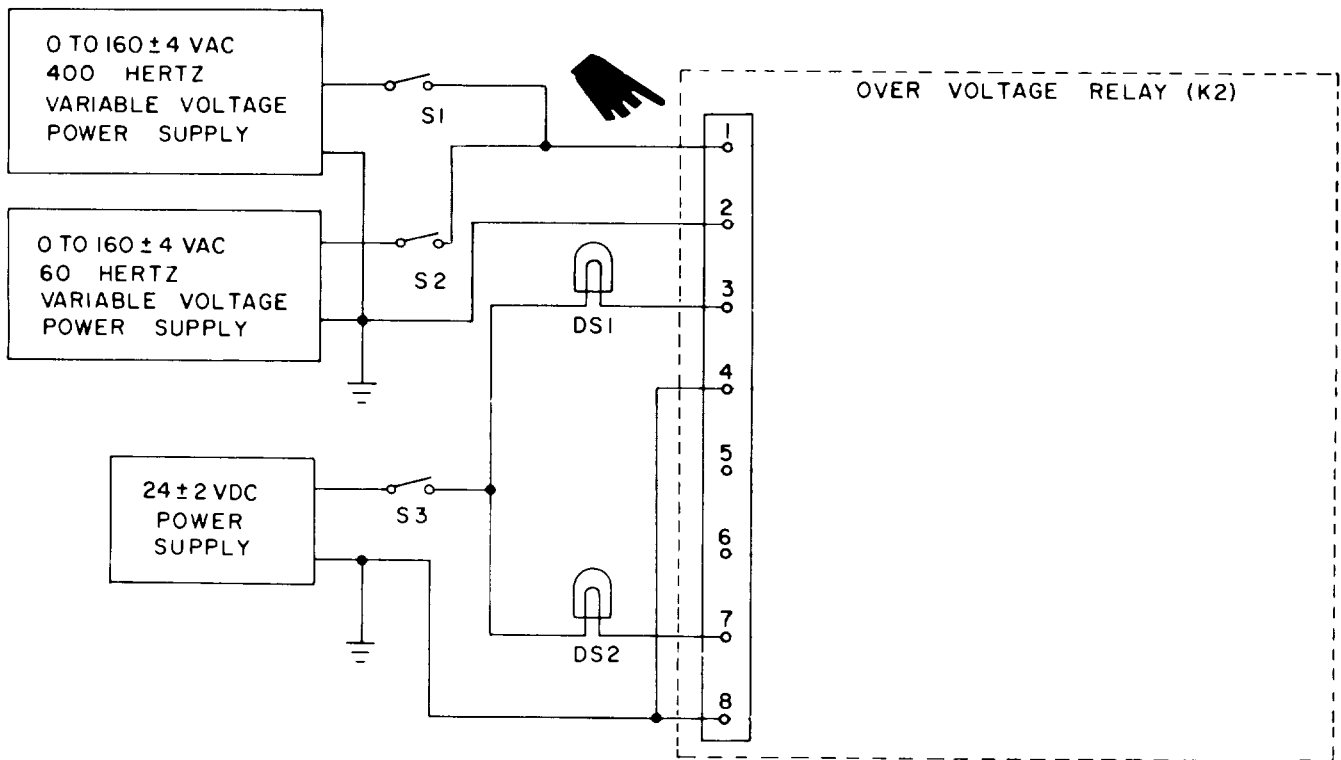


Figure 6-42. Over voltage relay (K2), test setup

meter leads and continue lowering the speed. Relay K15 should actuate when the voltage is  $2 \pm 0.1$  VDC, 50/60 hertz sets;  $5 \pm 0.1$  VDC, 400 hertz sets, and terminal 1 is positive. If the relay does not actuate under the preceding conditions, replace the relay.

b. Removal. Refer to figure 1-19 and 6-41 and tag, then disconnect wiring from the reverse power relay. Remove the four screw assemblies securing the relay in position.

6-168. BENCH TEST.

a. Connect the reverse power relay to the test equipment as illustrated in figure 6-43.

b. Energize 24VDC power supply and close switches S4 and S3. Indicator DS2 should be energized and DS1 should be deenergized.

c. Set Oscillator to 60 hertz, 10VAC (peak to peak). Close switch S1 and set S2 to position "A". Increase variable voltage DC power supply to 10VDC, then return to  $\emptyset$  VDC. Indicator DS2 should remain energized and DS1 should remain deenergized.

d. Set switch S2 to position "B". Increase variable DC voltage slowly. Indicator DS2 should deenergize and DS1 energize at 2 VDC, 50/60 hertz sets; 5 VDC, 400 hertz sets or less.

e. If the reverse power relay does not meet the requirement of the above tests, replace the relay.

f. Remove the reverse power relay from the test equipment. Reference figure 1-19 for wiring diagram.

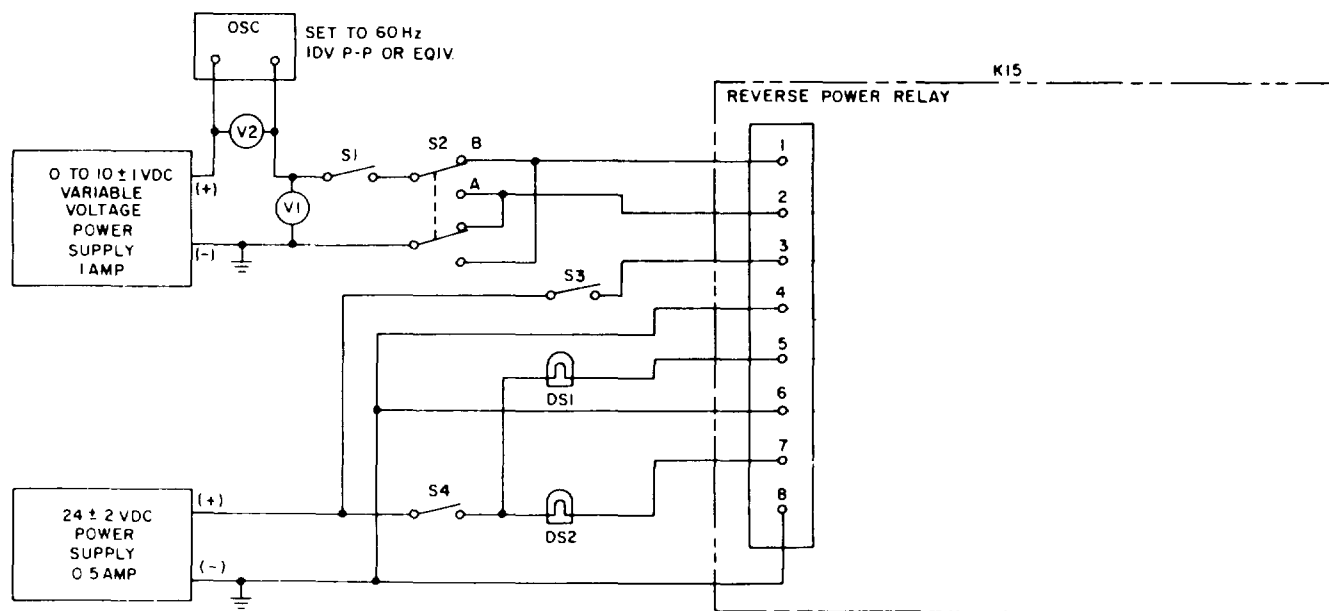


Figure 6-43. Reverse power relay (K15) test setup



NOTE

Remove cover from tactical relay box to gain access to test points, see figures 6-15 and 6-41.

6-169. **INSTALLATION.** Refer to figure 6-41 and install the reverse power relay in position using four screw assemblies. Refer to figure 1-19 and reconnect wiring. Replace the tactical relay box and cover.

6-170. SHORT CIRCUIT RELAY (K13).

6-171. **ON EQUIPMENT TEST.**

a. **Symptom and Isolation of Malfunction.** A malfunction of the short circuit relay K13 is usually indicated by failure of the generator fault monitoring system to detect and react to a rise in generator current output (in any phase) beyond preset limits. To isolate the malfunction, proceed as follows.

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside tactical relay box with generator set operating.

1. With the generator set at rated speed and voltage, and with the contactor closed, measure the voltage from terminals 8 and 5 (+) of the K13 relay to TB 2-5 (-). Voltage should read 20-32 VDC.

2. Apply 100 percent of rated load and measure the voltage from terminals 1-4, 2-4 and 3-4 of short circuit relay K13. Voltage should read  $5.6 \pm 0.5$  VAC. If the preceding conditions are met and the short circuit relay K13 does not actuate with application of a short circuit, replace the K13 relay.

b. **Removal.** Refer to figure 6-41 and tag, then disconnect wiring at the short circuit relay terminals, Remove the four screw assemblies securing the relay in position.

6-172. BENCH TEST.

a. Connect the short circuit relay to the test equipment as illustrated in figure 6-44.

b. Energize 24 VDC power supply and close switch S3. Indicator DS1 should be energized and DS2 should be deenergized.

c. Energize 0 to 50 variable power supply, set switch S2 to position "A" then close switch S1 and adjust power supply to obtain 3.375 amperes, 50/60 hertz sets; 1.429 amperes 400 hertz sets. Indicator DS2 should energize and DS1 should reenergize. Open switch S1.

d. Repeat step c. for switch S2 positions "B" and "C".

e. If the short circuit relay does not meet the requirements of the above tests, replace the relay.

f. Remove the short circuit relay from the test equipment.

6-173. INSTALLATION. Refer to figure 6-41 and install the short circuit relay in position using four screw assemblies.

Refer to figure 1-19 and reconnect wiring. Replace the tactical relay box and cover .-

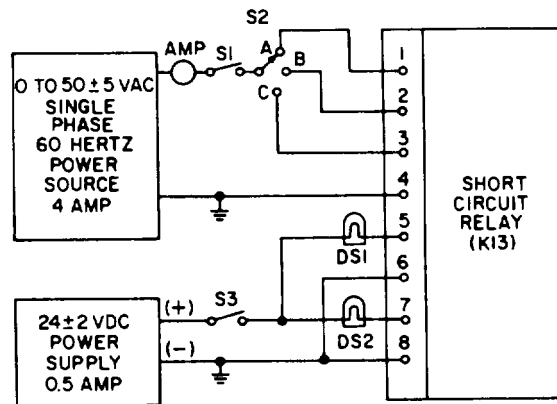


Figure 6-44. Short Circuit Relay (K13) test setup

6-174. OVERLOAD RELAY (K14).

6-175. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the overload relay K14 is usually indicated by failure of the generator fault monitoring system to detect and react to a current rise in any phase, beyond

preset limits. To isolate the malfunction, proceed as follows.

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside tactical relay box with generator set operating.

NOTE

Remove cover from tactical relay box to gain access to test points, see figures 6-15 and 6-41.

1. With the generator set operating at rated speed and voltage, and with the contactor closed, the voltage measured across the plus (+) and minus (-) terminals of the overload relay K14 should read 20-32 VDC. The voltage from the NO terminal (wire P200X16) to TB2-5 and from the NC terminal (wire P62K16) to TB2-5 should read 20-32 VDC.

2. Apply 130 percent load to the generator set. The relay should activate in  $8 \pm 2$  minutes. Determine that the unit current meter indicates 130% of current on all phases. No current reading would indicate an open current circuit. When the relay actuates a momentary dc voltage should be measured from the NO terminal (wire P209D16) to TB2-5 and there should be no dc voltage measured from the NC terminal (wire P62K16) to TB2-5. If the above conditions are not met, the K14 relay should be replaced.

NOTE

The K14 relay should not actuate with less than 110% load, if it does the relay should be replaced.

b. Removal. Refer to figure 6-41 and tag, then disconnect wiring at the overload relay terminals. Remove the four screw assemblies securing the relay in position.

6-176. BENCH TEST.

a. Connect the overload relay to test equipment as illustrated in figure 6-45.

b. With the 120/208 VAC power source deenergized, turn on the 24 vdc power supply and close switch S1. Indicator DS1 should energize and indicator DS2 should be deenergized.

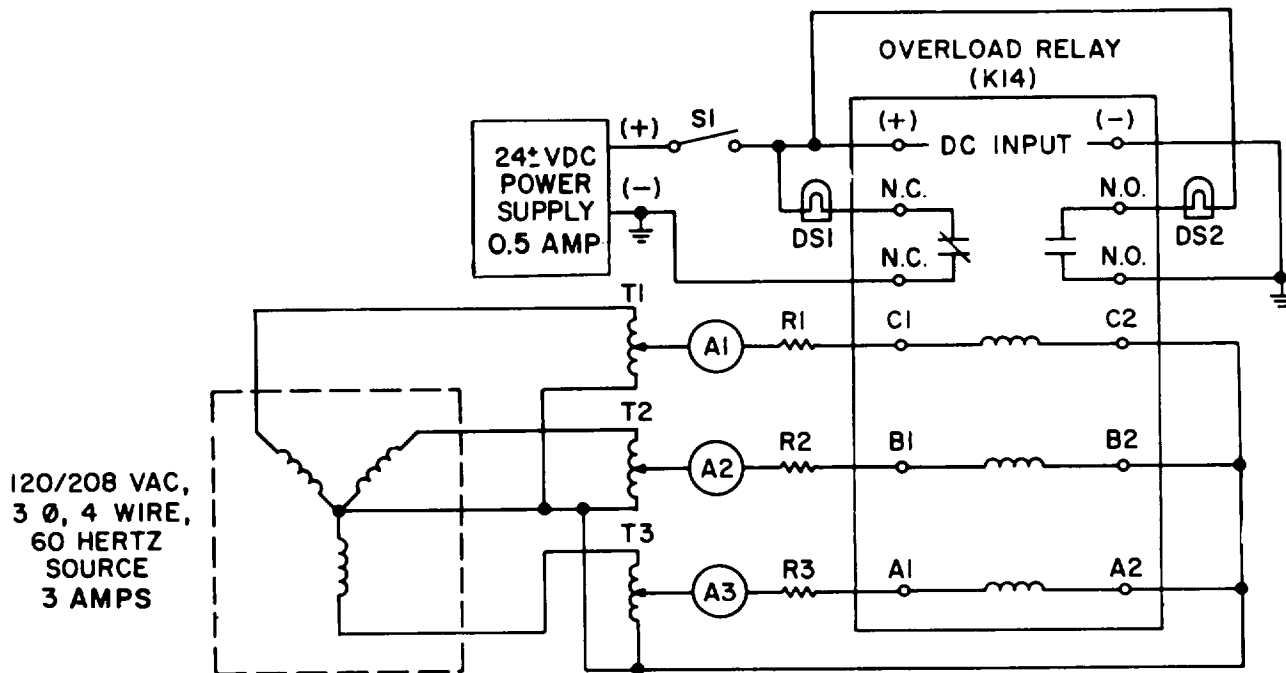
c. Energize the 120/208 VAC power source and adjust autotransformers until ammeters A1, A2, and A3 indicate 0.75 amperes. Indicators DS1 and DS2 should not change states.

d. Adjust autotransformer T 1 until ammeter A 1 indicates 0.975 amperes. After  $8 \pm 2$  minutes indicator DS1 should deenergize and indicator DS2 should energize.

e. Repeat step d for autotransformer T2 and T3. The test results should be the same as the results for adjustment of autotransformer T1.

f. If the overload relay does not meet the requirements of the above test, replace the overload relay.

6-177. INSTALLATION. Refer to figure 6-41 and install the overload relay in position using four screw assemblies. Refer to figure 1-19 and reconnect wiring. Replace the tactical relay box and cover.



**NOTES:**

1. RESISTORS R1, R2 AND R3 ARE 35 OHM, 50 WATT RESISTORS
2. T1, T2 AND T3 ARE AUTOTRANSFORMERS WITH 2 AMP RATING

Figure 6-45. Overload Relay (K14), test setup

6-178. TACTICAL RELAY BOX (A29).

**WARNING**

6-179. ON EQUIPMENT TEST.

Exercise extreme care not to touch exposed electrical connection when working inside tactical relay box with generator set operating.

**NOTE**

Remove cover from tactical relay box to gain access to test points, see figures 6-15 and 6-41.

Table 6-16. Tactical Relay Box (A29)  
 Continuity Test

1. To isolate a malfunction of the overvoltage relay, refer to paragraph 6-163.

2. To isolate a malfunction of the reverse power relay, refer to paragraph 6-167.

3. To isolate a malfunction of the short circuit relay, refer to paragraph 6-171.

4. To isolate a malfunction of the overload relay, refer to paragraph 6-175.

b. Removal. Refer to figure 6-15, disconnect the two electrical plug connectors at the tactical relay box receptacles, then remove the two screws and washers securing the box in position. Remove the tactical relay box.

6-180. BENCH TEST.

a. Refer to table 6-16 and perform a continuity test of the tactical relay box.

b. Connect the tactical relay box to test equipment as illustrated in figure 6-46 and perform test specified in procedural analysis table 6-17.

6-181. DISASSEMBLY. Disassemble the tactical relay box to the extent necessary to accomplish repair. Refer to figures 6-41 and 6-47 and disassemble in the order of index numbers assigned. Pay particular attention to the following.

NOTE

Remove the four screws and washers securing the cover to the relay chassis.

FROM CONNECTOR	TO CONNECTOR	REQUIRED RESULT
J51	J4	
S	A	Continuity
R	B	Continuity
d	G	Continuity
V	F	Continuity
U	E	Continuity
T	D	Continuity
X	N	Continuity
N	S	Continuity
J	C	Continuity
K	M	Continuity
K	K	Continuity
K	L	Continuity

a. Tag, then disconnect harness wiring from components.

b. Remove overvoltage relay (K2), overload relay (K14), short circuit relay (K13) and reverse power relay (K15) from the chassis by removing their attaching screw assemblies (4 each),

NOTE

Refer to paragraphs 6-162, 6-174, 6-170, and 6-166 respectively for relay maintenance instructions.

c. Remove terminal board (TB2), governor resistor assembly (19), and mounting bracket (30) as an assembly by removing screw assembly (29).

d. Remove the wire harness (6) from the chassis by removing eight screw assemblies (2 and 3) and nuts (4 and 5).



Table 6-17. Tactical Relay Box (A29) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
1.	Energize 24 VDC power supply.	Indicator lights DS3, DS4 and DS7 should light.		
2.	Energize 0-10 VDC power supply.			
2. a.	Position switch S5 so that J51-X is positive, then slowly adjust voltage from 0 to 10 VDC; return voltage to 0 VDC.	Indicator light DS4 should stay energized.	Defective reverse power relay K15.	Test relay in accordance with paragraph 6-168.
2. b.	Position switch S5 so that J51-N is positive, then slowly increase voltage to $2 \pm 0.5$ VDC, 50/60 hertz sets; $5 \pm 0.5$ VDC, 400 hertz sets; return voltage to 0 VDC.	Indicator light DS4 should extinguish and DS5 should light.	Same as step 2. a.	Same as step 2. a.

Change 3

6-139

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

Table 6-17. Tactical Relay Box (A29) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
3.	Energize 0-160 VAC power supply.			
3. a.	Adjust voltage to 156 VAC and close switch S4.	Indicator light DS3 should extinguish and DS2 should light.	Defective over voltage relay K2.	Test relay in accordance with paragraph 6-164.
3. b.	Deenergize 0-160 VAC power supply.			
4.	Energize 0-50 VAC power supply. Close switches S1, S2 and S3, then adjust power supply to obtain 3.375 amperes, 50/60 hertz sets; 1.429 amperes, 400 hertz sets on Ammeters AM1, AM2 and AM3. Open switches S1, S2 and S3.			
4. a.	Close switches S1 and S2 and S3 in turn.	Indicator light DS7 should deenergize and DS6 energize as each switch is closed and opened.	Defective short circuit relay K13.	Test relay in accordance with paragraph 6-172.



Table 6-17. Tactical Relay Box (A29) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
4. b.	Reduce voltage to 0 VAC.			
5.	Close switches S1, S2 and S3, then adjust 0-50 VAC power supply to obtain 0.75 amperes.			
5. a.	Adjust A phase voltage to obtain 0.957 ampere on AM1.	Indicator light DS4 should extinguish and DS1 should light within $8 \pm 2$ seconds.	Defective overload relay K14.	Test relay in accordance with paragraph 6-176.
5. b.	Repeat step 5. a. for Phase B and C.	Same as step 5. a.	Same as step 5. a.	Same as step 5. a.
5. c.	Turn off all power supplies.			

Change 3 6-141

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

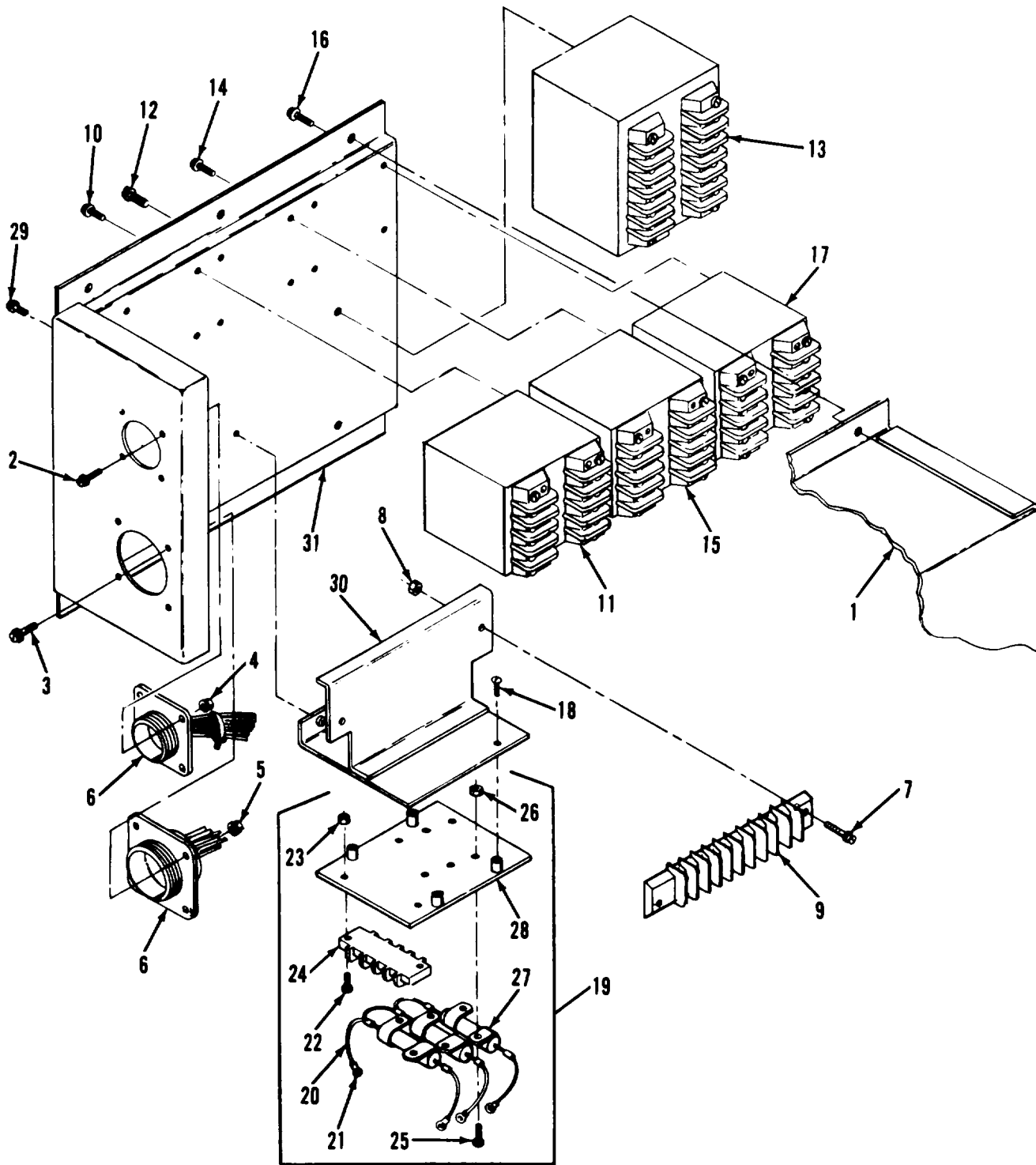


Figure 6-47. Tactical Relay Box (A29), exploded view

Legend to figure 6-47:

1. Cover
2. Screw assembly (4)
3. Screw assembly (4)
4. Nut (4)
5. Nut (4)
6. Harness assembly
7. Screw assembly (2)
8. Nut assembly (2)
9. Terminal board
10. Screw assembly (4)
11. Over voltage relay (K2)
12. Screw assembly (2)
13. Overload relay (K14)
14. Screw assembly (4)
15. Short circuit relay (K13)
16. Screw assembly (4)
17. Reverse power relay (K15)
18. Screw assembly (2)
19. Governor resistor assembly
20. Wire
21. Terminal lug (4)
22. Screw (2)
23. Nut assembly (2)
24. Terminal board TB2
25. Screw (6)
26. Nut (6)
27. Resistor (R1, R2, R3)
28. Mount
29. Screw assembly (6)
30. Bracket
31. Chassis assembly

6-182. CLEANING. Clean all components with a lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

6-183. INSPECTION AND TEST.

a. Harness.

1. Inspect harness wiring for defective insulation and continuity.

2. Inspect harness connectors for damaged threads; bent, loose or missing pins and for shorts.

b. Inspect resistors R23, R24 and R25 for rated resistance;  $7.5 \Omega \pm 1$  percent, 10 watts.

c. Inspect terminal board (TB2 for cracks and missing hardware.

6-184. REPAIR.

a. Repair or fabricate tactical relay box wire harness in accordance with figure 6-48.

b. Straighten dented or distorted sheet metal parts using proper tools. Blend in repaired area with a suitable abrasive

paper and touch up painted surfaces. Restencil panel markings as necessary.

6-185. REASSEMBLY. Refer to figures 6-41 and 6-47 and reassemble the tactical relay box in reverse order of index numbers assigned. Pay particular attention to the following.

a. Install wire harness (6) in chassis assembly (31) and secure in position with eight screw assemblies (2 and 3) and nuts (4 and 5).

b. Assemble governor resistor assembly (19) and terminal board (9) to bracket (30), then install the assembly in chassis assembly (31).

c. Install overvoltage relay (11), overload relay (13), short circuit relay (15), and reverse power relay (17) in position using four each screw assemblies.

d. Refer to figures 6-48 and 1-19 and connect wire harness leads to componentry.



WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	P58D16	J51-A	2	K2-3	4	10.00
2	BLACK	P50T16	J51-B	↑	K2-4	4	10.00
3	BLACK	P206D16	J51-C		K2-7	4	12.25
4	BLACK	P295D16	J51-D		K15-6	4	18.25
5	BLACK	P69A16	J51-E		K15-7	4	17.75
6	BLACK	P293D16	J51-F		K13-7	4	15.75
7	BLACK	P209D16	J51-G		K14-NO	4	26.00
8	BLACK	P62K16	J51-H		K14-NC	4	26.00
9	BLACK	X9W16	J51-J		TB2-1	4	8.75
10	BLACK	X12CC16	J51-K		TB2-2	4	9.25
11	BLACK	P50BB16	J51-L		TB2-4	4	9.75
12	BLACK	P55BB16	J51-M		TB2-5	4	10.25
13	BLACK	K102D16	J51-N		TB2-6	4	11.00
14	BLACK	P200U16	J51-P		TB2-8	4	12.50
15	BLACK	X8K16	J51-R		J4-B	3	8.00
16	BLACK	X7K16	J51-S		J4-A	3	8.00
17	BLACK	X17E16	J51-T		K14-A1	4	26.00
18	BLACK	X18E16	J51-U		K14-B1	4	26.00
19	BLACK	X19E16	J51-V		K14-C1	4	26.00
20	BLACK	P55BH16	J51-W		GRDLUG	4	17.00
21	BLACK	K101D16	J51-X		TB2-7	4	11.50
22	BLACK	P63A16	J51-a		K13-5	4	16.50
23	BLACK	P62F16	J51-b	↓	K13-6	4	16.50
24	BLACK	D24F16	J51-c	2	A7-TB1-4	4	7.50
25	BLACK	X9Y16	J4-C	3	TB2-1	4	9.50
26	BLACK	X116B16	J4-E	3	A7-TB1-2	4	10.00
27	BLACK	X117B16	J4-F	3	A7-TB1-3	4	10.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
28	BLACK	D24J16	J4-G	3	A7-TB1-4	4	9.50
29	BLACK	X115B16	J4-D	↑	A7-TB1-1	4	10.50
30	BLACK	X12HH16	J4-K		TB2-3	4	10.00
31	BLACK	X12KK16	J4-L		TB2-3	4	10.00
32	BLACK	X12DD16	J4-M		TB2-2	4	10.50
33	BLACK	K101B16	J4-N	↓	TB2-7	4	12.50
34	BLACK	K102B16	J4-S	3	TB2-6	4	12.00
35	BLACK	X9X16	TB2-1	4	K2-1	4	10.25
36	BLACK	X12FF16	TB2-2	4	K2-2	4	11.00
37	BLACK	P50DD16	TB2-4	4	K14-(+)	4	28.50
38	BLACK	P55JJ16	TB2-5	4	K14-(-)	4	29.00
39	BLACK	K102C16	TB2-6	4	K15-1	4	12.00
40	BLACK	K101C16	TB2-7	4	K15-2	4	12.00
41	BLACK	P50CC16	TB2-4	4	K15-3	4	13.00
42	BLACK	P55NN16	TB2-5	4	K15-4	4	12.50
43	BLACK	P200Z16	TB2-8	4	K2-8	4	10.00
44	BLACK	P209Y16	TB2-8	4	K15-5	4	23.00
45	BLACK	P200W16	TB2-9	4	K13-8	4	10.00
46	BLACK	P200X16	TB2-9	4	K14-NO	4	19.00
47	BLACK	P61A16	K15-8	4	K14-NC	4	18.00
48	BLACK	D24H16	A7-TB1-4	4	K13-4	4	13.75
49	BLACK	X117D16	A7-TB1-3	4	K13-3	4	14.50
50	BLACK	X116D16	A7-TB1-2	4	K13-2	4	16.75
51	BLACK	X115D16	A7-TB1-1	4	K13-1	4	16.50
52	BLACK	X117C16	A7-TB1-3	4	K14-C2	4	28.00
53	BLACK	X116C16	A7-TB1-2	4	K14-B2	4	28.00
54	BLACK	X115C16	A7-TB1-1	4	K14-A2	4	28.50

4			TYPE F FORM Ua				
			GRADE a, CL 1	34	TUBING, INSULATION		
			CATEGORY 1		.106 ID X .216 WALL X .62 LG	MIL-I-631	
8			SN60W-RAPD	AR	SOLDER, LEAD TIN-ALLOY, ROSIN CORE	QQ-S-751	NOTE 3
7			MS3367-4-9	8	STRAP, TIEDOWN		NYLON
6			MS3367-1-9	19	STRAP, TIEDOWN		NYLON
5			MS39020-1	1	BAND, MARKER		AL ALY
4			MS25036-106	72	TERMINAL, LUG, CRIMP STYLE		
3			MS3102R20-29P	1	CONNECTOR, PLUG		
2			MS3102R20-12P	1	CONNECTOR, PLUG		
1			MS066-2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
QTY	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 8.
- CABLE STRAPS, FIND NO. 6 AND 7, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5086, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.

WIRE LENGTH TOLERANCES		
OVER	INCL	TOL ±
0	50	.12
50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 6-48. Tactical Relay Box (A29), wiring harness (sheet 2 of 2)

e. Test tactical relay box as outlined in paragraph 6-180.

f. Secure cover (1) to chassis assembly (31) using four screw assemblies (16).

6-186. INSTALLATION. Refer to figure 6-15 and install the tactical relay box in position using two screws and washers. Reconnect electrical plug connector to receptacles J4 and J51.

## Section X. PRECISE RELAY BOX

### 6-187. GENERAL.

The precise relay box (A25) is-used only for precise, 50/60 hertz generator sets. It contains the under frequency relay, under voltage relay, permissive paralleling relay, frequency mode selector switch, governor paralleling control or load sharing rheostat, governor feedback capacitor, and the frequency adjust device fixed resistors. (Refer to schematic diagram, figure 1-20.

a. The 50/60 hertz under frequency relay (K12) is a solid state device which functions to protect the load in the event generator frequency decreases below preset limits. It actuates when frequency decreases to  $55 \pm 1$  hertz for 60 hertz operation and  $46 \pm 1$  hertz for 50 hertz opera-

tion. Upon actuation, contacts within the underfrequency relay, close to signal the fault locator and open to deenergize the load contactor, resulting in display of the fault condition and removal of the load from the generator.

b. The under voltage relay (K11) is a solid state device which functions to protect the load in the event generator voltage decreases below preset limits. This relay is identical to the K11 relay used in the mode II relay box assembly. Refer to paragraph 6-104, step c. for a description of relay circuitry.

c. The permissive paralleling relay is utilized only on precise generator sets, Its function is to ensure that a generator set

cannot be paralleled with other generator sets until synchronization is accomplished. This relay is identical to the K16 relay used in the mode II relay box assembly. Refer to paragraph 6-104, step d. for a description of relay circuitry.

d. The electronic components assembly (A6) consists of C1, R4, and R5. The assembly connects to the governor control unit and acts as a feedback circuit to provide the governor with greater frequency stabilization. This assembly is identical to the A6 assembly used in the mode II relay box assembly.

e. The governor paralleling control is a rheostat (R28) which permits initial matching of the governor paralleling circuits for sets operating in parallel. Its function is to ensure proper real load sharing. It has a slotted shaft with locking device which when rotated counterclockwise will cause an increase in signal appearing at paralleling receptacles, causing the generator to assume a greater share of the load. This rheostat is identical to the R28 rheostat used in the mode II relay box assembly.

#### 6-1880 50/60 HERTZ UNDER FREQUENCY RELAY (K12).

#### 6-189. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the underfrequency relay K12 is usually indicated by the illumination of the UNDER FREQUENCY fault light or by failure of the load contactor to close with the generator output frequency normal. To isolate the malfunction, proceed as follows:

#### WARNING

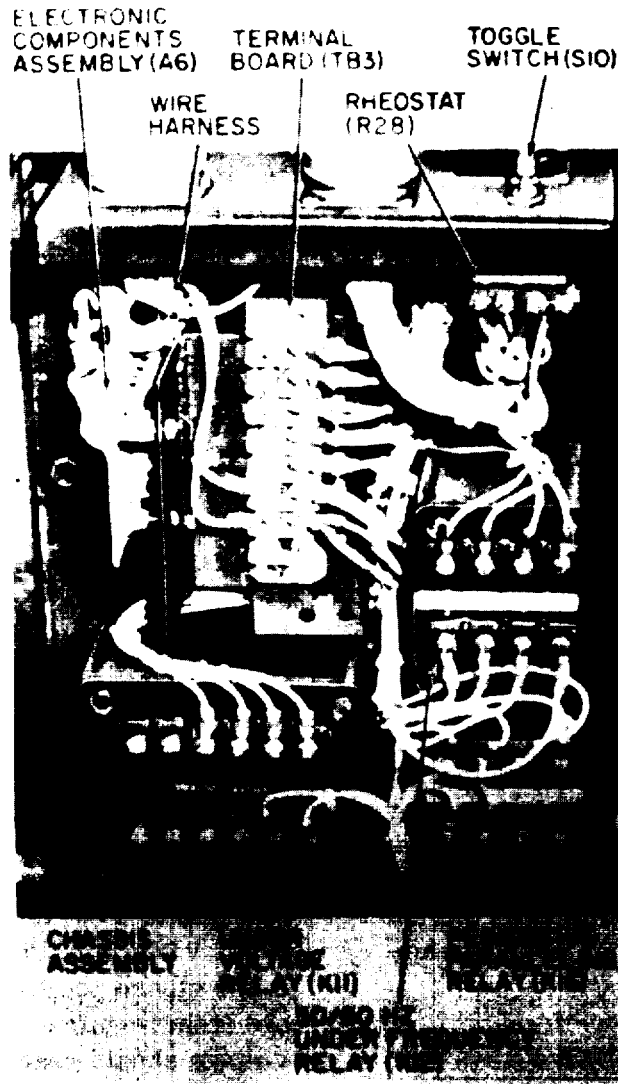
Exercise extreme care not to touch exposed electrical connections when working inside precise relay box with generator set operating.

#### NOTE

Remove cover from precise relay box to gain access to test points, see figures 6-15 and 6-49.

1. With the generator set at rated speed and voltage, measure the voltage from terminal 1 to terminal 2 of the K12 relay. Nominal voltage is 120 VAC.
2. If the voltage at terminal 1 and 2 is normal and fault light is still illuminated, remove the wire from terminal 6 of K12 relay and reset fault 1 amp. If fault lamp can be reset, relay K12 is defective.
3. If the voltage at terminals 1 and 2 is normal and the contactor CB2 will not close, measure the voltage from terminal 3 of K12 to TB3-1. Voltage should read 20-32 VDC, with the contactor switch S3 in the closed position. Measure the voltage from terminal 4 of K12 to TB3-1. Voltage should read 20-32 vdc with the contactor switch S3 in the closed position. If no voltage, is present, replace relay K12.
4. Reduce frequency below 54 Hz (45 Hz for 50 Hz sets); relay should trip. If not, replace relay.

b. Removal. Refer to figure 6-49 and tag, then disconnect wiring to the underfrequency relay. Remove the four screw assemblies securing the relay in position.



NOTES:

1. REMOVE THE FOUR SCREWS AND WASHERS SECURING THE COVER TO THE CHASSIS TO GAIN ACCESS TO THE TEST POINTS.
2. PRECISE RELAY BOX MUST BE REMOVED FROM GENERATOR SET TO ACCOMMODATE REPLACEMENT OF RELAYS. TO REMOVE THE BOX ASSEMBLY, TAG AND DISCONNECT THE TWO ELECTRICAL PLUG CONNECTORS AT J8 AND J32, THEN REMOVE TWO SCREWS AND WASHERS SECURING THE BOX IN POSITION.
3. REPLACE ASSEMBLY BY REVERSING ABOVE PROCEDURES.

Figure 6-49. Precise relay box (A25) 50/60 Hz precise generator sets, cover removed



6-190. BENCH TEST.

a. Connect the under frequency relay to the test equipment as illustrated in figure 6-50.

**WARNING**

Exercise extreme care when making tests as high voltages present will cause injury to personnel upon contact.

b. Energize 24VDC power supply. Energize 120 VAC variable frequency power supply and adjust frequency to 60 Hertz. Close switches S1 and S2. Indicator DS1 should be energized and DS2 should be deenergized.

c. Decrease input frequency until indicator DS1 deenergizes and DS2

energizes. Indicated frequency should be  $55 \pm 1$  Hertz.

d. Open all switches. Adjust input frequency to 50 Hertz. Close switches S1, S2, and S3. Indicator DS1 should be energized and DS2 should be deenergized.

e. Decrease frequency until indicator DS1 deenergizes and DS2 energizes. Indicated frequency should be  $46 \pm 1$  Hertz.

f. If the under frequency relay does not meet the requirements of the above tests, replace the relay.

g. Remove the under frequency relay from the test equipment.

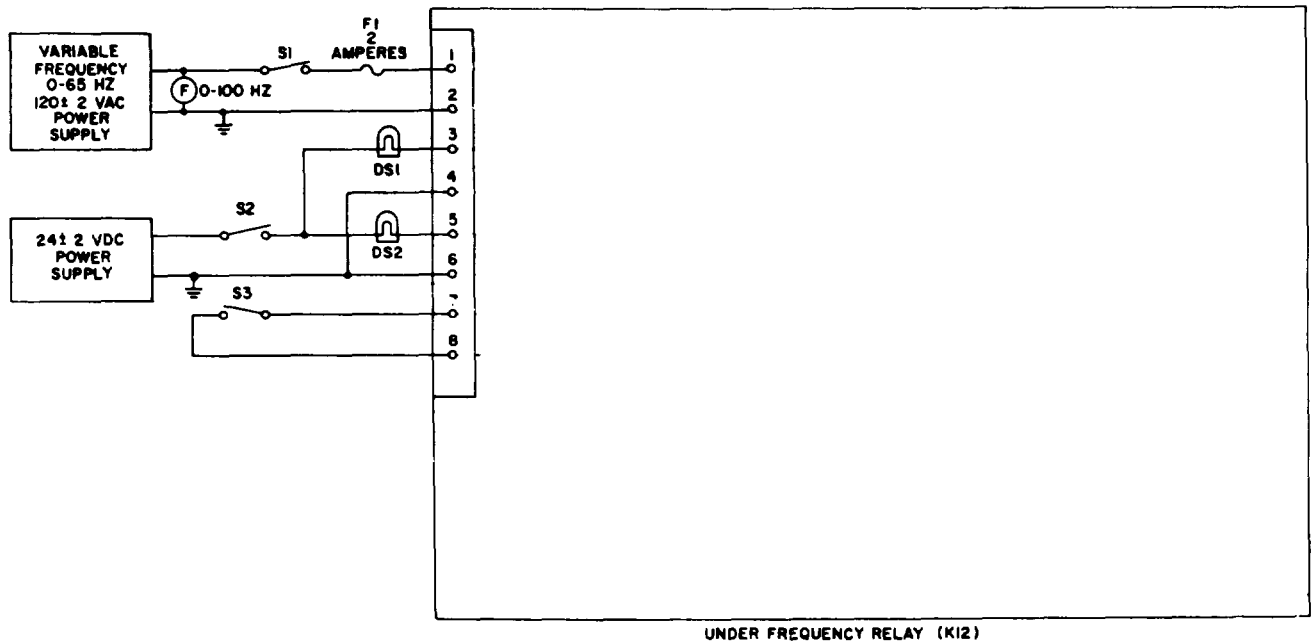


Figure 6-50. 50/60 Hertz under frequency relay (K12), test setup

6-191. INSTALLATION. Refer to figure 6-49 and install the under frequency relay in the precise relay box. Secure the relay in position with four screw assemblies, then refer to figure 1-21 and reconnect wiring. Replace precise relay box and cover.

6-192. PRECISE RELAY BOX (A25).

6-193. TEST AND REMOVAL.

a. Symptom and Isolation of Malfunction. A malfunction of the precise relay box is usually indicated by a failure of the under frequency relay, under voltage relay, permissive paralleling relay, electronic components assembly, and unequal real load sharing when the generator set is operated in parallel. To isolate the malfunction, refer to figure 1-20 and proceed as follows.

WARNING

Exercise extreme care not to touch exposed electrical connections when working inside precise relay box with generator set operating.

NOTE

Remove cover from precise relay box to gain access to test points, see figures 6-15 and 6-49.

1. To isolate a malfunction of the under frequency relay, refer to paragraph 6-189.

2. To isolate a malfunction of the under voltage relay, refer to paragraph 6-111.

3. To isolate a malfunction of the permissive paralleling relay, refer to paragraph 6-115.

4. To isolate a malfunction of the electronic components assembly, refer to paragraph 6-119.

5. To isolate a malfunction in the real load sharing circuit, measure the resistance of rheostat R28. Resistance should be adjustable in the range of 15K ohms  $\pm$ 10 percent.

b. Removal. Refer to figure 6-15, disconnect the two electrical plug connectors at the precise relay box receptacles, then remove the two screws and washers securing the box in position. Remove the precise relay box.

6-194. BENCH TEST.

a. Refer to table 6-18 and perform a continuity and resistance test of the precise relay box.

b. Connect the precise relay box to test equipment as illustrated in figure 6-51 and perform test specified in procedural analysis table 6-19.

6-195. DISASSEMBLY. Disassemble the precise relay box to the extent necessary to accomplish repair. Refer to figures 6-49 and 6-52 and disassemble in the order of index numbers assigned. Pay particular attention to the following.

NOTE

Remove the four screws and washers securing the cover to the relay chassis.

a. Tag, then disconnect harness wiring from components.

b. Remove under voltage relay (K11), under frequency relay (K12) and permissive paralleling relay (16) from the chassis by removing their attaching screw assemblies (4 each).

Table 6-18. Precise Relay Box (A25) Continuity and Resistance Test

FROM	TO	REQUIRED RESULT
J32-S	J8-S	Continuity
J32-U	J8-U	Continuity
J32-M	J8-M	Continuity
J32-T	J8-T	249 ohms
J32-N	J8-N	249 ohms
J32-A	J8-A	Continuity
J32-B	J8-B	Continuity
J32-D	J8-D	Continuity
J32-C	J8-C	Continuity
J32-G	J8-G	Continuity
J32-J	J8-J	Continuity
J8-E	J8-F	15K ohms
J8-E	J8-H	0-15K ohms
J8-F	J8-H	0-15K ohms
J8-K	J8-L	Continuity with switch S10 in 50 Hz position.
J8-R	J8-P	With ohmmeter set to RX 10,000 scale meter should read 0 ohms and slowly rise to infinity.

**NOTE**

Refer to paragraphs 6-110, 6-188, and 6-114 respectively for relay maintenance instructions.

c. Remove terminal board (TB3) and electronic components assembly (A6) and mounting bracket from the chassis as an assembly by removing two screw assemblies (35, figure 6-52).

d. Remove the three screw assemblies (7) securing the electronic components assembly (A6) to bracket (36).

**NOTE**

Refer to paragraph 6-118 for assembly maintenance.

e. Remove the wire harness from the chassis by removing eight screw assemblies and nuts.

**6-196. CLEANING.** Clean all components with a lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

██████████

Table 6-19. Precise Relay Box (A25) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
1.	Energize DC power supply.	Indicator lights DS1 and DS2 should light.	Defective relays K11, K12, or K16.	Test relays in accordance with paragraphs 6-108, 6-112 and 6-116.
2.	Energize AC power supply. Adjust input for $120 \pm 1$ VAC, $60 \pm 1$ Hz. Set switch S10 to 60 Hz position.	Indicator lights DS1 and DS2 should extinguish and DS3 should light.	Defective relays K11 and K12.	Test relays in accordance with paragraph 6-108 and 6-112.
3.	Adjust T1 so that voltmeter VM2 reads 15-20 VAC.	Indicator light DS3 should extinguish.	Defective relay K16.	Test relay in accordance with paragraph 6-116.
4.	Lower voltage (step 3 preceding) below 10 VAC.	Indicator light DS3 should light.	Same as step 3.	Same as step 3.
5.	Lower AC voltage to 99 VAC (read on voltmeter VM1).	Indicator light DS3 should extinguish and DS2 should light in approximately $6 \pm 2$ seconds.	Defective relay K11.	Test relay in accordance with paragraph 6-112.

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Table 6-19. Precise Relay Box (A25) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
6.	Reset voltage to 120 ± 1 volt AC. See Note 1	Indicator light DS2 should extinguish and DS3 should light.	Same as step 5.	Same as step 5.
7.	Lower frequency to 54 Hz.	Indicator light DS3 should extinguish and DS1 should light.	Defective relay K12.	Test relay in accordance with paragraph 6-108.
8.	Reset frequency to 60±1 Hz.	Indicator light DS1 should extinguish and DS3 should light.	Same as step 7.	Same as step 7.
9.	Set switch S10 to 50 Hz position and lower frequency to 45 Hz.	Indicator light DS3 should extinguish and DS1 should light.	Same as step 7.	Same as step 7.
10.	Turn off power supplies.			
<p>NOTE: 1. Install a 100 Ω, 5 watt, resistor in parallel with R5, located on assembly (A26) in the precise relay box in order to lower frequency to 54 hertz.</p>				

Change 3

6-155

P-9-TM-457-35 T.O. 35C2-3-442-2  
 TM-07464A-35 TM 5-6115-457-34

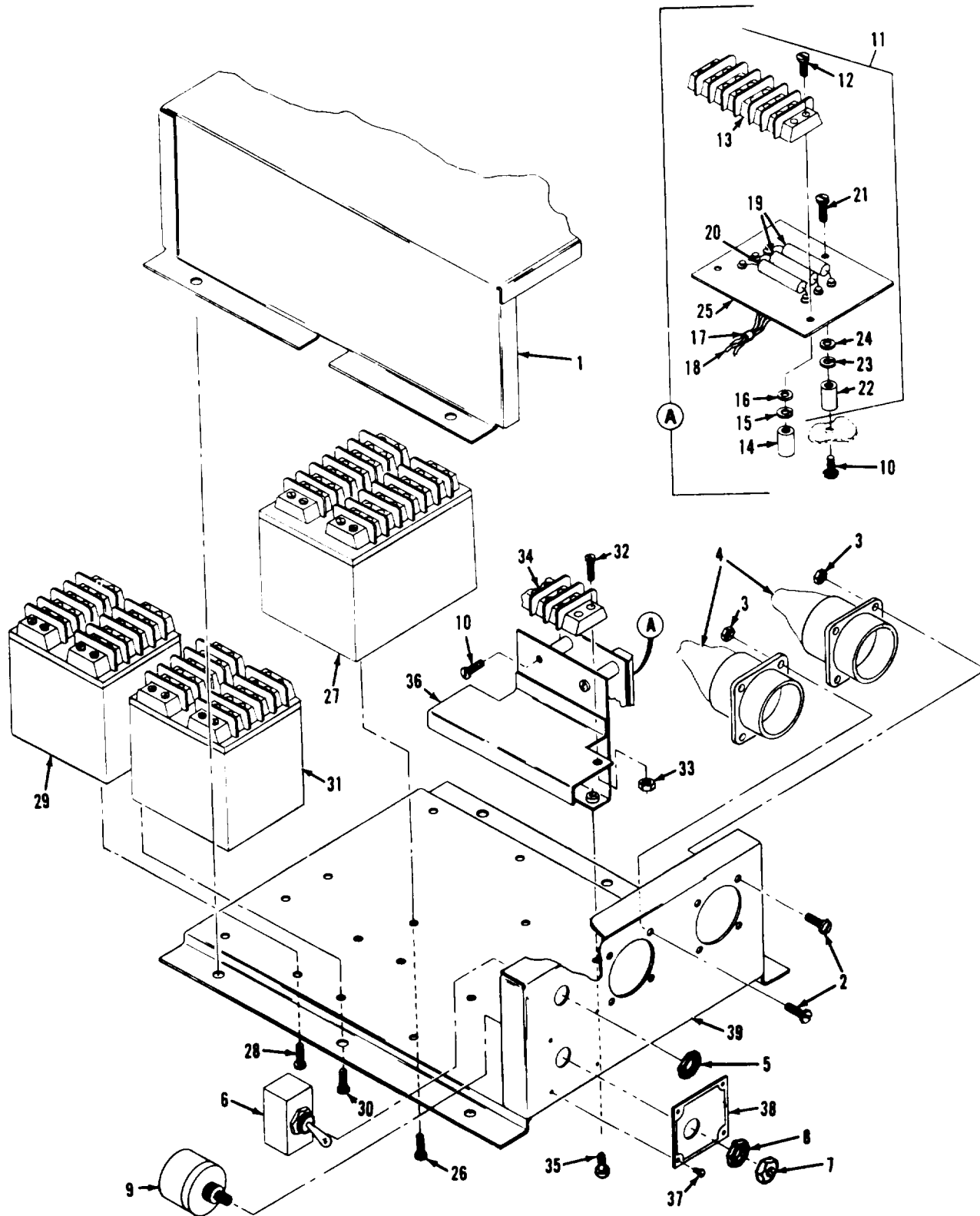


Figure 6-52. Precise relay box (A25), exploded view

Legend to figure 6-52:

1. Cover
2. Screw assembly (8)
3. Nut assembly (8)
4. Wire harness
5. Nut
6. Toggle switch (S10)
7. Nut
8. Nut
9. Variable resistor (R28)
10. Screw assembly (3)
11. Electronic component assembly (A6)
12. Screw (2)
13. Terminal board (TB1)
14. Threaded standoff (2)
15. Lock washer (2)
16. Lock washer (2)
17. Cable Strap
18. Wire
19. Resistor (R4, R5)
20. Capacitor (C 1)
21. Screw
22. Threaded standoff
23. Lock washer
24. Washer
25. Terminal board assembly
26. Screw assembly (4)
27. Under voltage relay (K11)
28. Screw assembly (4)
29. Permissive paralleling relay (K16)
30. Screw assembly (4)
31. Under frequency relay (K12) (50/60 hertz)
32. Screw assembly (2)
33. Nut assembly (2)
34. Terminal board (TB3)
35. Screw assembly (2)
36. Bracket
37. Rivet (4)
38. Identification plate
39. Chassis assembly

#### 6-197. INSPECTION AND TEST.

- a. Harness.
  1. Inspect harness wiring for defective insulation and continuity.
  2. Inspect harness connectors for damaged threads; bent, loose or missing pins and for shorts.
- b. Test rheostat (R28) for full resistance value; 0-15K ohm  $\pm$  10 percent.
- c. Test switch (S10) for proper make and break operation.
- d. Inspect terminal board (TB3) for cracks and missing hardware.

#### 6-198. REPAIR.

- a. Repair or fabricate precise relay box wire harness in accordance with figure 6-53.
- b. Straighten dented or distorted sheet metal parts using proper tools. Blend in repaired area with a suitable abrasive paper and touch up painted surfaces. Re-stencil panel markings as necessary.

**6-199. REASSEMBLY.** Refer to figures 6-49 and 6-52 and reassemble the precise relay box in reverse order of index numbers assigned. Pay particular attention to the following.





WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X9M16	J32-A	2	TB3-1	7	11.50
2	BLACK	X12P16	J32-B	4	TB3-3	7	12.50
3	BLACK	P81B16	J32-C		J8-C	3	14.50
4	BLACK	P55AD16	J32-D		TB3-6	7	14.25
5	BLACK	P50N16	J32-E		TB3-5	7	13.50
6	BLACK	P204D16	J32-F		K11-3	7	20.50
7	BLACK	K110B16	J32-G		J8-G	3	14.50
8	BLACK	P57J16	J32-H		K11-7	7	21.00
9	BLACK	K111B16	J32-J		J8-J	3	14.50
10	BLACK	P200E16	J32-K		TB3-7	7	14.75
11	BLACK	P60E16	J32-L		K16-8	7	20.25
12	BLACK	K32E16	J32-M		J8-M	3	14.50
13	BLACK	K33E16	J32-N		A6-TB1-2	7	9.25
14	BLACK	L93F16	J32-P		K16-1	7	18.50
15	BLACK	X15L16	J32-R		K16-2	7	19.75
16	BLACK	K102J16	J32-S		J8-S	3	14.50
17	BLACK	K34E16	J32-T		A6-TB1-4	7	9.00
18	BLACK	K101J16	J32-U		J8-U	3	14.50
19	BLACK	P210D16	J32-V		K12-5	7	19.25
20	BLACK	P558E	J32-Z	2	GRD LUG	7	5.50
21	BLACK	X9N16	J8-A	3	TB3-2	7	9.75
22	BLACK	X12R16	J8-B	3	TB3-4	7	10.75

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
23	BLACK	P55AF16	J8-D	3	TB3-6	7	12.50
24	BLACK	K105B16	J8-E	4	R28-3	7	11.75
25	BLACK	K107B16	J8-F		R28-1	7	11.25
26	BLACK	K106B16	J8-H		R28-2	7	12.25
27	BLACK	K114B16	J8-K		S10-11	7	11.50
28	BLACK	K115B16	J8-L		S10-12	7	11.25
29	BLACK	K103B16	J8-M		A6-TB1-1	7	16.50
30	BLACK	K108B16	J8-P		A6-TB1-5	7	15.00
31	BLACK	K109B16	J8-R	7	A6-TB1-6	7	14.00
32	BLACK	K104B16	J8-T	3	A6-TB1-3	7	16.00
33	BLACK	X9R16	TB3-1	7	K11-1	7	16.50
34	BLACK	X9S16	TB3-2	7	K12-1	7	9.00
35	BLACK	X12T16	TB3-3	7	K11-2	7	14.75
36	BLACK	X12U16	TB3-4	7	K12-2	7	8.25
37	BLACK	P50P16	TB3-5	7	K16-3	7	11.75
38	BLACK	P55AE16	TB3-6	7	K16-4	7	20.75
39	BLACK	P200F16	TB3-7	7	K11-4	7	23.50
40	BLACK	P200H16	TB3-7	7	K12-6	7	11.25
41	BLACK	K144A16	K12-7	7	S10-6	7	16.75
42	BLACK	K145A16	K12-8	7	S10-5	7	16.75
43	BLACK	P59A16	K12-4	7	K16-7	7	16.75
44	BLACK	P71A16	K12-3	7	K11-8	7	17.50

FIND NO.	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
9			TYPE F, FORM Ua GRADE a, CL1 CATEGORY 1	32	TUBING, INSULATION, .106 ID X .016 WALL X .62 LG	MIL-I-631	
8			SN60:RAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	
7			MS25036-106	50	TERMINAL, LUG, CRIMP STYLE		
6			MS3367-4-9	12	STRAP, TIEDOWN		NYLON
5			MS3367-1-9	13	STRAP, TIEDOWN		NYLON
4			MS39020-2	1	BAND, MARKER		AL ALY
3			MS3102R24-285	1	CONNECTOR, RECEPTACLE		
2			MS3102R24-28P	1	CONNECTOR, RECEPTACLE		
1			MS0862 16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

NOTES:

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 8. SOLDER CONNECTIONS PER MIL-STD-454, REPT 5
- CABLE STRAPS, FIND NO. 5 AND 6, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, PARA 3.3.3 AND 3.9.3.1 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 6-53. Precise relay box (A25), wire harness (sheet 2 of 2)



- a. Install wire harness (4) in chassis assembly (39) and secure in position with eight screw assemblies (2) and nuts (4).
- b. Assemble electronic components assembly (11) and terminal board (34) to bracket (36), then install the assembly in chassis assembly (39).
- c. Install under voltage relay (27), permissive paralleling relay (29), and underfrequency relay (31) in position using four each, screw assemblies.

**WARNING**

Avoid breathing fumes generated by Unsoldering/soldering. Eye protection is required.

- d. Refer to figures 6-53 and 1-21 and connect wire harness leads to componentry.

**NOTE**

Solder connections shall be made using solder, Federal Specification QQ-S-571, Sn 60.

- e. Test precise relay box as outlined in paragraph 6-194.
- f. Secure cover (1) to chassis assembly (39), using four screws and washers.

**6-200. INSTALLATION.** Refer to figure 6-15 and install the precise relay box in position using two screws and washers. Reconnect electrical plug connectors to receptacles J8 and J32.

**Section XI. PRECISE GOVERNOR CONTROL UNIT**

**6-201. GENERAL.**

- a. The precise governor control unit (A23), figure 3-2 is utilized only on precise generator sets. The precise governor is an engine speed frequency regulating unit. It provides high control sensitivity, fast response, and minimum engine speed frequency deviations with load fluctuations. It senses electrical frequency and load. Load sensing and sharing circuitry permits paralleling of more than two generator sets on an isochronous basis.
- b. The precise governor control unit is the device that senses the change in generator speed (frequency) and as a result, commands actuator to move the throttle. The governor circuits include:

1. A frequency error detection circuit to measure the exact instantaneous frequency at which the generator is operating.

A frequency reference circuit to select desired frequency for operation.

2. A magnetic amplifier to amplify the measured error between the outputs of the frequency measuring and frequency reference circuits. This error signal is amplified to a level which is usable by the governor actuator.

3. A transistor inverter circuit to convert 24 vdc to approximately 1000 hertz to power the magnetic amplifier.

4. A throttle position feedback circuit for governor stability.

5. Provisions for accepting the load measurement unit signals to provide isochronous parallel operation, and improved transient response.

## 6-202. ON EQUIPMENT TEST

a. Symptom and Isolation of Malfunction. A malfunction of the governor control unit is usually indicated by loss of frequency control, unstable frequency, or by instability only when operating sets in parallel. To isolate the malfunction, proceed as follows:

### WARNING

Exercise extreme care not to touch exposed electrical connections when working inside precise relay box with generator set operating.

### **NOTE**

Fold hinge cover away from precise governor control unit to gain access to test points as shown in figure 6-54.

1. Loss of Control. - With the set operating under manual speed control, measure the input voltage to the P1 connection, pins A and B (nominal 120 VAC). Also measure input voltage to the P2 connection, pins A(+) and B(-) (20 to 32 VDC). If the control unit is properly energized, measure the voltage at test points A to B and C to D with A and D(+) (4 to 6 VDC). If either voltage is approximately 15 VDC, check for an open circuit to the actuator coils. The actuator coil resistance should be 10 ohms  $\pm 10\%$ . If there is no voltage, the control unit should be replaced. If the above readings are correct, check the circuit to the frequency adjusting rheostat (R1) on control cubicle from the PI connection. Pins N to T should measure 950 ohms  $\pm 10\%$ , pins M to N and M to T should measure 750 ohms  $\pm 10\%$ . If the above checks have not indicated the malfunction, disconnect all cables from the control unit, rotate potentiometers R11,

R12, R14, R15, R16, and R18 full CW. Measure resistance between points indicated in table 6-20. Readings which do not agree with the values given in the table indicate a malfunctioning component in the control unit and it should be replaced.

2. Unstable frequency. - Refer to the alignment procedures (paragraph 6-211) and check the adjustment of the magamp bias gain R12, the load measurement gain R15, the frequency gain R18, and the feedback gain R16. If the above adjustments are correct, connect a DC voltmeter (0 to 50 volt scale) across test points 1 and 2 of the control unit. The voltage should be zero at rated speed and should swing as the frequency is varied above and below rated speed by manually forcing the actuator linkage above and below its normal position. If the readings are correct, check the throttle position transducer circuit by measuring the voltage across test points 3 and 4 (+) with a DC voltmeter. Operate the set manually with connection P2 disconnected and move the actuator manually, the voltage across TP3 and TP4 should vary with actuator movement. Capacitor (C1) can cause unstable frequency and should be checked for a short or excessive current leakage. If the cause of this unstable frequency is not located by the above checks, perform the resistance checks listed in table 6-20 and observe any intermittent readings when the adjustment potentiometers are turned. Also check the resistance of all pins to ground with an 100,000 ohm scale. All readings shall be infinite resistances. Readings other than those specified indicate replacement of the control unit.

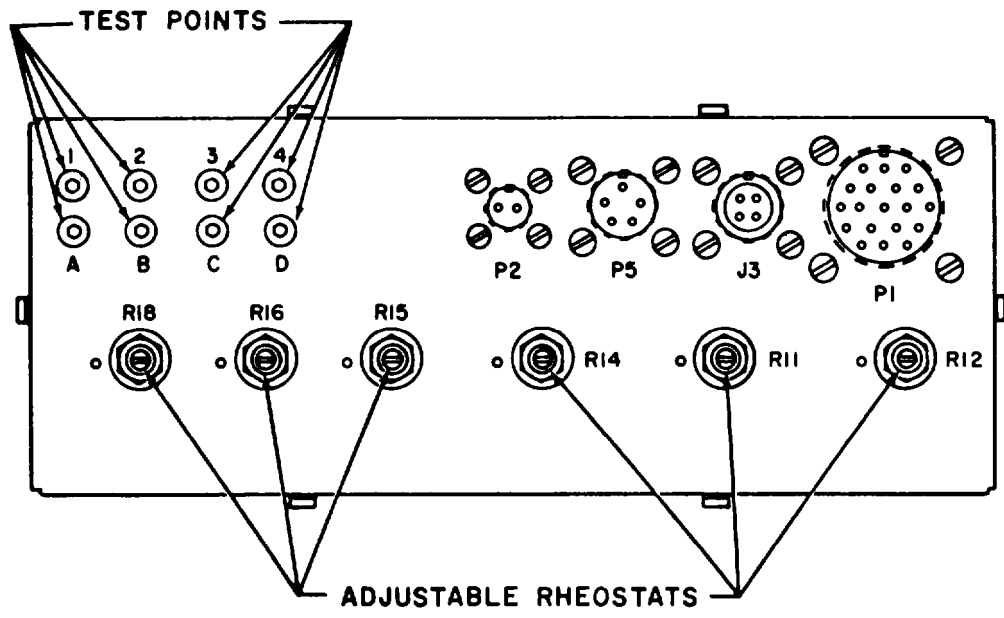
3. Instability when operating in parallel. Check this setting of the load sharing potentiometers (R28). Both units should be set at  $4.6 \pm 0.25$  volts with Pi-G positive (pin A of the paralleling receptacle). Also the frequency gain (R18) and feedback

Table 6-20. Precise Governor Control Unit (A23) Resistance Checks

*TEST POINTS (P1)	POTENTIOMETER POSITION	NOMINAL RESISTANCE IN OHMS		ALLOWABLE RANGE IN OHMS	
		50/60 HZ UNIT	400 HZ UNIT	50/60 HZ UNIT	400 HZ UNIT
T-N (T+)		2800 CW			
T-N (T+)		4300 CCW	2550	4000-4600	2300-2800
M-N (M+)		2180	1480	1950-2400	1200-1700
M-N (M+)	R18 CCW	12180	11480	11000-13000	10000-12000
F-N (F+)		6000	4160	5000-7000	3500-5500
F-N (F+)	R16 CCW	31000	29160	30000-32000	27000-31000
F-N (F+)	R15 CCW	6500	4660	5500-7500	4000-5500
E-G (E+)		5500	5500	4500-6500	4500-6500
R-G (R+)		120	120	100-140	100-140
F-G (F+)		650	650	550-750	550-750
J-H (J+)			LESS THAN 0.2		
T-P (T+)		2100	2300	2500-2900	2100-2500
T-P (T+)	R14 CCW	2400	2500	2800-3400	2200-2800
U-S (U+)		525	520	450-600	450-600

\*Pin letter with + in parenthesis indicates connection point for positive ohmmeter lead.

Note: Always return to CW position after reading.



•Figure 6-54. Precise governor control unit (A23) adjustments and test points.

gain (R16) as set for single unit operation are too high for parallel operation. The gain adjustments of both units should be reduced the same amount. If the above adjustments do not eliminate the instability, remove all connections and perform the resistance checks listed in table 6-20. Readings which do not agree with the values in the table indicate a malfunctioning component in the control unit and it should be replaced,

b. Remove precise governor control unit from right hand side of lifting frame as follows: Refer figure 3-2.

1. Remove hinge cover from top of unit by removing two screws.
2. Tag and disconnect harness assembly.
3. Lift unit out of retainer.

#### 6-203. BENCH TEST.

a. Connect the governor control unit to test equipment as illustrated in figure 6-55 and perform test as specified in procedural analysis table 6-21.

#### NOTE

Figure 1-22 (50/60 Hz sets) and figure 1-23 (400 Hz sets) illustrates the precise governor control unit schematic. Refer to the appropriate figure when checking individual components for required values.

b. Remove the precise governor control unit from the test equipment.

#### 6-204. DISASSEMBLY .

a. Refer to figure 6-56 and disassemble the precise governor control unit to the extent necessary to accomplish repair. Pay particular attention to the following.

Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
1	<p>With all cables disconnected from control unit, rotate potentiometers R11, R12, R14, R15, R16, and R18 to full CW position. Measure resistance between points indicated in table 6-20.</p> <p style="text-align: center;">NOTE</p> <p>For any measurement with a potentiometer positioned to full CCW, return potentiometer to full CW position after measurement.</p>	<p>Refer to table 6-20 for proper resistance values.</p>	<p>a. For measurements taken with all potentiometers in full CW position, a defective component in control unit circuitry between test points is cause for error.</p> <p>b. For measurements taken with potentiometer R14, R15, R16, or R18 in full CCW position, probable cause is defective potentiometer.</p>	<p>a. Unpot unit, check components between test points. Repot unit after defective component has been isolated and replaced.</p> <p>b. Check applicable potentiometer.</p>
2	<p>Measure resistance between each pin of all connectors on control unit, and each test point to governor control unit container.</p>	<p>Resistance measured in 100,000 ohm scale (or equivalent) should be infinity.</p>	<p>Defective connector or test point.</p>	<p>Replace defective connector or test point.</p>

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Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
3	<p>Connect control unit to test equipment as depicted in TEST A of figure 6-55. With switch S1 open, rotate governor potentiometers R11, R12, R14, R16, and R18 full CW.</p> <p>a. Energize 120 VAC power supply and close switch S1. Adjust R11 and R12 for equal indications of 450 ma on meters MA1 and MA2.</p>	<p>a. Meters MA1 and MA2 should both indicate 450 ma.</p>	<p>a. (1) Defective components in magnetic amplifier bias control winding circuit.</p> <p>a. (2) Defective transformer T1.</p>	<p>a. (1) Check resistors R4, R8, R14, and R20, capacitor C5, reactor L3, full wave bridge CR3, and continuity of control windings 12 and 8, and 12 and 9 of mag amp SL1.</p> <p>a. (2) Measure voltage at terminals 5 and 6 of T1. Voltage should be 120 VAC.</p>



Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
3 (continued)	<p>a. (Continued)</p> <p>b. Adjust R12 full CW.</p> <p>c. Adjust R12 full CCW.</p>	<p>a. (Continued)</p> <p>b. Meters MA1 and MA2 should indicate 0 to 300 ma and their readings should be within 150 ma of each other.</p> <p>c. Meters MA1 and MA2 should indicate 600 to 1000 ma. and should be within 50 ma. of each other.</p>	<p>a. (3) Defective components in transistor inverter circuit.</p> <p>a. (4) Defective primary windings of MAG AMP SL1.</p> <p>a. (5) Defective rectifier assembly CR4.</p> <p>b. Defective bias balance potentiometer R11.</p> <p>c. Defective bias level adjustment potentiometer R12.</p>	<p>a. (3) Check capacitors C7 and C9, resistor R5, and transistors Q1 and Q2. Check continuity of windings of transformer T2.</p> <p>a. (4) Check continuity of primary windings A, B, C, and D.</p> <p>a. (5) Check rectifier assembly with ohmmeter.</p> <p>b. Check potentiometer with ohmmeter.</p> <p>c. Check potentiometer with ohmmeter.</p>

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Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
3 (continued)	d. Readjust R11 and R12 for equal indications of 450 ma on meters MA1 and MA2 and lock potentiometer adjustment screws for R11 and R12 after balanced reading.	d. Meters MA1 and MA2 should both indicate 450 ma.	a. Refer to step 3., a. (1) through 3., a. (5) above.	
4	Connect control unit to test equipment as depicted in TEST B of figure 6-55. With switch S1 open, adjust potentiometers R14, R15, R16, and R18 full CW. Adjust Ra full CCW.  a. Energize ac power supply and close switch S1. Reduce frequency of ac power supply until meters MA1 and MA2 indications are equal.	a. Frequency at balanced condition should be 57.5 to 58 or 375 to 380 for 50/60 or 400 hertz control units, respectively.	a. (1) Defective components in frequency control winding reference circuit.	a. (1) Check resistors R2 and R10, and check full wave bridge CR3.

Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
4 (continued)	<p>a. (Continued)</p> <p>b. Adjust Ra full CW. Increase frequency of 120 VAC supply until meters MA1 and MA2 indications balance.</p>	<p>a. (Continued)</p> <p>b. Balance frequency should be 62 to 62.5 or 420 to 425 Hertz for 50/60 or 400 Hertz control units, respectively.</p>	<p>a. (2) Defective component in frequency control winding frequency sensing circuit.</p> <p>a. (3) Defective mag amp control winding 2 to 16.</p> <p>a. (4) Defective transformer T1.</p> <p>b. Refer to step 4a(1) through a(4) above.</p>	<p>a. (2) Check resistors R1 and R1A, full wave bridge CR2, reactors L1 and L2, and capacitor C3.</p> <p>a. (3) Check continuity between terminals 2 and 16 of mag amp SL1.</p> <p>a. (4) Measure voltage across terminals 3 and 4 of T1. Voltage should be 110 VAC for 60 Hertz or 55 VAC for 400 Hertz control units.</p>

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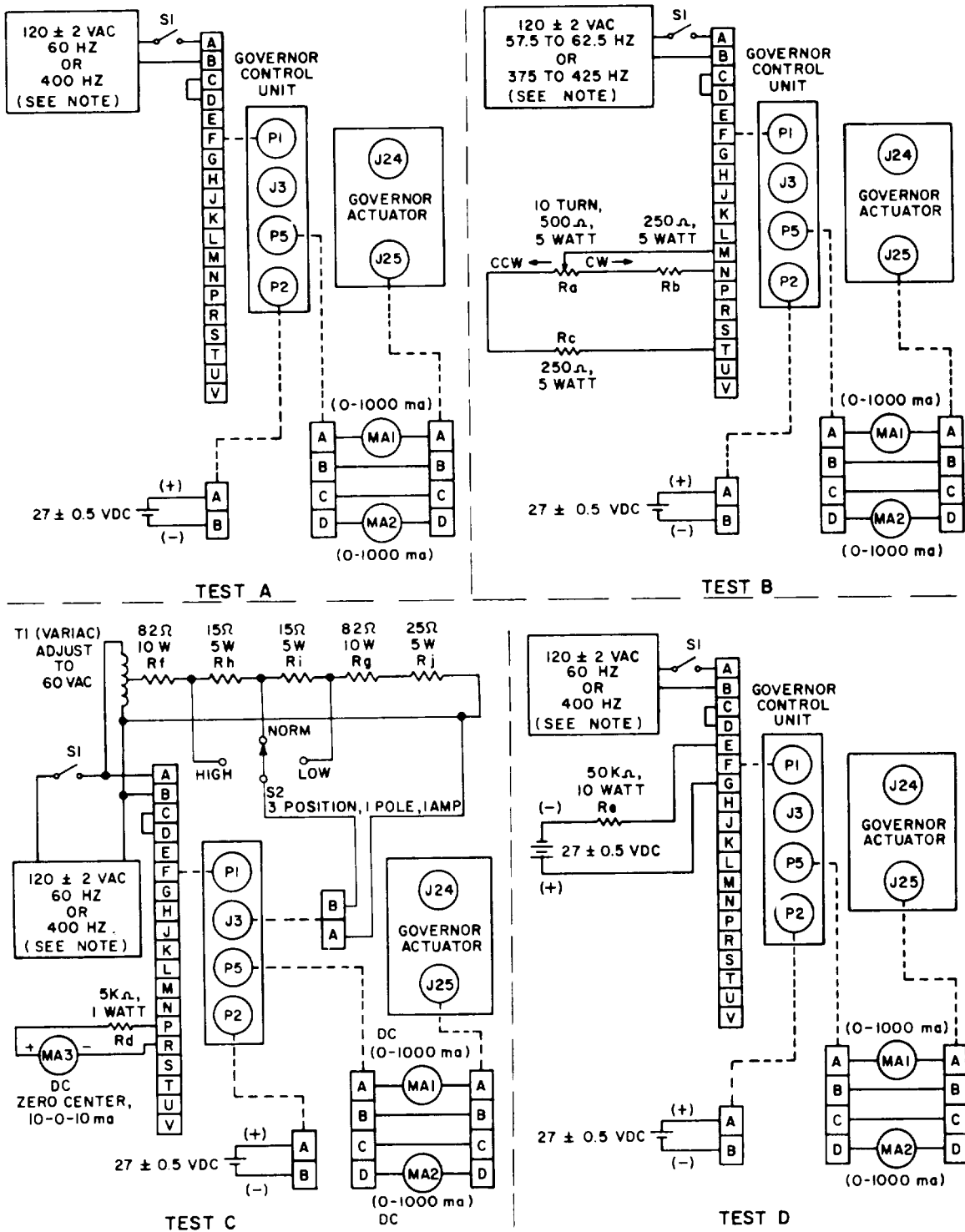
Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
5	<p>Connect control unit to test equipment as depicted in TEST C of figure 6-55. With switch S1 open, adjust R14, R15, R16, and R18 full CW.</p> <p>a. Energize 60 VAC power supply and close switch S1. With switch S2 in NORMAL position, adjust R14 and R15 full CCW.</p> <p>b. Adjust R14 clockwise until meters MA1 and MA2 indications are equal. Rotate switch S2 to LOW position.</p>	<p>a. Meter MA3 should indicate from -5 to -7 ma.</p> <p>b. Meter MA1 should indicate 600 to 840 ma. Meter MA2 should indicate 0 to 300 ma. Meter MA3 should indicate within 0 to +1.5 ma.</p>	<p>a. (1) Defective components in feed back control winding circuitry.</p> <p>a. (2) Defective feed-back control winding in mag amp SL1.</p> <p>a. (3) Defective capacitor C2 and 60 Hertz control units.</p> <p>b. Refer to step 5a(1) through 5a(3) above.</p>	<p>a. (1) Check resistor R37, potentiometers R14, R15, and R16, and full wave rectifier bridge CR5 with ohmmeter.</p> <p>a. (2) Check continuity of control winding 4 to 14 of mag amp SL1 with ohmmeter.</p> <p>a. (3) Check capacitor for shorts or leaks.</p>

Table 6-21. Precise Governor Control Unit (A23) Procedural Analysis (Continued)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECKOUT PROCEDURE
5 (continued)	c. Rotate switch S2 to HIGH position.	c. Meter MA1 should indicate 0 to 300 ma. Meter MA2 should indicate 600 to 840 ma. Meter MA3 should indicate within 0 to -1.5 ma.	c. Refer to step 5a(1) through 5a(3) above.	
6	<p>Connect control unit to test equipment as depicted in TEST D of figure 6-55. With switch S1 open, adjust R14, R15, R16, and R18 full CW.</p> <p>a. Energize the 120 VAC supply and close switch S1.</p> <p>b. Reverse polarity of battery connected at pins P1-G and P1-E in TEST D, figure 6-55.</p>	<p>a. Meter MA1 should indicate 0 to 300 ma. Meter MA2 should indicate 600 to 840 ma.</p> <p>b. Meter MA1 should indicate 600 to 840 ma. Meter MA2 should indicate 0 to 300 ma.</p>	<p>a. Defective components in parallel control winding circuit.</p> <p>b. Defective components in parallel control winding circuit.</p>	<p>a. Check resistor R22 and mag amp control winding 5 to 13 with ohmmeter.</p> <p>b. Check resistor R22 and mag amp control winding 5 to 13 with ohmmeter.</p>

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NOTE:  
 USE APPROPRIATE POWER SUPPLY  
 (60 OR 400 HERTZ) FOR 50/60  
 OR 400 HERTZ CONTROL UNITS  
 RESPECTIVELY.

Figure 6-55. Precise governor control unit (A23), test setup

1. Remove potting from governor control unit by performing steps 2. through 6.

2. Remove six screws (1) and lock washers (2) holding panel (20) to cabinet (25).

3. Lift off panel and set across top of cabinet at a slight angle to keep the potentiometers out of the compound.

4. Place the complete unit in a temperature controlled oven large enough to allow air to circulate completely around unit. Set oven temperature to 170°F.

#### CAUTION

The flash point of the compound is 515°F. Do not unpot the unit by placing it on a hot plate type surface or by using an open flame, as high temperatures (hot spots ) could damage componentry.

#### NOTE

Melting usually occurs in eleven to twelve hours.

5. To remove printed wiring board assembly (21) from cabinet, use heavy gloves and remove entire unit from oven, being careful not to spill the wax from the cabinet or allow wax to get on the panel or potentiometers.

#### WARNING

Use care in handling the hot wax as it can cause severe injury to personnel.

6. Prior to making repairs, the printed wiring board assembly must be

placed on a drain board and allowed to cool to room temperature.

b. Refer to figure 6-57 and disassemble the governor printed wiring board assembly to the extent necessary to accomplish repair. Pay particular attention to the following:

#### NOTE

Exercise care not to apply excessive heat to components when unsoldering connections.

#### 6-205. CLEANING.

Clean all components with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

#### 6-206. INSPECTION.

a. Inspect electrical components and printed wiring board in accordance with paragraph 6-53.

b. Inspect wiring and electrical connectors for damage.

#### 6-207. REPAIR.

Repair printed wiring board in accordance with paragraph 6-54, step f.

#### 6-208. REBUILD.

Refer to figure 6-58 and rebuild precise governor control unit wiring harness.

#### 6-209. REASSEMBLY.

a. Refer to figure 6-57 and reassemble the precise governor printed wiring board. Pay particular attention to the following.

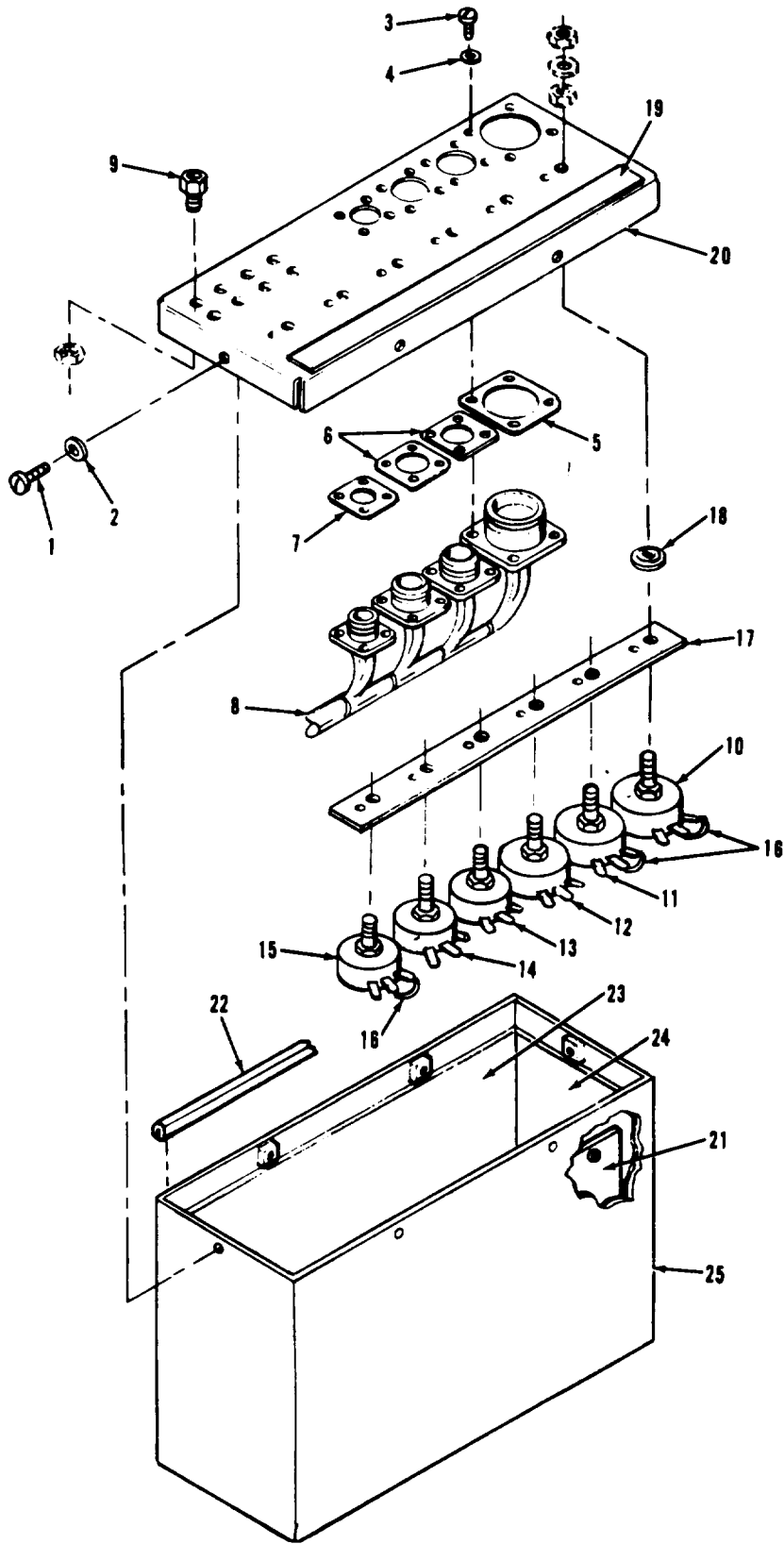


Figure 6-56. Precise governor control unit (A23), exploded view



Legend to figure 6-56:

- |                     |                    |                                      |
|---------------------|--------------------|--------------------------------------|
| 1. Screw (6)        | 10. Resistor       | 19. Identification plate             |
| 2. Lockwasher (6)   | 11. Resistor       | 20. Panel                            |
| 3. Screw (16)       | 12. Resistor       | 21. Printed wiring board<br>assembly |
| 4. Lock washer (16) | 13. Resistor       | 22. Gasket                           |
| 5. Gasket           | 14. Resistor       | 23. Insulation                       |
| 6. Gasket (2)       | 15. Resistor       | 24. Insulation                       |
| 7. Gasket           | 16. Wire           | 25. Cabinet                          |
| 8. Wiring harness   | 17. Spacer         |                                      |
| 9. Connector (8)    | 18. Sealing washer |                                      |

NOTE

Exercise care not to apply excessive heat to components when unsoldering connections.

b. Refer to figure 6-56 and reassemble precise governor control unit. Pay particular attention to the following.

1. Re-pot governor control unit by performing steps 2 through 8.

2. Place the governor cabinet in a temperature controlled oven in order to melt the wax.

3. Prior to installing printed wiring board assembly in cabinet, remove it from oven and ensure the insulation paper is positioned next to cabinet shell.

4. Use suitable potting fixture to locate and maintain cradle for harness.

5. To install the unit in cabinet, use heavy gloves and slowly lower the assembly into the cabinet.

WARNING

Use extreme care not to splash hot wax on personnel as severe injury can occur.

6. Take unit away from heat and let wax cool. Place near or in front of cooling device in order for wax to set more rapidly.

7. Remove potting fixture when wax is hard.

8. Install panel (20) to cabinet (25) and secure with screws (1) and lock washer (2).

c. Test the precise governor control unit in accordance with paragraph 6-203.

6-210. INSTALLATION.

a. Install precise governor control unit on right hand side of lifting frame as follows:

1. Place unit into retainer.

2. Connect harness assembly.

3. Install hinge cover to top of unit and secure with two screws.

6-211. ALIGNMENT.

a. If necessary, refer to Operator and Organizational Maintenance Manual and adjust precise governor actuator linkage.

b. Refer to figure 6-54 for location of adjustments and test points.

NOTE

Normally, operating adjustments should be limited to desired readjustments of frequency reference adjustment R1, and real load sharing adjustment R28. The following alignment procedure is used only for initial installation of governor or when any one of the governor components are replaced, or when adjustments of R7 or R28 will not correct improper operation.

### 1. Isochronous Operation

(a) Before starting engine, rotate

frequency adjust rheostat R1, on main generator control panel for precise generator sets to a mid-rotation position.

Legend to figure 6-57:

- |                          |                                     |
|--------------------------|-------------------------------------|
| 1. Screw (2)             | 35. Lock washer (8)                 |
| 2. Nut (2)               | 36. Washer (8)                      |
| 3. Lock washer (2)       | 37. Stud (8)                        |
| 4. Washer (4)            | 38. Panel assembly                  |
| 5. Transformer T1        | 39. Capacitor (C 2)                 |
| 6. Screw (2)             | 40. Rectifier (CR7, CR8, CR9, CR10) |
| 7. Nut (2)               | 41. Resistor (R37)                  |
| 8. Lock washer (2)       | 42. Terminal (4)                    |
| 9. Washer (4)            | 43. Plate                           |
| 10. Filter reactor (L2)  | 44. Capacitor (C 5)                 |
| 11. Screw (2)            | 45. Resistor (R4 and R8)            |
| 12. Nut (2)              | 46. Screw (2)                       |
| 13. Lock washer (2)      | 47. Nut (2)                         |
| 14. Washer (4)           | 48. Lock washer (2)                 |
| 15. Filter reactor (L1)  | 49. Washer (2)                      |
| 16. Resistor (R23)       | 50. Washer (4)                      |
| 17. Capacitor (C 7)      | 51. Washer (2)                      |
| 18. Resistor (R5)        | 52. Adjustable resistor (R10)       |
| 19. Screw (2)            | 53. Magamp (SL1)                    |
| 20. Nut (2)              | 54. Capacitor (C6)                  |
| 21. Lock washer (2)      | 55. Screw (2)                       |
| 22. Washer (2)           | 56. Nut (2)                         |
| 23. Power transistor (2) | 57. Lock washer (2)                 |
| 24. Screw (2)            | 58. Washer (2)                      |
| 25. Nut (2)              | 59. Washer (4)                      |
| 26. Lock washer (2)      | 60. Washer (4)                      |
| 27. Washer (4)           | 61. Resistor (R1 and R1A)           |
| 28. Heat sink (2)        | 62. Wire (8)                        |
| 29. Filter reactor (L3)  | 63. Wire (3)                        |
| 30. Diode (CR3)          | 64. Rectifier (CR2)                 |
| 31. Capacitor (C2)       | 65. Capacitor (C3, C4)              |
| 32. Resistor (R20)       | 66. Transformer (T2)                |
| 33. Resistor (R20)       | 67. Printed wiring board            |
| 34. Nut (8)              |                                     |

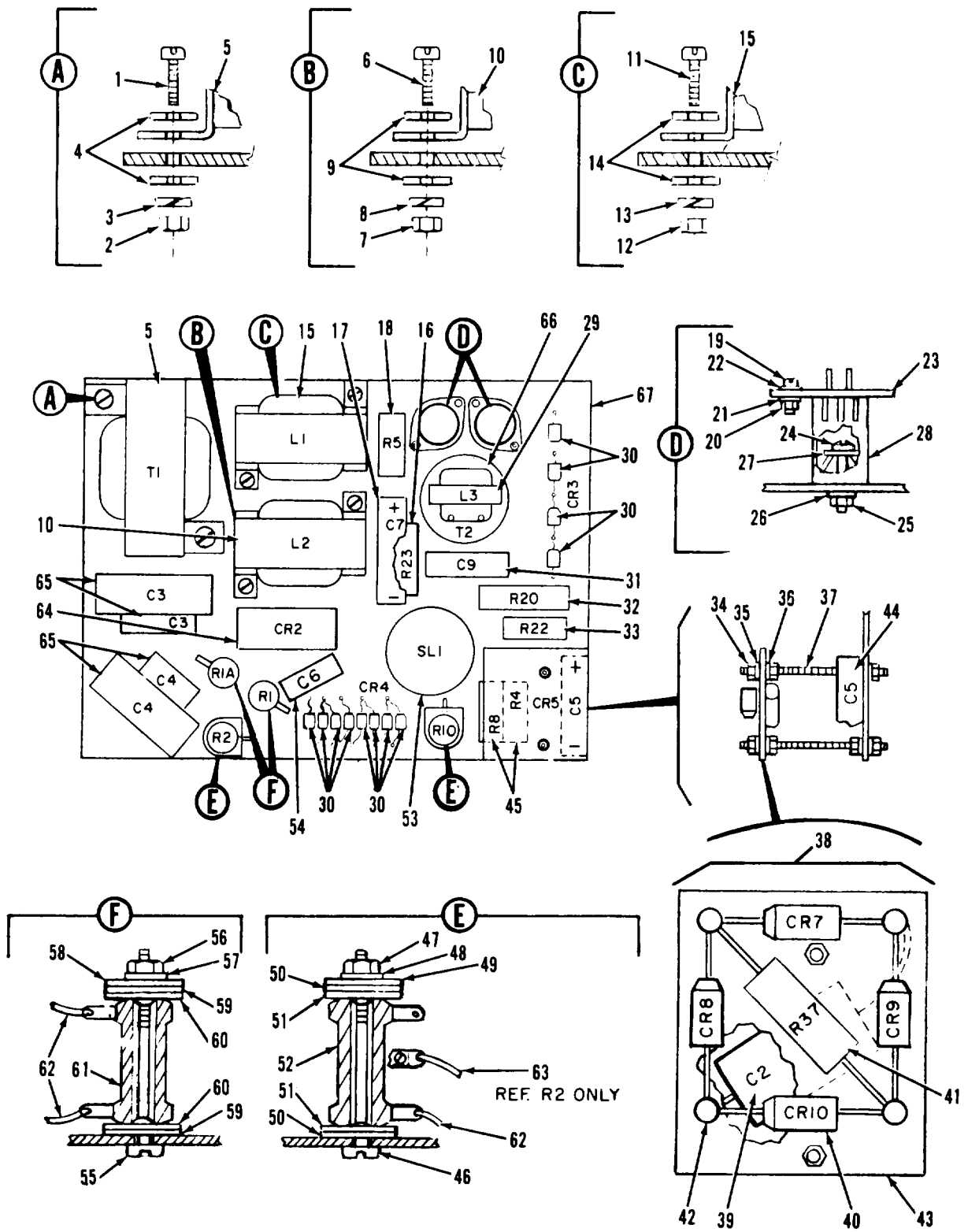


Figure 6-57. Precise governor control unit (A23), printed wiring board assembly

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 Change 3

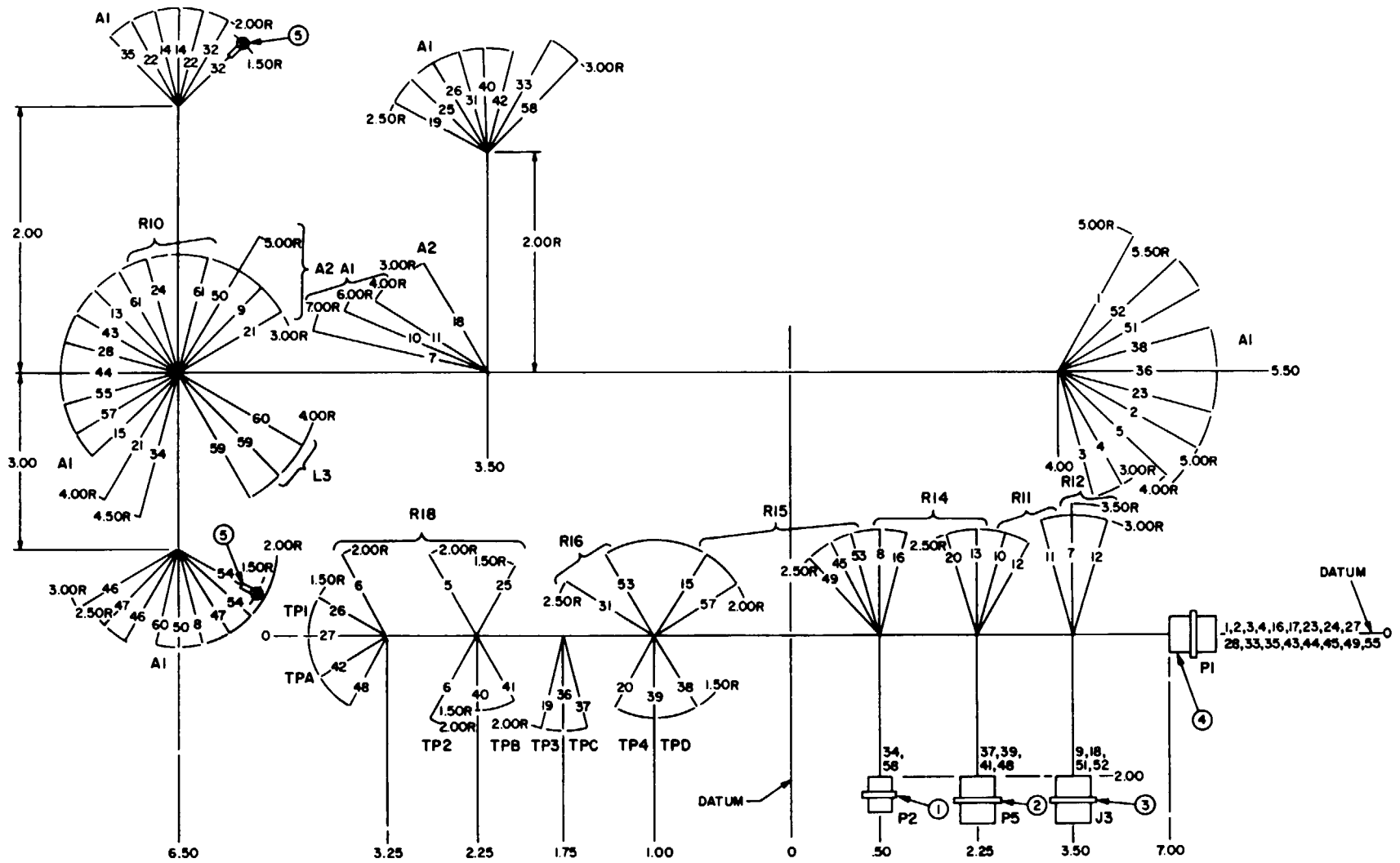


Figure 6-58. Precise governor control unit (A23), wiring harness diagram (sheet 1 of 2)

WIRE NO. (REF)	TERMINATION		WIRE FIND NO.	WIRE CUT-LENGTH (REF)
	FROM	TO		
1	P1-B	A1-1	6	22.00
2	P1-A	A1-2	6	22.00
3	P1-K	A1-3	6	20.00
4	P1-L	A1-4	6	20.00
5	R18-2	A1-5	6	18.50
6	TP2	R18-1	6	6.00
7	R12-3	A1-7	6	24.00
8	R14-1	A1-8	6	20.50
9	J3-A	A2-B	6	21.50
10	R11-1	A1-10	6	20.00
11	R11-3	A1-11	6	20.00
12	R11-2	R12-1	6	7.00
13	R14-3	A1-13	6	20.00
14	Q1-E	A1-E1	6	4.50
15	R15-1	A1-15	6	18.50
16	P1-P	R14-2	6	11.00
17	P1-H	P1-J	6	2.50
18	J3-B	A2-A	6	21.00
19	TP3	A1-19	6	18.00
20	TP4	R14-2	6	8.00
21	A2-D	A1-21	6	7.50
22	Q1-B	A1-B1	6	4.50
23	P1-N	A1-23	6	22.00
24	P1-T	R10-1	6	23.00
25	R18-3	A1-25	6	19.00
26	TP1	A1-26	6	20.00
27	P1-M	TP1	6	13.00
28	P1-G	A1-28	6	23.00

WIRE NO. (REF)	TERMINATION			WIRE FIND NO.	WIRE CUT-LENGTH (REF)
	FROM	TERM. FIND NO. (REF)	TO		
31	R16-2	-	A1-31	6	19.00
32	Q1-C	5	A1-C1	6	4.00
33	P1-C	-	A1-33	6	22.00
34	P2-A	-	A1-34	6	20.00
35	P1-C	-	A1-35	6	24.00
36	TPC	-	A1-36	6	19.00
37	P5-C	-	TPC	6	8.50
38	TPC	-	A1-38	6	19.00
39	P5-D	-	TPD	6	7.00
40	TPB	-	A1-40	6	18.00
41	P5-B	-	TPB	6	10.00
42	TPA	-	A1-42	6	18.00
43	P1-E	-	A1-43	6	23.00
44	P1-R	-	A1-44	6	23.00
45	P1-S	-	R15-3	6	12.00
46	Q2-E	-	A1-E2	6	6.00
47	Q2-B	-	A1-B2	6	5.00
48	P5-A	-	TPA	6	10.00
49	P1-F	-	R15-3	6	11.00
50	A2-C	-	A1-50	6	11.00
51	J3-D	-	A1-51	6	22.00
52	J3-C	-	A1-52	6	22.00
53	R15-2	-	R16-3	6	6.50
54	Q2-C	5	A1-C2	6	4.00
55	P1-U	-	A1-15	6	23.00
57	R15-1	-	A1-44	6	18.00
58	P2-B	-	A1-33	6	19.00
59	A1-7	-	L3-1	6	8.50
60	A1-8	-	L3-2	6	9.50
61	A1-61	-	R10-2	6	6.50

- NOTES:
1. INSTALL CABLE STRAPS, FIND NO. 7, AT 1.5 INTERVALS AND AT EACH CABLE BREAKOUT.
  2. CRIMP TERMINALS. FIND NO. 5 IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 19.
  3. CONDUCTOR ENDS WITHOUT TERMINALS OR CONNECTORS SHALL BE STRIPPED .25 INCH AND TINNED IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT NO. 5.
  4. SOLDER ALL CONNECTORS.
  5. EACH WIRE SHALL BE PERMANENTLY AND LEGIBLY IDENTIFIED AT EACH END OF THE WIRE.
  6. INSTALL INSULATION SLEEVING, FIND NO. 8 OVER EACH SOLDER CONNECTION TO CONNECTORS (FIND NO. 1, 2, 3 AND 4) AND HEAT SHRINK TO A FIRM FIT. SLEEVING SHALL EXTEND OVER WIRE INSULATION AT A MINIMUM OF .25 IN.

8			CL 1	AR	INSULATION SLEEVING, ELEC, HEAT SHRINKABLE, POLYVINYL CHLORIDE, FLEX CROSSLINKED, .125 MIN ID, AS SUPPLIED, .062 MAX ID X .025 WALL, AFTER UNRESTRICTED SHRINKAGE, AR L	MIL-I-23053/2
7			MS3367-1-9	AR	STRAP, CABLE, ADJ, SELF-CLINCHING, PLASTIC, TYPE 1, CL 1, 1.5 MAX BDL DIA, NATURAL	
6	B			AR	WIRE, ELEC, TYPE C-20, 105°C, 1000V	MIL-W-16878/2
5			MS25036-101	2	TERMINAL, LUB, CRIMP STYLE, COP., TIN PLD, INSUL, RING-TONGUE, BELL-MOUTHED, TYPE II, CL 1, 22-18 TERM, SIZE, NO. 6 STUD SIZE	
4	M	B	69-502-5	1	CONN, RECEPTACLE, PN MS3102R-22-14P	
3	M	B	69-502-3	1	CONN, RECEPTACLE, PN MS3102R-14S-2S	
2	M	B	69-502-4	1	CONN, RECEPTACLE, PN MS3102R-14S-5P	
1	M	B	69-502-6	1	CONN, RECEPTACLE, PN MS3102R-10SL-4P	
FIND NO.	SYM	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

Figure 6-58. Precise governor control unit (A23), wiring harness diagram (Sheet 2 of 2)

(b) Before starting engine, rotate magamp bias balance adjustment potentiometer R11, feedback null adjustment potentiometer R14, feedback gain adjustment potentiometer R16, and frequency gain adjust potentiometer R18 on electric governor control unit to a mid-position position. Then rotate load measurement gain adjustment potentiometer R15 to a full-rotation counterclockwise position, and the magamp bias level adjustment potentiometer R12 to a three-quarter-rotation counterclockwise position.

#### NOTE

To determine desired rotation position of a potentiometer or rheostat, turn shaft clockwise to stop. Then rotate shaft counterclockwise to stop, counting the number of turns between clockwise and counterclockwise stops. Now, rotate shaft clockwise for a given number of turns to obtain desired rotation position.

(c) Start engine and observe frequency meter and voltmeter readings for indication of fluctuation in either voltage or frequency. Also listen to engine for sound of engine hunting. If high frequency, low amplitude engine hunting is observed, proceed to step (d) and make the necessary adjustment; if low frequency, high amplitude engine hunting is observed, proceed to step (e) and make the necessary adjustments. If frequency and voltage outputs are stabilized, skip steps (d) and (e), proceed to step (f) and continue with alignment procedures.

(d) To eliminate a high frequency, low amplitude hunting condition, reduce magamp bias level by rotating potentiometer (R12) in a clockwise direction, and

reduce high feedback gain by rotating potentiometer (R16) counterclockwise,

(e) To eliminate a low frequency, high amplitude hunting condition, reduce frequency gain by rotating potentiometer R18 counterclockwise. When a reduction of frequency gain does not correct the condition, increase feedback gain by rotating potentiometer R16 clockwise. When a reduction of frequency gain and/or an increase in feedback gain does not eliminate slow hunting, rotate potentiometer R12 more in a counterclockwise direction to increase magnetic amplifier bias level. Should none of the above adjustments correct and stabilize the system, increase the capacitance (non-polarized, 50 vdc, 25 mfd to 100 mfd electrolytic) of capacitor C1 located in the governor resistor assembly A6 in the precise relay box for 50/60 hertz sets or the mode II relay box for 400 hertz sets. Refer to relay box diagram figures 1-16 and 1-20. Alternately change capacitance value and repeat potentiometer R18, R16, and R12 adjustments until the system is stabilized, thus eliminating the low frequency, high amplitude hunting condition.

(f) With the engine running and the system stabilized, insert test probes of a 0-10 volt DC voltmeter in test jacks 3 and 4 (test jack 4 is positive). Rotate frequency adjust rheostat R1 for a 60-hertz (400 hertz on 400 hertz unit) reading on the frequency meter. Then adjust potentiometer R14 for a zero voltage reading between test jacks 3 and 4 under no load condition.

(g) Before removing the voltmeter from test jack 3 and 4, install test probes from a similar voltmeter in test jacks 1 and 2, (test jack 1 is positive) and alternately adjust potentiometer R11 and the frequency adjust rheostat to obtain a zero voltage across test points 1 and 2, and 3

and 4, at 60-hertz or 400 hertz with no load. When adjustment will not provide a zero reading across test points 1 and 2, then adjust for a minimum reading.

(h) Connect a 0 to 10 vdc voltmeter between test jacks A and B and check for a normal DC voltage reading of approximately 4 to 6 volts. Adjust potentiometer R12 to obtain proper voltage readings.

(i) To achieve optimum transient performance, adjust the load measurement gain control potentiometer R15. Adjustment of R15 to a full clockwise rotation position provides maximum load measurement gain.

(j) To obtain optimum performance, adjust potentiometer R18 to a maximum clockwise rotation position and potentiometer R16 to a maximum counterclockwise rotation position without causing an oscillation to develop for any position setting of potentiometer R15. The value of capacitor C 1 (referred to in precise mode II relay box schematic electronic component assembly A6) will also affect transient frequency response. Small values of capacitance will give faster transient frequency response; however, if the capacitance of C 1 is too small, the system will oscillate.

(k) For any position of potentiometer R18, there is an optimum position setting for potentiometer R16. To improve transient performance even further, rotate potentiometer R18 in a clockwise direction. If a hunt develops, re-adjust potentiometer R16 to achieve stability. If, however, no hunting condition develops, then apply and remove the load and observe stability of generator under such transient conditions, while continuing to adjust potentiometer R18 in a clockwise direction. when a potentiometer R18 has been adjusted to a point where adjustment of potentiometer R16 will

not stability the generator, then reduce frequency gain R18 to a stable region and optimize generator stability and performance by adjusting potentiometer R1 6.

#### NOTE

For long term generator stability, frequency gain should be reduced to a point where the system is not on the edge of instability.

When a steady state frequency of full load is slightly lower than no load steady state frequency (droop), re-adjust potentiometers R12, R14, or R18 slightly. Rotating potentiometer R18 full clockwise for all operating conditions will often eliminate droop, and under certain circumstances, adjusting potentiometer R14 for voltage reading above zero at test jacks 3 and 4 will also eliminate droop. A slight readjustment of the magamp bias lever potentiometer R12 will provide isochronous operation under certain conditions.

#### 2. Parallel Operation Alignment and Adjustment

(a) With the generator operating under no load, disconnect electrical connector J 17 at electric governor control unit. Use a dc voltmeter and check for zero voltage between pins G and J (pin G is positive).

(b) With the DC voltmeter connect across pins G and J of connector J17, apply full load to generator set and adjust the real load sharing potentiometer R12 in the precise relay box or the mode II relay box through its full range. The dc voltmeter should indicate between 5 and 10 volts dc. Note and record the exact range of dc voltage available on set number one by adjusting the real load sharing potentiometer.

(c) Repeat the procedures outlined in steps (a) and (b) on set to be connected in parallel with set number one.

(d) Adjust the real load sharing potentiometer R28 on each generator set so that the voltage across pins G and J in connector J17 is identical.

#### NOTE

Make sure during the procedure outlined in steps (a) and (b) that the load contactor switch is open so that pin G or J of one generator set connector J17 is not connected to pins G or J of another generator set contactor J17.

Refer to Operator and Organizational Maintenance Manual and begin parallel operation.

(e) If the generator sets tend to oscillate during the first attempt at parallel operation, remove from parallel operation, readjust real load sharing potentiometer R28 for a lower voltage across pins G and J in connector J17, and place generator sets in parallel operation again. It may be necessary to repeat this operation several times until the proper voltage is obtained. When the proper voltage setting on each generator set has been obtained, and it will be possible to parallel isochronously with equal load sharing during each paralleling operation.

(f) If other than equal load sharing is desired, then adjust potentiometer R28 to obtain the proper ratio voltage desired.

#### NOTE

Under normal conditions, any adjustment of potentiometer

R28 should be made when the generator set is not operating in parallel. However, if a slight readjustment of load sharing between parallel operating sets is necessary, such a slight readjustment is permissible. The same results can usually be obtained, however, by adjusting the frequency reference adjustment potentiometer R1.

#### 6-211A. ALIGNMENT PROCEDURES PECULIAR TO OPERATION OF 400 HZ GENERATOR SETS IN SUPPORT OF E3A AIRCRAFT.

a. If necessary, refer to Operator and Organizational Maintenance Manual and adjust precise governor actuator linkage.

b. Refer to figure 6-54 for location of adjustments and test points.

##### 1. Isochronous Operation.

(a) Before starting engine, rotate frequency and adjust rheostat R1 on main generator control panel for precise generator sets to a mid-rotation position.

(b) Before starting engine, rotate magamp bias balance potentiometer R11, feedback null adjustment potentiometer R14, feedback gain adjustment potentiometer R16, and frequency gain adjustment potentiometer R18 on precise governor control unit to a mid-rotation position. Then rotate load measurement gain adjustment potentiometer R15 to a three-quarter-rotation clockwise position.

(c) Start engine and operate at 400 hertz, no load. Observe governor actuator unit piston for hunting. If governor actuator unit piston is hunting, adjust R18



counter clockwise to stop hunting. If actuator is still hunting after R18 was adjusted, rotate R16 to stop hunting.

#### NOTE

It may require that R18 be readjusted to a new position and R16 rotated again to stop hunting.

(d) With engine running and the system stabilized. insert test probes of a 0-10 volt dc voltmeter in test jacks 3 and 4 (test jack 4 is positive) . Rotate frequency adjust rheostat R1 for a 400 Hz reading on the frequency meter. Then adjust potentiometer R14 for a zero voltage reading between test jacks 3 and 4 under no load condition.

(e) Insert test probes of a 0-10 volt dc voltmeter in test jacks A and B (test jack A is positive). Adjust potentiometer R12 for a voltage reading of 5.0 volts dc between test jacks A and B.

(f) Insert test probes of a 0-10 volts dc voltmeter in test jacks A and B (test jack A is positive). Adjust potentiometer R12 for a voltage reading of 4.0 to 6.0 volts dc. Adjust to highest voltage within range that does not allow actuator to hunt.

(g) Note governor actuator piston for no movement. If necessary

readjust R16 and R18 potentiometers to stop movement.

(h) Vary potentiometer R16 either clockwise or counterclockwise to obtain best stability. If moving R16 has no effect. then set R16 at its mid-rotation position.

2. Parallel Operation Alignment and Adjustment.

(a) Load unit with a load bank set to obtain a load of 50 KW at unity power factor.

(b) Connect test probes of a 0-10 volt dc voltmeter across pins A and B (pin A is positive) of any paralleling receptacle (J45, J46 or J47). Adjust the real load sharing potentiometer R28 on the precise relay box to obtain a reading of 1.5 volts dc.

(c) Place parallel/single unit switch (S6) in the parallel position. Ensure shorting plug is removed then connect test probes of a 0-10 voltmeter across pins C and D of any paralleling receptacle (J45, J46 or J47) . Adjust reactive current sharing potentiometer R29 on the precise relay box to obtain a reading of 5.5 volts ac (7.5 volts ac with 50 KVA at 0.8 power factor) .

(d) When all alignment procedures have been complied with. ensure all locknuts on potentiometers are tightened.

#### Section XII. LOAD MEASUREMENT UNIT

##### 6-212. GENERAL.

The load measurement unit is utilized on both precise and utility generator sets. The unit consists of a three phase transformer, rectifiers, and a variable load resistor. It measures the total load on the generator

set regardless of power factor or phase and provides a dc voltage output proportional to this load. On precise generator sets this output signal is applied to the load-sensing circuits in the control unit to provide a load rate signal to the feedback circuit, and a voltage



proportional to load that is used for the parallel system. If a dummy load kit is utilized with the generator set the load measurement unit is interconnected with the kit sensing circuit.

#### 6-213. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the load measurement unit is not easily detected during single unit operation unless the set is equipped with a dummy load kit and the automatic load removal feature is utilized. Then a malfunction is usually indicated by failure of the dummy load kit automatic removal circuit. When the unit malfunctions in a generator set that is operating in parallel, the malfunction is usually indicated by unequal load sharing. To isolate the malfunction, proceed as follows:

1. Remove connector P16 from load measurement unit and with generator set operating at rated speed and voltage, measure voltage at connector P16, pins A to K, B to L, and C to M; voltage should be 120 VAC nominal. Also measure voltage across connector pins G to D, G to E, and G to F; voltage should be 5.6 VAC at rated load.

2. If above voltages are met, connect connector P16 to load measurement unit. Operate generator set, controlling speed with the manual speed control and check load measurement unit output by removing connector P1 from the governor control unit. Measure voltage across connector P1 pins U(+) and S, voltage should be 9.8 VDC with generator set operating at rated load.

3. If input voltages are correct and the output does not vary between 0 and

9.8 VDC proportional to load, the load measurement unit should be replaced.

- b. Removal. Refer to figure 6-59 and remove load measurement unit by removing electrical connector and screws.

#### 6-214. TEST AND ADJUSTMENT.

- a. Connect load measurement unit to the test equipment as illustrated in figure 6-60.

- b. Test and adjust load measurement unit as specified in table 6-22.

#### 6-215. DISASSEMBLY.

Refer to figure 6-61 and disassemble load measurement unit in the order of index numbers assigned. Pay particular attention to the following.

- a. Remove cover (5).

#### NOTE

Leave wires connected to receptacle (7).

- b. Tag and unsolder wires from components, exercising care not to apply excessive heat. Unsolder diodes (19) from transformer (24),

#### 6-216. CLEANING.

- a. Clean electrical components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly,

- b. Clean remaining parts in an approved cleaning solvent and dry thoroughly.

6-217. INSPECTION.

a. Inspect wire for defective insulation. Check each wire to connector pin for continuity. Check connector pins for shorts to case and surrounding pins. Inspect connector for damaged threads.

b. Check forward and reverse resistance of diodes. Measured from anode (+) to cathode (-) value should be low, reverse meter leads value should be infinity.

c. Check resistor for proper ohmic value, resistor should be adjustable from 0 to 500 ohms.

d. Inspect transformer for burnt areas, defective insulation, and missing terminals.

e. Inspect threads for damage.

f. Inspect sheet metal parts for cracks, dents, and distortion.

g. Inspect nameplate for security and legibility.

h. Inspect paint for damage.

6-218. REPAIR.

a. Repair defective wiring by removing defective wire from connector and installing wire of same size and length in its place.

b. Chase damaged threads.

c. Repair cracked sheet metal parts by welding. Straighten dented or distorted parts using suitable tools.

d. Fasten loose nameplate to cover using a suitable adhesive.

e. Remove damaged paint. Blend in edges, prime, and paint damaged areas.

6-219. REASSEMBLY.

Refer to figure 6-61 and reassemble the load measurement unit in the reverse order of index numbers assigned.

a. Solder diodes (19) and wires to transformer (24).

proportional to load that is used for the parallel system. If a dummy load kit is utilized with the generator set the load measurement unit is interconnected with the kit sensing circuit.

#### 6-213. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the load measurement unit is not easily detected during single unit operation unless the set is equipped with a dummy load kit and the automatic load removal feature is utilized. Then a malfunction is usually indicated by failure of the dummy load kit automatic removal circuit. When the unit malfunctions in a generator set that is operating in parallel, the malfunction is usually indicated by unequal load sharing. To isolate the malfunction, proceed as follows:

1. Remove connector P16 from load measurement unit and with generator set operating at rated speed and voltage, measure voltage at connector P1 6, pins A to K, B to L, and C to M; voltage should be 120 VAC nominal. Also measure voltage across connector pins G to D, G to E, and G to F; voltage should be 5.6 VAC at rated load.

2. If above voltages are met, connect connector P16 to load measurement unit. Operate generator set, controlling speed with the manual speed control and check load measurement unit output by removing connector P1 from the governor control unit. Measure voltage across connector P1 pins U(+) and S, voltage should be 9.8 VDC with generator set operating at rated load.

3. If input voltages are correct and the output does not vary between 0 and 9.8 VDC proportional to load, the load measurement unit should be replaced.

- b. Removal. Refer to figure 6-59 and remove load measurement unit by removing electrical connector and screws.

#### 6-214. TEST AND ADJUSTMENT.

- a. Connect load measurement unit to the test equipment as illustrated in figure 6-60.

- b. Test and adjust load measurement unit as specified in table 6-22.

#### 6-215. DISASSEMBLY.

Refer to figure 6-61 and disassemble load measurement unit in the order of index numbers assigned. Pay particular attention to the following.

- a. Remove cover (5).

#### WARNING

Avoid breathing fumes generated by Unsoldering/soldering. Eye protection is required.

#### NOTE

Leave wires connected to receptacle (7).

- b. Tag and unsolder wires from components, exercising care not to apply excessive heat. Unsolder diodes (19) from transformer (24).

#### 6-216. CLEANING.

- a. Clean electrical components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- b. Clean remaining parts in an approved cleaning solvent and dry thoroughly.

6-217. INSPECTION.

- a. Inspect wire for defective insulation. Check each wire to connector pin for continuity. Check connector pins for shorts to case and surrounding pins. Inspect connector for damaged threads.
- b. Check forward and reverse resistance of diodes. Measured from anode (+) to cathode (-) value should be low, reverse meter leads value should be infinity.
- c. Check resistor for proper ohmic value, resistor should be adjustable from 0 to 500 ohms.
- d. Inspect transformer for burnt areas, defective insulation, and missing terminals.
- e. Inspect threads for damage.
- f. Inspect sheet metal parts for cracks, dents, and distortion.
- g. Inspect nameplate for security and legibility.
- h. Inspect paint for damage.

6-218. REPAIR.

- a. Repair defective wiring by removing defective wire from connector and in-

stalling wire of same size and length in its place.

- b. Chase damaged threads.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- c. Repair cracked sheet metal parts by welding. Straighten dented or distorted parts using suitable tools.
- d. Fasten loose nameplate to cover using a suitable adhesive.
- e. Remove damaged paint. Blend in edges, prime, and paint damaged areas.

6-219. REASSEMBLY.

Refer to figure 6-61 and reassemble the load measurement unit in the reverse order of index numbers assigned.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- a. Solder diodes (19) and wires to transformer (24).



400 HERTZ SETS

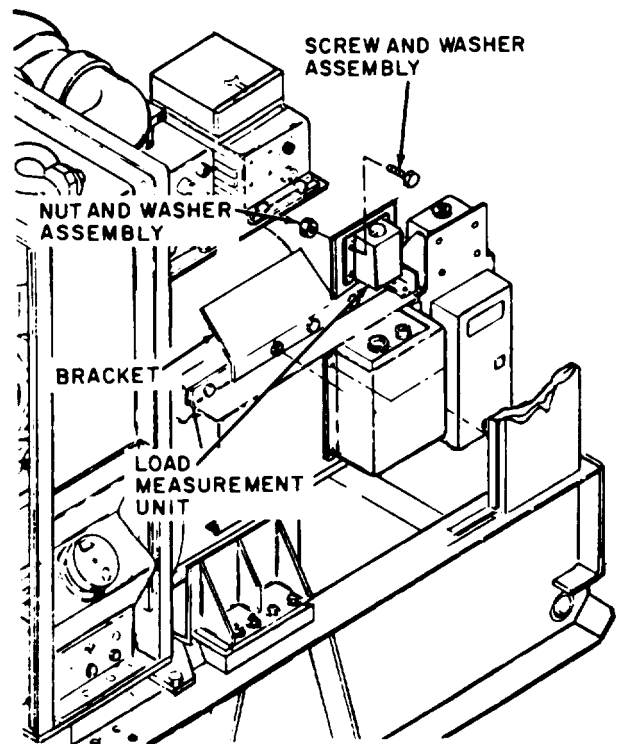


Figure 6-59. Load measurement unit, removal and installation

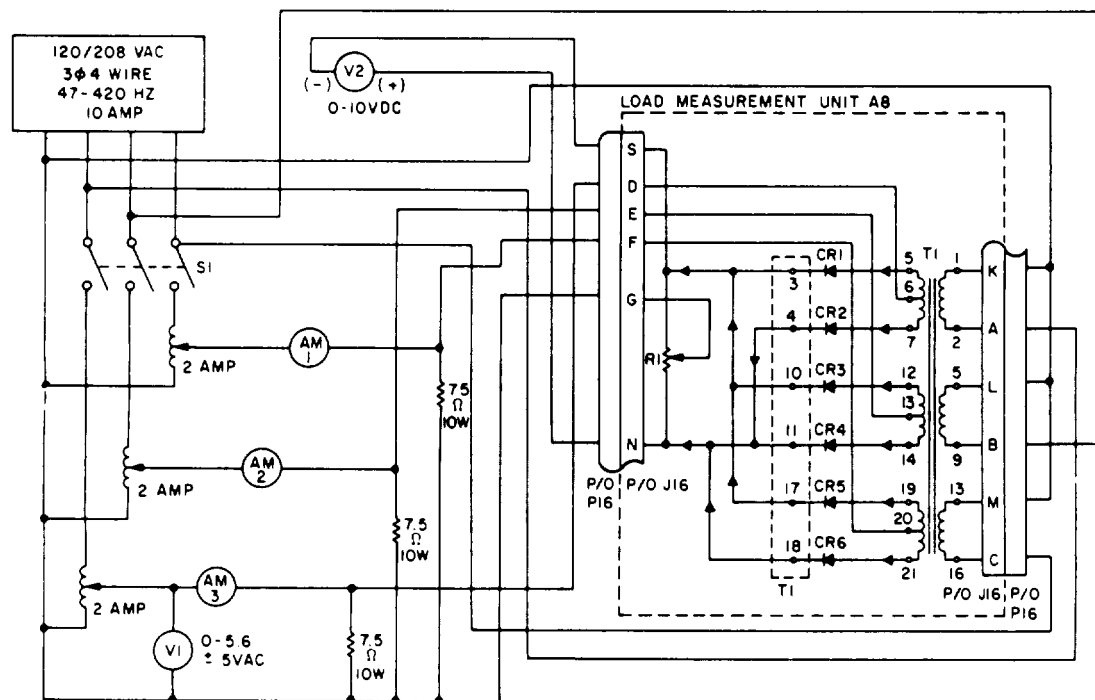


Figure 6-60. Load measurement unit (LMU), test setup

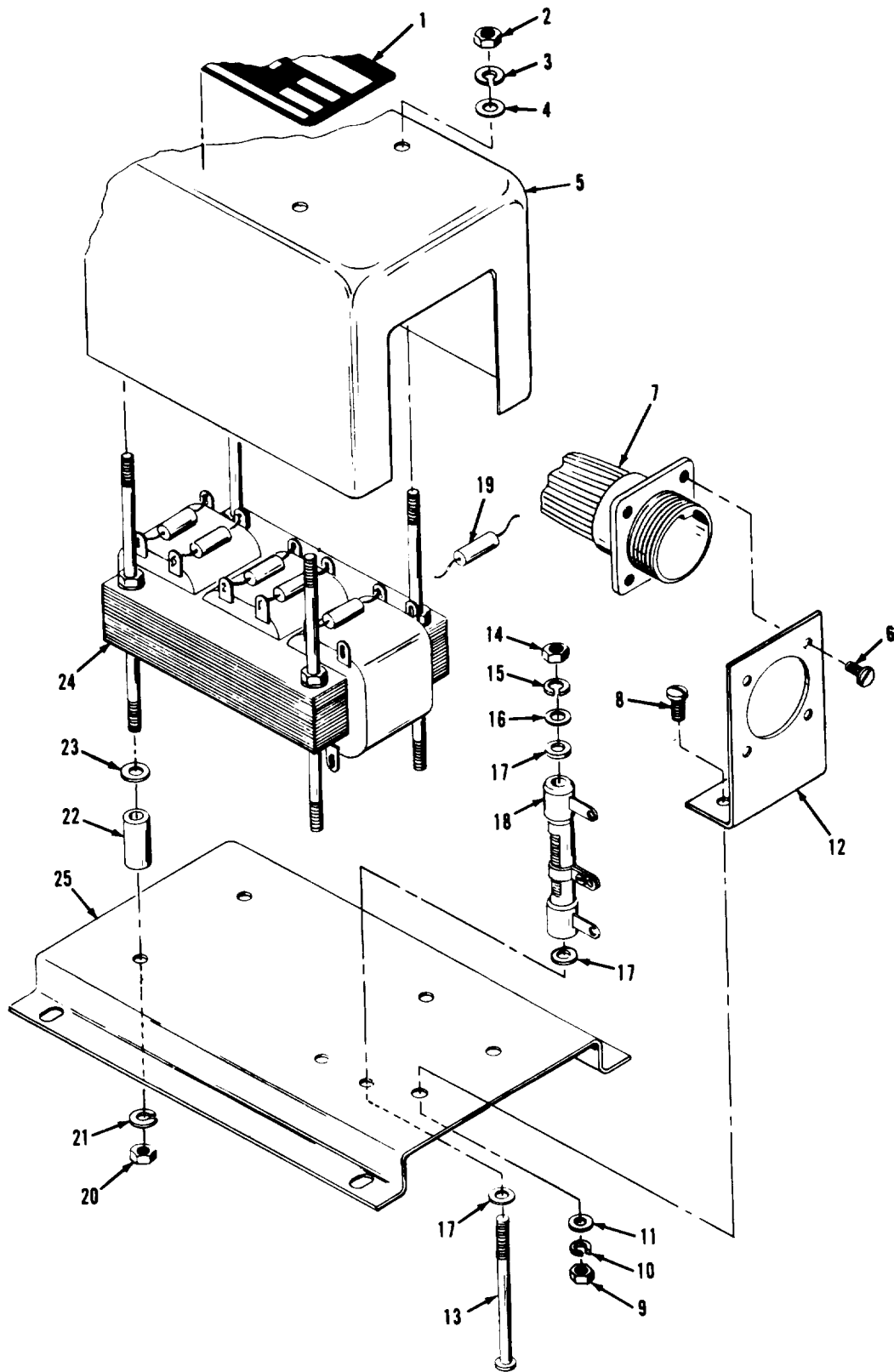


Figure 6-61. Load measurement unit, exploded view



Legend to figure 6-61:

- |                     |                              |
|---------------------|------------------------------|
| 1. Nameplate        | 13. Screw                    |
| 2. Nut (4)          | 14. Nut                      |
| 3. Lock washer (4)  | 15. Lock washer              |
| 4. Washer (4)       | 16. Washer (2)               |
| 5. Cover            | 17. Washer (2)               |
| 6. Screw (4)        | 18. Adjustable resistor (R1) |
| 6A. Washer (4)      | 19. Diode (CR1 through CR6)  |
| 7. Receptacle (J16) | 20. Nut (4)                  |
| 8. Screw (2)        | 21. Lock washer (4)          |
| 9. Nut (2)          | 22. Tube (4)                 |
| 10. Lock washer (2) | 23. Washer (4)               |
| 11. Washer (2)      | 24. Transformer (T1)         |
| 12. Bracket         | 25. Bracket                  |

b. Prior to installing cover (5) test and adjust load measurement unit as specified in paragraph 6-214.

c. Install cover after test.

#### 6-220. INSTALLATION.

Refer to figure 6-59 and install load measurement unit on bracket and secure with screws. Connect electrical connector to unit.

Table 6-22. Load Measurement Unit Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
1.	Turn on the 120/208 VAC power supply with switch S1 open.	Voltmeter V2 should indicate from 0 to 0.4 VDC. Voltmeter V1 should indicate 0 VAC.	Resistor R1 not adjusted.  Defective resistor R1, transformer T1, or diodes CR1 through CR6.	Adjust resistor R1 to obtain required result.  Check components with ohmmeter.
2.	Close switch S1 and adjust T1, T2, and T3 so that AM1, 2, and 3 indicate 0.60 amps.	Voltmeter V1 should indicate 5.6 VAC. Voltmeter V2 should indicate 9.4 to 9.8 VDC.	Resistor R1 not adjusted.  Defective resistor R1, transformer T1, or diodes CR1 through CR6.	Adjust R1 to obtain required result.  Check components with ohmmeter.

6-188

Change 3

All data on pages 6-189 through 6-220, including figures 6-66 through 6-75 deleted.

## CHAPTER 7

### GENERATOR ASSEMBLY REPAIR INSTRUCTIONS

#### 7-1. GENERAL.

The generator is a brushless type with a rotating exciter. The armature of the exciter, the field of the generator and the rectifier assembly are mounted on the same rotating shaft. The field of the exciter and armature of the generator are stationary. The output of the generator armature is kept at a predetermined constant value by the generator set output. In order to build up the voltage of a generator, the residual magnetism of its pole pieces is generally relied upon to produce a small initial voltage which increases as the generator comes up to speed. If this is not sufficient, the exciter regulator flashes the field. This voltage is fed from the exciter armature to the bridge rectifier assembly, the dc output of which is coupled to the generator field rotating on the same shaft with the exciter armature and rectifier assembly. The generator field induces an ac voltage in the stationary armature windings.

#### 7-2. ON EQUIPMENT TEST.

a. Symptom and Isolation of Malfunction. A malfunction of the generator is usually indicated by either low output voltage or no voltage output. To isolate the malfunction proceed as follows:

1. Disconnect generator set air intake doors, below control cubicle, by removing fourteen screws, washers, and nuts.
2. Disconnect generator set air inlet louver and screen assembly, by removing twenty screws, forty washers and sixteen nuts.

#### WARNING

Stay clear of generator output leads.

3. Remove electrical connector P61 from right side of generator endbell.
4. Connect a variable dc voltage supply (0-10 volt, 15 amperes) in series with a 0-10 dc ammeter to connector J61 pin C (positive) and pin B (negative). Set variable voltage supply to zero.
5. Start generator set and operate engine at rated speed, 1800 RPM, for 50/60 hertz generator sets or 2000 RPM for 400 hertz generator sets.
6. Adjust variable voltage supply until normal generator output voltage is obtained (120/208 or 240/416). Test dc ammeter should indicate 3 to 3.5 amperes for 50/60 hertz generator sets and 6.25 to 6.75 amperes for 400 hertz generator sets.
7. Remove external power supply and shut down generator set.
8. If above requirements are met, refer to paragraph 6-76 and test the exciter regulator. If requirements are not met, proceed as indicated below.

#### NOTE

Generator temperature should be approximately 77° F during resistance test.

9. Check resistance between connector J61 pins B and C using a Wheatstone Bridge or other suitable low resistance measuring device. Resistance should be 1.23 ohms  $\pm 10$  percent for 50/60 hertz generator sets and 1.51 ohms  $\pm 10$  percent for 400 hertz generator sets.

10. Check insulation resistance of exciter stator by electrically bonding connector J61 pins B and C together. Connect lead from pins to a 500 volt megger and connect other megger lead to frame. Resistance reading should be a minimum of 50K ohms.

**NOTE**

Interconnecting wiring information is contained in Operator and Organizational Maintenance Manual.

11. Remove plastic shield from reconnection panel. Remove voltage change over board. Disconnect electrical connector P10 from mode I or mode II relay box connector J10, and electrical connector P13 from exciter regulator connector J13. Check resistance between generator leads T1-T4, T2-T5, T3-T6, T7-T10, T8-T11, and T9-T12, using a Kelvin Bridge or other suitable low resistance measuring device. Resistance should be 0.00974 ohm  $\pm 10$  percent for 50/60 hertz generator sets and 0.00490 ohm  $\pm 10$  percent for 400 hertz generator sets.

12. Check insulation resistance of main stator by electrically bonding all twelve leads (T1 thru T12) together. Connect a lead from the twelve generator leads to a 500 volt megger and connect other megger lead to frame. Resistance reading should be a minimum of 50K ohms. Connect electrical connector P10 to J10 on mode I or mode II relay box and electrical connector P13 to J13 on exciter regulator. Install voltage change over board and plastic shield over the reconnection board.

**NOTE**

Figure 1-28 is the generator assembly simplified schematic.

13. Disconnect end bell and exciter stator assembly (61, figure 7-1) from generator by removing screws (59) and lock washer (60). Tag and disconnect six diode leads from rectifier assembly (12) and test each diode for an open or short.

14. Tag and disconnect two main rotor leads from rectifier assembly. Check resistance between two stator leads using a Kelvin Bridge or other suitable low resistance measuring device. Resistance should be 0.834 ohm  $\pm 10$  percent for 50/60 hertz generator sets and 0.703 ohms  $\pm 10$  percent for 400 hertz generator sets.

15. Check insulation resistance of main rotor by electrically bonding the two leads together. Connect leads to a 500 volt megger and connect other megger lead to rotor shaft. Resistance reading should be a minimum of 50K ohms.

16. Tag and disconnect three exciter rotor leads from rectifier assembly. Check resistance between exciter rotor leads R1-R2 and R1-R3, using a Kelvin Bridge or other suitable low resistance measuring device. Resistance should be 0.0772 ohm  $\pm 10$  percent.

17. Check insulation resistance of exciter rotor by electrically bonding the three leads together. Connect leads to a 500 volt megger and connect other megger lead to rotor shaft. Resistance reading should be a minimum of 50K ohms.

18. Connect main stator, exciter rotor, and diode leads to rectifier assembly. Install endbell and exciter stator assembly (61). Connect electrical connector P61 to electrical connector J61 on generator endbell. Install generator air inlet louver and

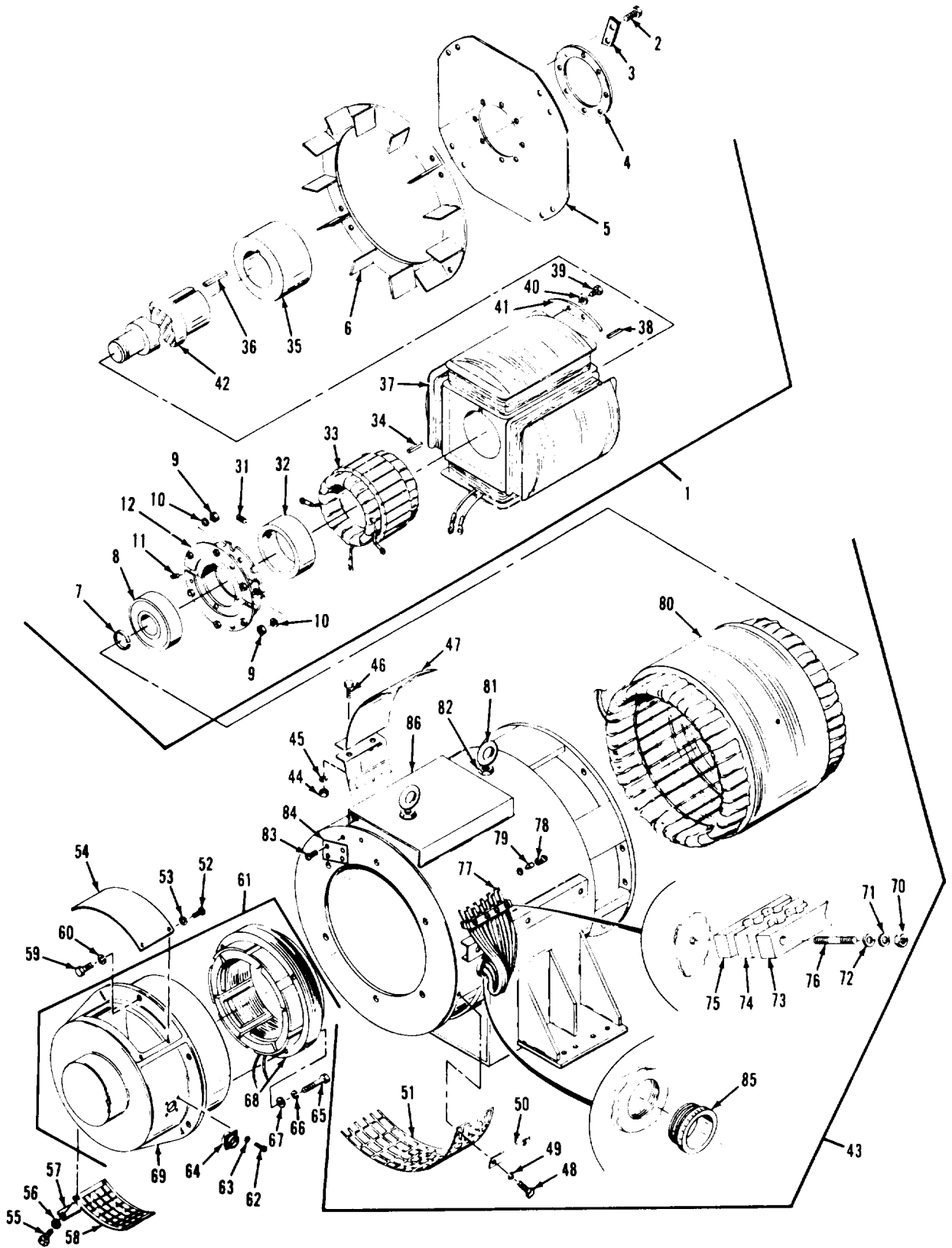


Figure 7-1. Generator assembly, exploded view  
(sheet 1 of 2)

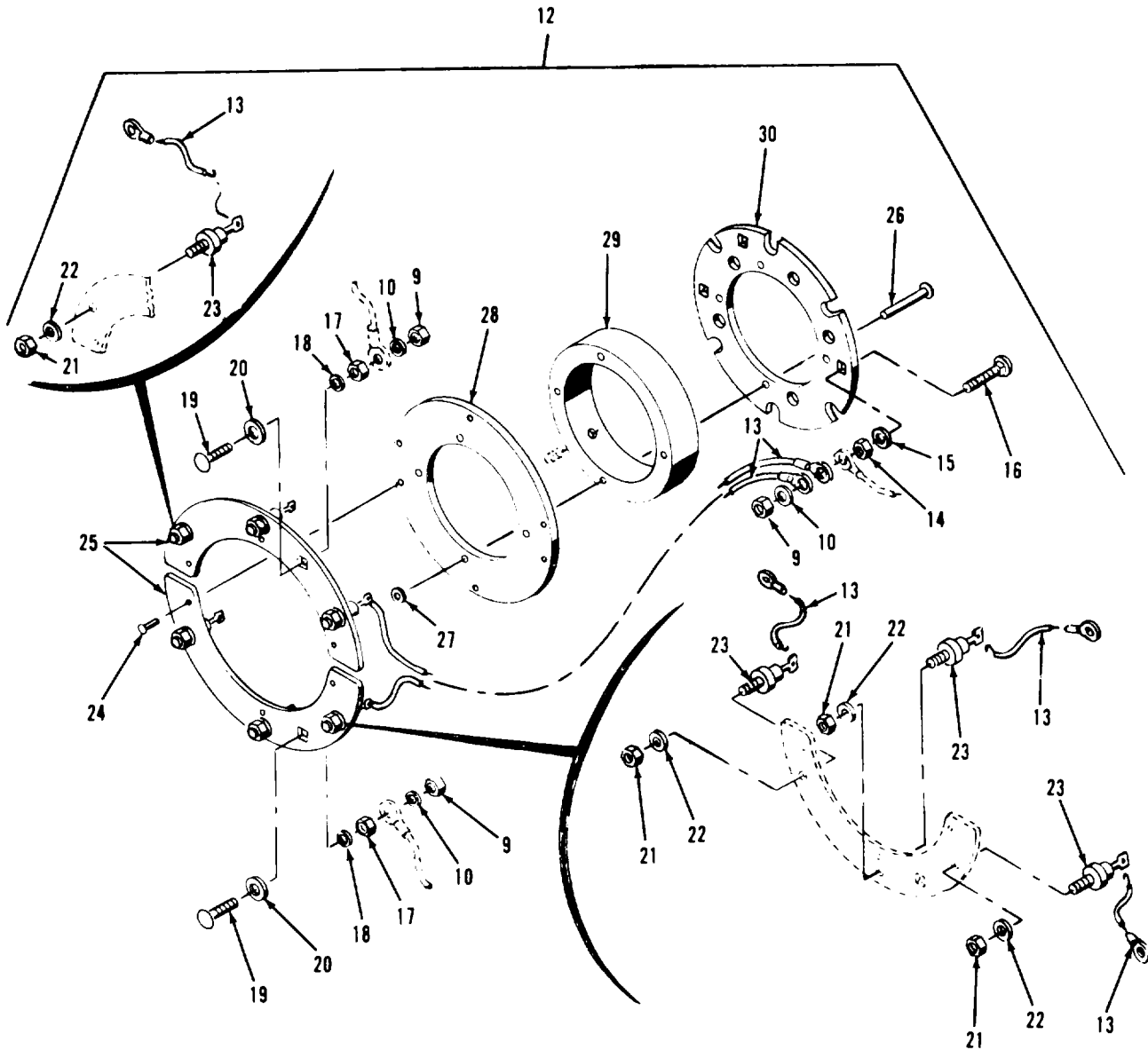


Figure 7-1. Generator assembly, exploded view  
(sheet 2 of 2)

screen assembly and secure with screws, washers, and nuts. Install generator set air intake doors and secure with screws, washers, and nuts.

b. REMOVAL. Remove the generator as specified in paragraph 2-7.

### 7-3. DISASSEMBLY.

Refer to figure 7-1 and disassemble generator in the order of index numbers assigned. Pay particular attention to the following:

Legend to figure 7-1:

- |                                  |                                    |  |
|----------------------------------|------------------------------------|--|
| 1. Main rotor and shaft assembly | 30. Insulator                      | 59. Screw (6)                            |
| 2. Screw (8)                     | 31. Setscrew                       | 60. Lock washer (6)                      |
| 3. Clip locks(4)                 | 32. Spacer                         | 61. End bell and exciter stator assembly |
| 4. Retainer                      | 33. Exciter rotor assembly         | 62. Screw (4)                            |
| 5. Shaft coupling (3)            | 34. Key                            | 63. Lock washer (4)                      |
| 6. Fan                           | 35. Hub                            | 64. Connector                            |
| 7. Snap ring                     | 36. Key                            | 65. Screw (6)                            |
| 8. Bearing                       | 37. Main rotor subassembly         | 66. Lock washer (6)                      |
| 9. Nut (5)                       | 38. Key                            | 67. Washer (6)                           |
| 10. Lock washer (5)              | 39. Screw (AR*)                    | 68. Exciter stator assembly              |
| 11. Setscrew                     | 40. Lock washer (AR*)              | 69. End bell                             |
| 12. Rectifier assembly           | 41. Balance weight (AR*)           | 70. Nut (4)                              |
| 13. Diode lead (6)               | 42. Shaft                          | 71. Lock washer (4)                      |
| 14. Nut (3)                      | 43. Main stator and frame assembly | 72. Washer (4)                           |
| 15. Lock washer (3)              | 44. Nut (2)                        | 73. clamp                                |
| 16. Bolt (3)                     | 45. Lock washer (2)                | 74. clamp                                |
| 17. Nut (2)                      | 46. Screw (2)                      | 75. c lamp                               |
| 18. Lock washer (2)              | 47. Screen                         | 76. Stud                                 |
| 19. Screw (2)                    | 48. Screw (4)                      | 77. Leads (12)                           |
| 20. Washer (2)                   | 49. Lock washer (4)                | 78. Setscrew (2)                         |
| 21. Nut (6)                      | 50. Clip (2)                       | 79. Pin (2)                              |
| 22. Lock washer (6)              | 51. Screen                         | 80. Main stator assembly                 |
| 23. Diode (6)                    | 52. Screw (4)                      | 81. Lifting eye bolt (2)                 |
| 24. Rivet (6)                    | 53. Lock washer (4)                | 82. Nut (2)                              |
| 25. Heatsink (2)                 | 54. Cover                          | 83. Screw (4)                            |
| 26. Rivet (4)                    | 55. Screw (4)                      | 84. Name plate                           |
| 27. Washer (4)                   | 56. Lock washer (4)                | 85. Insulation bushing                   |
| 28. Plate                        | 57. Clip (2)                       | 86. Main stator frame                    |
| 29. Hub                          | 58. Screen                         |  |

(AR\*) As Required

a. Before disassembly, insure that shipping block (refer to figure 2-1) is installed on main stator and frame assembly (43) and fan (6) is secure to shaft couplings (5).

**WARNING**

Insure that generator is properly blocked to prevent injury to personnel during disassembly.

b. Attach a suitable cable hook and lifting device to generators lifting eye (81). Position generator in a vertical position resting generator end bell and exciter stator assembly (61) on wooden blocks. Position two each twelve inch by twelve inch wooden blocks under generator mounting brackets on frame assembly (85) to prevent generator from tipping over. Remove lifting device.

c. Remove shipping block. Bend down corners of clip locks (3) and using a suitable tool hold shaft couplings (5) and remove two screws (2) 180 degrees apart. Install lifting fixture (figure 2-1, view I) and secure with two (0.500-20 x 3.00) screws to main rotor and shaft assembly (1). Install lifting eyebolt (81) in lifting fixture. Using a cable hook and lifting device, lift main rotor and shaft assembly (1) from main stator and frame assembly (43).

d. Place main rotor and shaft assembly (1) on a bench resting the main rotor sub-assembly (37) on cushion material, to prevent damage. Allow fan (6) and shaft coupling (5) to hang over side of bench.

e. Remove lifting eyes from main rotor and shaft assembly (1).

f. Remove screws (2), clip locks (3), retainer (4), shaft couplings (5), and fan (6). Disconnect fan (6) from shaft couplings (5) by removing shipping screws and nuts.

#### CAUTION

Do not remove bearing (8) unless proven defective at time of inspection or further disassembly is required.

g. Remove snap ring (7) and using a suitable puller, remove bearing (8) from shaft (42).

h. Tag and disconnect electrical leads from rectifier assembly (12) by removing nuts (9) and lock washers (10). Remove setscrew (11) and remove rectifier assembly (12) from shaft (42).

#### NOTE

Do not disassembly rectifier assembly unless proven defective at time of inspection.

i. Disassembly of rectifier assembly (12) as follows:

1. Disconnect diode leads (13).
2. Remove diodes (23) from heat sinks (25).

#### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

3. Unsolder leads (13) from diodes (23) using suitable soldering equipment.
4. Remove heat sinks (25) from plate (28) by removing rivet (24).
5. Separate insulator (30), hub (29), and plate (28).

j. Remove setscrew (31) and using a suitable puller, remove spacer (32), exciter rotor assembly (33), and key (34) from shaft (42).

#### CAUTION

Do not **remove** main rotor sub-assembly (37) from shaft (42) unless found defective at inspection.

k. Using a suitable puller, remove hub (35) and key (36) from shaft (42).

l. Using a suitable press, press shaft (42) from main rotor subassembly (37) and remove key (38).

m. Turn main stator and frame assembly (43) over and position frame assembly on wooden blocks with end bell on top. Block assembly to prevent tipping.

n. Remove screens (47, 51, and 58) and cover (54).

o. Remove end bell and exciter stator assembly (61).

p. Lift connector (64) from side of end bell (69), tag and unsolder exciter stator (68) leads from connector (64). Remove exciter stator assembly (68) from end bell assembly.



CAUTION

Remove main stator assembly (80) only if found defective at time of inspection.

- q. Remove clamps (73, 74, and 75).

WARNING

Drilling operations create metal chips which may enter the eye. Eye protection is required.

- r. Remove two setscrews (78) and using 0.1250 inch drill, drill a hole 0.375 inch deep in each pin (79). Using an easy out tool remove pins and remove main stator assembly (80) from main stator frame (86) using a suitable puller.

7-4. CLEANING.

WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

- a. Use a clean cloth and low-pressure compressed air (10-15 pounds pressure) and remove dust and dirt from windings and frame.
- b. Use a clean lint-free cloth moistened with an approved cleaning solvent to remove heavy deposits from windings and dry thoroughly.
- c. Clean rectifier assembly with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- d. Clean all metal parts with an approved cleaning solvent and dry thoroughly.

NOTE

Appropriate glass head blasting may be used to remove paint and corrosion as necessary. In accordance with TO 1-1-2.

7-5. INSPECTION.

- a. Inspect generator frames for cracks and burred mating surfaces.
- b. Inspect generator frames for cracked welds and distortion.
- c. Inspect shaft couplings for distortion and elongated holes.
- d. Inspect shaft for nicks and scratches.
- e. Inspect fan for distortion, elongated holes, cracked welds or chipped blades.
- f. Inspect screens for distortion and bent corners.
- g. Inspect nuts, bolts, and screws for damaged threads and heads.
- h. Rotate bearing and check for freedom of movement, flat spots, binding, and signs of overheating. Measure bearing inside diameter, diameter should be +0.0000 -0.0008 inches. Measure bearing outside diameter, diameter should be +0.0000 -0.0008 inches.
- i. Measure shaft bearing contact surface, shaft should be 2.7565 to 2.7560 inches.
- j. Measure end bell bearing contact, end bell should be 5.9062 to 5.9055 inches.

NOTE

Generator windings temperature should be approximately 77° F during resistance checks. Resistance checks should be made using a Kelvin Bridge for resistance values below one ohm, and a Whetstone Bridge for values above one ohm. Other suitable low resistance type measuring devices may be used. Resistance values of windings are to be within a tolerance of ± 10 percent.

- k. Check main stator resistance values

between leads: T1-T4, T2-T5, T3-T6, T7-T10, T8-T11, and T9-T12. Resistance should be 0.00974 ohm for 50/60 hertz generator sets and 0.00490 ohm for 400 hertz generator sets.

1. Check main rotor resistance value between leads R4 and R5. Resistance should be 0.834 ohm for 50/60 hertz generator sets and 0.750 ohm for 400 hertz generator sets.

m. Check exciter rotor resistance values between leads R1-R2 and R1-R3. Resistance should be 0.0772 ohms.

n. Check exciter stator resistance value between leads F1 and F2. Resistance should be 1.23 ohms for 50/60 hertz generator sets and 1.51 ohms for 400 hertz generator sets.

#### NOTE

Generator windings insulation resistance checks should be made using a 500 volt megger. Resistance readings should be a minimum of 50K ohms.

o. Check insulation resistance of main stator windings by electrically bonding all twelve leads together and connecting a megger between leads and stator frame.

p. Check insulation resistance of main rotor winding by electrically bonding rotor leads together and connect a megger between leads and rotor frame or rotor shaft.

q. Check insulation resistance of exciter rotor winding by electrically bonding the three rotor leads together and connecting a megger between leads and rotor frame or rotor shaft.

r. Check insulation resistance of exciter stator winding by electrically bonding stator leads together and connecting a megger between leads and stator frame.

s. Inspect rectifier assembly as follows:

1. Disconnect diodes from the rectifier assembly and test each diode separately using a suitable multimeter

2. Connect the multimeter across the diode, meter positive lead on the anode (back end of arrow) and negative meter lead on the cathode (tip of the arrow). A low resistance should be indicated.

3. Reverse multimeter leads, a high resistance (several K ohms) should be indicated,

t. Inspect paint for damage.

#### 7-6. REPAIR OR REBUILD.

#### WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

a. Repair cracks by welding as long as it does not distort or impair strength of part.

b. Remove burrs or nicks using a suitable file or stone.

c. Straighten dented or distorted sheet metal parts using suitable tools.

d. Repair or rebuild main stator assembly as specified in figure 7-2 for 50/60 hertz generators or figure 7-3 for 400 hertz generators.

e. Repair or rebuild main rotor assembly as specified in figure 7-4 for 50/60 hertz generators or figure 7-5 for 400 hertz generators.

#### NOTE

Apply 6 to 12 VDC to rotor leads. Pass a compass around the diameter of the rotor noting which pole of the compass pointer is attracted to each of the wound poles. If the windings are correctly connected, all wound poles will attract the same compass pole.

f. Repair or rebuild exciter rotor assembly as specified in figure 7-6 for 50/60 hertz generators or figure 7-7 for 400 hertz generators.

g. Repair or rebuild exciter stator assembly as specified in figure 7-8 for 50/60 hertz generators or figure 7-9 for 400 hertz generators.

h. Remove damaged paint with a suitable scraper. Blend in edges, prime, and paint damaged areas.

7-7. REASSEMBLY.

Refer to figure 7-1 and reassemble generator in the reverse sequence of index

numbers assigned. Pay particular attention to the following.



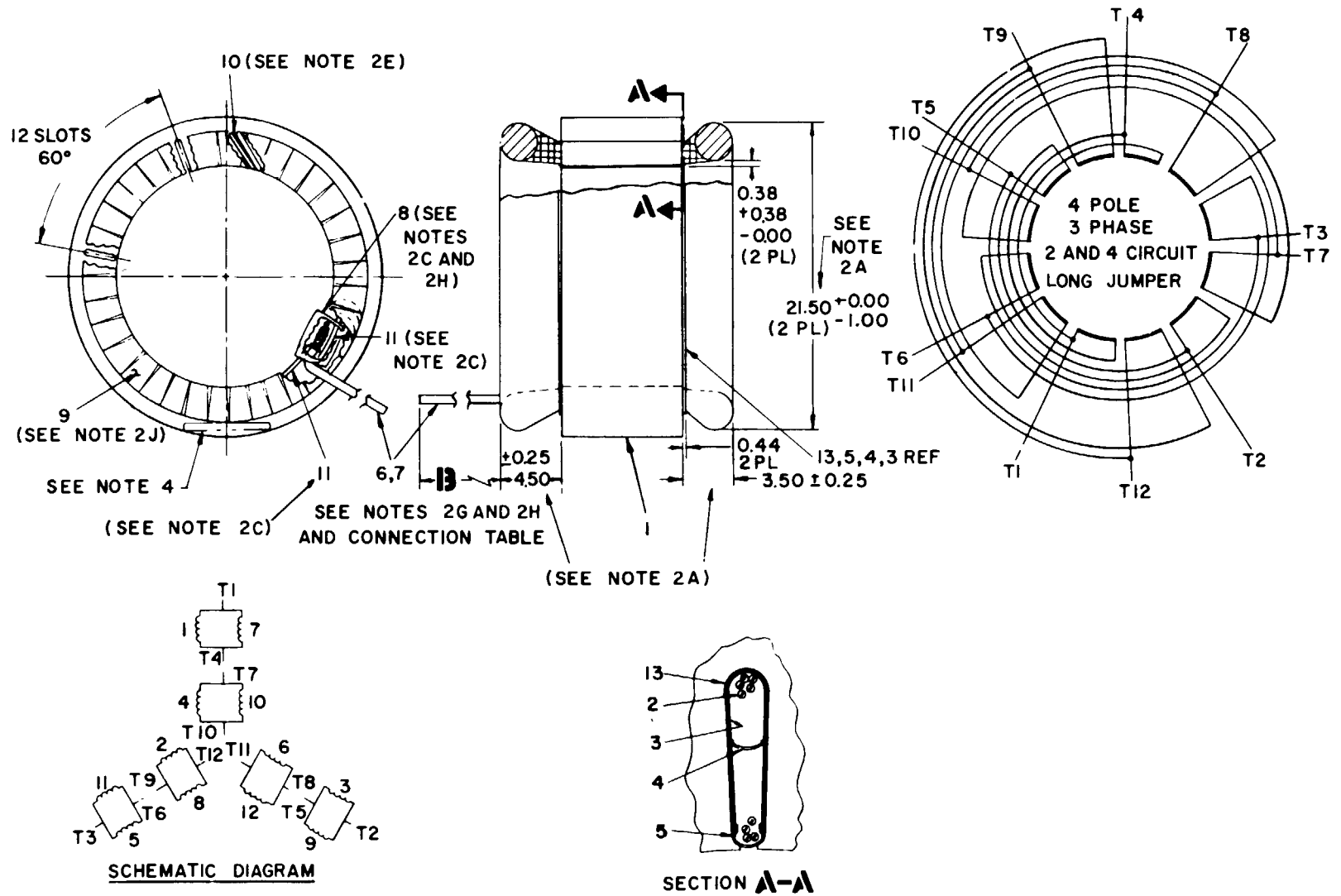


Figure 7-2. 50/60 Hertz generator, main stator rewind data  
(sheet 1 of 2)

NOTES:

1. COIL DATA:
  - A. WIRE SIZE: .064 DIA (#14 GA) CLASS 155, TYPE L2.
  - B. NUMBER OF WIRES PER TURN: 10
  - C. NUMBER OF TURNS PER COIL: 3
  - D. NUMBER OF WIRES PER COIL: 30
  - E. COIL GROUPING: 12 GROUPS OF 6 COILS.
  - F. COIL SPAN: SLOTS 1 AND 13.
2. STATOR WINDING PROCEDURE:
  - A. WIND COILS TO PROPER SHAPE, SPECIFIED DIMENSIONS AND NUMBER OF TURNS.
  - B. HOLD COILS TOGETHER WITH TAPE, INDEX 9.
  - C. APPLY SLEEVING, INDEX 11, AND INDEX 8, (LOOSE).
  - D. SELECT AN ARBITRARY SLOT ON CORE, INDEX 1, AND INSERT FIRST COIL GROUP WITH START LEAD IN THE BOTTOM OF SLOT NO. 1 AND THE ENDING LEAD IN THE TOP OF SLOT NO. 13. (COIL SPAN 1 AND 13).
  - E. INSERT THE NEXT COIL GROUP PER ABOVE GROUPING SEQUENCE. INSERT PHASE INSULATION, INDEX 10, DURING PLACING OF COILS. REPEAT SEQUENCE UNTIL WINDING IS COMPLETE.
  - F. MAKE PHASE CONNECTION PER CONNECTION DIAGRAM (HOMOGENEOUS WELD).
  - G. CONNECT LEADS, INDEX 6 AND 7 INDIVIDUALLY AND ISOLATED FROM EACH OTHER WITH INDEX 8 PER CONNECTION TABLE (HOMOGENEOUS WELD WIRE ENDS).
  - H. APPLY SLEEVING, INDEX 8, OVER LEAD, INDEX 6 AND 7, CONNECTIONS AND PHASE CONNECTIONS.
  - J. WRAP WINDING WITH TAPE, INDEX 9.
3. VARNISH AS FOLLOWS:
  - STEP 1: PREBAKING -  
 PUT INTO OVEN AT 110° C(230° F) HOLD AT TEMPERATURE FOR 4 HOURS. COOL TO APPROXIMATELY 50° C(122° F).
  - STEP 2: DIPPING -  
 IMMERSER IN VARNISH, MIL-1-24092, UNTIL BUBBLING CEASES. VISCOSITY SHALL BE HELD TO 60 ZAHN SECONDS USING NO. 2 CUP. THIN WITH SOLVENT, MIL-N-15178, TYPE A/B.
  - STEP 3: DRAINING -  
 DRAIN AND AIR DRY FOR 1 HOUR. ROTATE WOUND APPARATUS TO PREVENT POCKETING THE VARNISH.
  - STEP 4: WIPING -  
 AFTER DRAINING BUT BEFORE BAKING, THE METAL SURFACES OF THE ARMATURE, THE BORE OF THE STATOR AND THE POLE FACES OF THE FIELD STRUCTURE SHALL BE WIPED WITH A CLOTH MOISTENED WITH SOLVENT, MIL-N-15178, TYPE A/B.
  - STEP 5: BAKING -  
 BAKE IN CIRCULATING TYPE, FORCED EXHAUST, BAKING OVEN AT TEMPERATURE OF 165° C(329 F),
  - STEP 6: COOLING -  
 REMOVE FROM OVEN AND COOL TO APPROXIMATELY 50° C(122° F).
  - STEP 7: SECOND TREATMENT (DIP IN OPPOSITE DIRECTION) - REPEAT STEPS 2 (IMMERSE FOR 1 MINUTE) 3, 4, 5, AND 6.
  - STEP 8: THIRD TREATMENT (DIP IN ORIGINAL DIRECTION) - REPEAT STEPS 2 (IMMERSE FOR 1 MINUTE), 3, 4, 3, AND 6.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT.
5. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN 7-5, STEPS K AND O.

CONNECTION TABLE		
INDEX NO.	LEAD NO.	<b>13</b> LEAD LENGTH (INCHES)
6	T1, T2, T3, T7, T8, T9	90.00 Min
7	T4, T5, T6, T10, T11, T12	54.00 Min

Figure 7-2. 50/00 Hertz generator, main stator rewind data (sheet 2 of 2)

Legend to figure 7-2:

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Stator core</li> <li>2. Magnet wire 0.064 DIA (#14)</li> <li>3. Slot cell insulation (72)</li> <li>4. Center spacer 0.032 thick</li> <li>5. Wedge (72)</li> <li>6. Lead (6)</li> <li>7. Lead (6)</li> </ol> | <ol style="list-style-type: none"> <li>8. Insulation sleeving 0.625 ID</li> <li>9. Untreated glass tape 0.010 x 0.75</li> <li>10. Phase insulation</li> <li>11. Insulation sleeving 0.330 ID</li> <li>12. Varnish</li> <li>13. Insulation slot cell (72)</li> </ol> |
|---|---|

**NOTE**

Figure 1-28 is the generator assembly simplified schematic diagram.

a. Heat main stator frame (86) in a suitable oven to 200°F for ease of installing main stator assembly (80).

b. Place heated main stator frame assembly (86) in a vertical position, resting exciter end on wooden blocks.

**CAUTION**

Exercise care when installing main stator assembly (80) into main stator frame (86) to prevent damage to windings.

c. Position main stator assembly (80) so that pin (79) holes are aligned with holes in main stator frame (86). Start leads (77) through insulation bushing (85). Pull leads and slide main stator assembly (80) into main stator frame (86) until pin (79) holes are aligned.

d. Install pin (79) and setscrew (78) tighten to 5 foot-pound torque.

e. Cut output leads (77) to lengths specified in table 7-1. Strip insulation back 0.62 inches and install terminal lugs on leads (77).

Table 7-1. Generator Output Lead Lengths

LEAD NUMBER	LEAD LENGTH IN INCHES (TOLERANCE $\begin{matrix} +0.005 \\ -0.0 \end{matrix}$ )
T1	58
T2	52
T3	65
T4	20
T5	20
T6	17
T7	60
T8	52
T9	63
T10	18
T11	18
T12	18

f. Position clamp (75) on generator and install generator output leads in the following sequence starting at exciter end: T12, T11, T10, T9, T8, and T7. Install clamp (74) and install following output leads starting at exciter end: T6, T5, T4, T3, T2, and T1. Install clamp (73) and tighten nuts (70) finger tight.

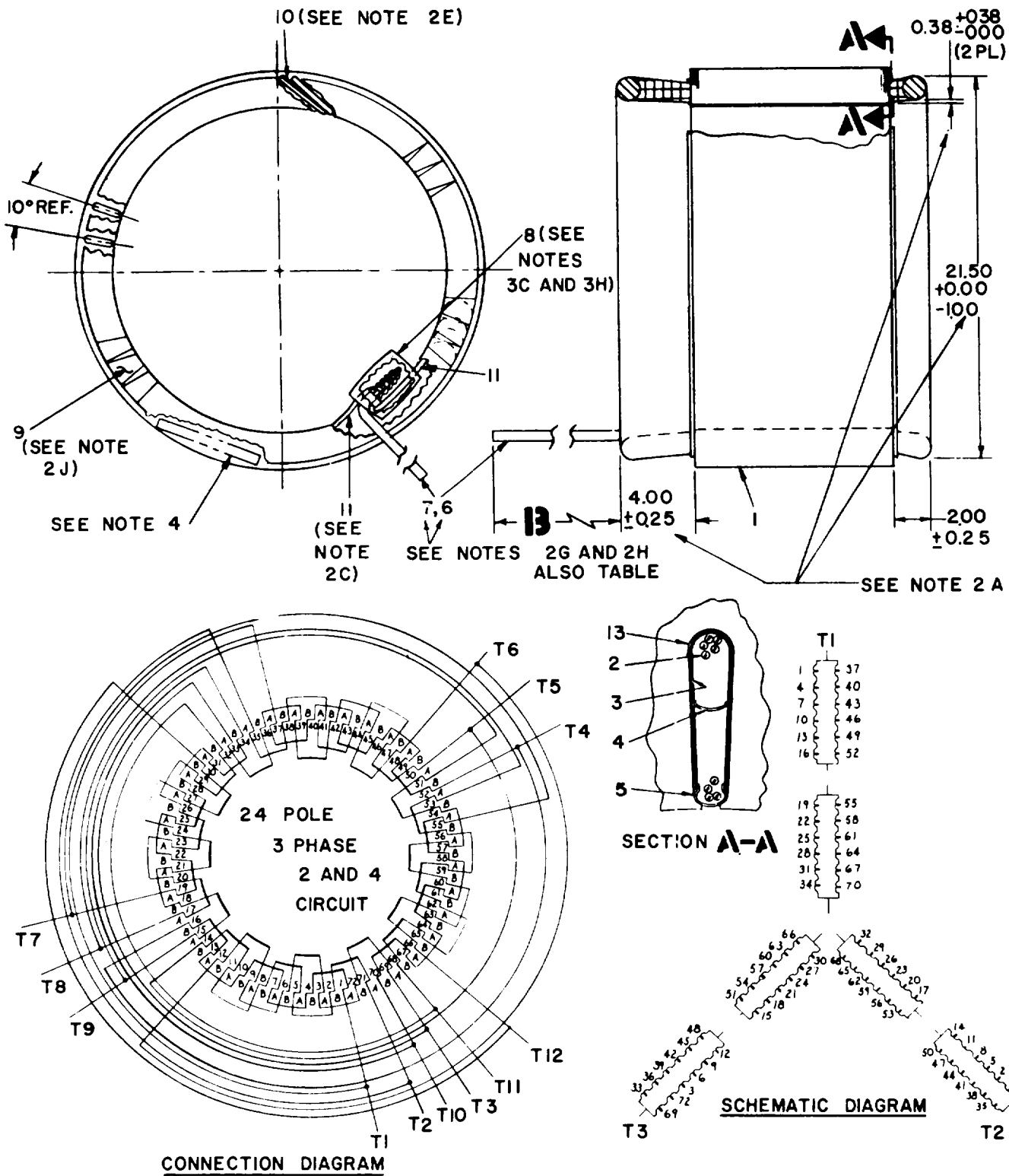


Figure 7-3. 400 Hertz generator, main stator rewind data (sheet 1 of 2)



CONNECTION TABLE		
FIND NO.	LEAD NO. REF	LEAD LENGTH
6	T1, T2, T3, T7, T8, T9	90.00 MIN
7	T4, T5, T6, T10, T11, T12	54.00 MIN

NOTES:

1. COIL DATA
  - A. WIRE SIZE:0.051 DIA (#16 GA) CLASS 155, TYPE L2.
  - B. NUMBER OF WIRES PER TURN: 20
  - c. NUMBER OF TURNS PER COIL: 1
  - D. NUMBER OF WIRES PER COIL: 20
  - E. COIL GROUPING: 36 GROUPS OF 2 COILS  
36 GROUPS OF 1 COIL
  - F. COIL SPAN: SLOTS 1 & 4
2. STATOR WINDING PROCEDURE:
  - A. WIND COILS TO PROPER SHAPE, SPECIFIED DIMENSIONS AND NUMBER OF TURNS.
  - B. HOLD COILS TOGETHER WITH TAPE, INDEX NO. 9
  - c. APPLY SLEEVING, INDEX NO. 11 & INDEX NO. 8( LOOSE).
  - D. SELECT AN ARBITRARY SLOT ON CORE, INDEX NO. 1, AND INSERT FIRST COIL GROUP WITH START LEAD IN THE BOTTOM OF SLOT NO. 1 AND THE ENDING LEAD IN THE TOP OF SLOT NO. 4, (COIL SPAN 1 & 4).
  - E. INSERT THE NEXT COIL GROUP PER ABOVE GROUPING SEQUENCE. INSERT PHASE INSULATION, INDEX NO. 10, DURING PLACING OF COILS. REPEAT SEQUENCE UNTIL WINDING IS COMPLETE.
  - F. MAKE PHASE CONNECTION PER CONNECTION DIAGRAM, HOMOGENEOUS WELD.
  - G. CONNECT LEADS, INDEX NO. 6 TO T1, T2, T3, T7, T8, T9 AND LEADS, INDEX NO. 7 TO T4, T5, T6, T10, T11, T12" PER CONNECTION DIAGRAM & TABLE, HOMOGENEOUS WELD.
  - H. APPLY SLEEVING, INDEX NO. 8 OVER LEAD, INDEX NO. 6 & 7, CONNECTIONS AND PHASE CONNECTIONS.
  - J. WRAP WINDING WITH TAPE, INDEX NO. 9.
3. VARNISH DATA SPECIFIED IN FIGURE 7-2 NOTE 3.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT.  
30554 ASSY 70-4521  
MFG (MFG CODE)
5. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5. STEPS K AND O.

Figure 7-3. 400 Hertz generator, main stator rewind data  
 (sheet 2 of 2)

Legend to figure 7-3:

- |                                |                                      |
|--------------------------------|--------------------------------------|
| 1. Stator core                 | 8. Insulation sleeving 0.625 ID      |
| 2. Magnet wire 0.051 DIA (#16) | 9. Untreated glass tape 0.010 x 0.75 |
| 3. Slot cell insulation (108)  | 10. Phase insulation                 |
| 4. Center spacer 0.032 thick   | 11. Insulation sleeving 0.330 ID     |
| 5. Wedge (108)                 | 12. Varnish                          |
| 6. Lead (6)                    | 13. Slot cell insulation (108)       |
| 7. Lead (6)                    |                                      |

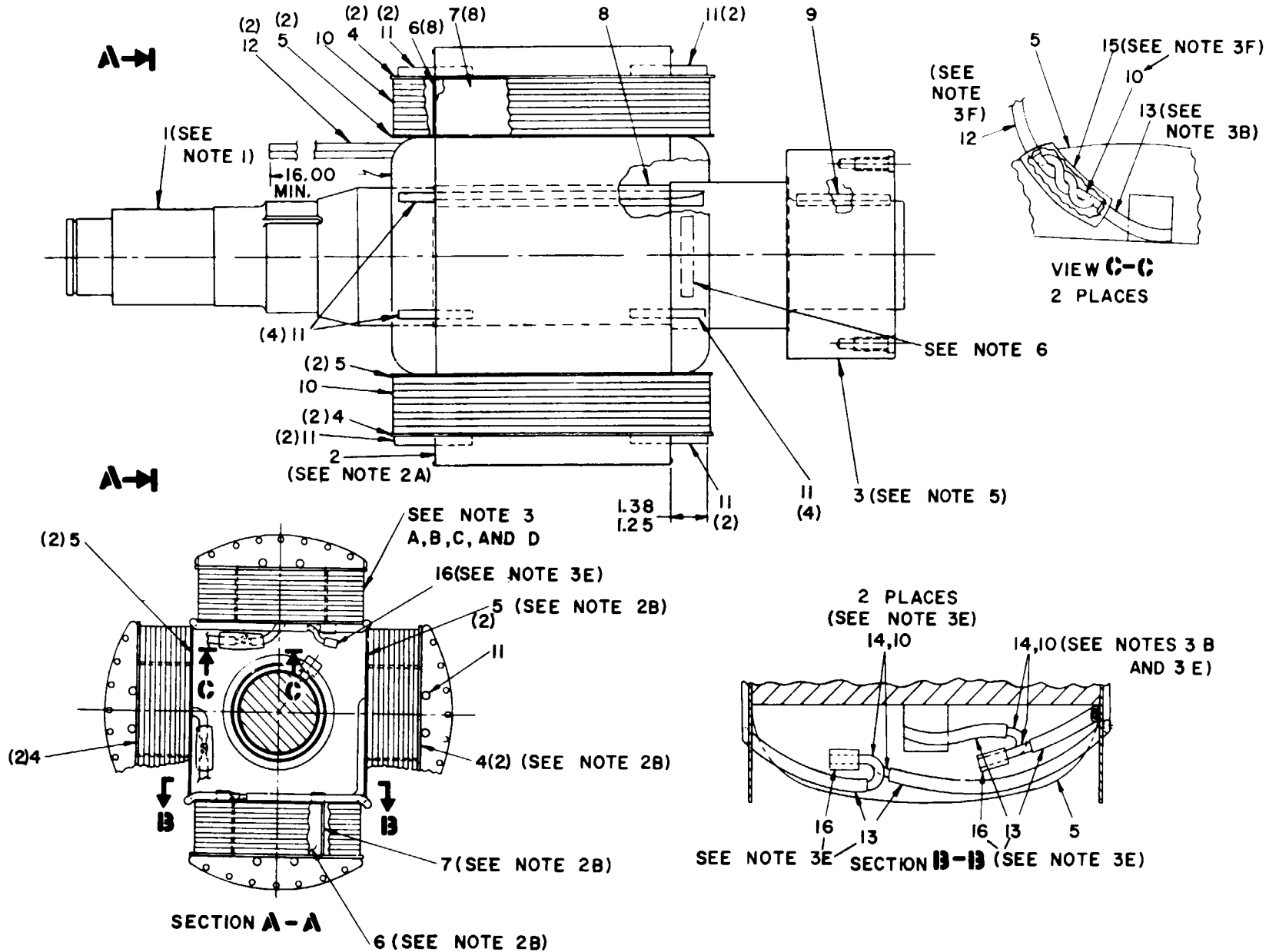


Figure 7-4. 50/60 Hertz generator, main rotor rewind data (sheet 1 of 2)

NOTES:

1. PRESS FIT SHAFT, INDEX 1, INTO CORE, INDEX 2, TO SHOULDER ON SHAFT INDEX 1.
2. INSULATING:
  - A. APPLY EPOXY, INDEX 14, TO POLE BOTTOM, POLE SIDES AND POLE ENDS.
  - B. INSTALL INSULATION, INDEX 5, ON BOTTOM POLE SIDES. INSTALL INSULATION, INDEX 4, ON TOP POLE SIDES. INSTALL INSULATION, INDEX 6, ON POLE ENDS. INSTALL INSULATION, INDEX 7, ON POLE SIDES.
3. WINDING:
  - A. ADJUST WIRE TENSION TO 70 LBS.
  - B. APPLY SLEEVE, INDEX 13, TO START LEAD OF EACH COIL.
  - C. WIND THE FIRST LAYER WITH 10 TURNS TO FILL THE WINDING SPACE. FORM THE COIL SIDES WITH A FIBRE BLOCK TO OBTAIN FLAT AND TIGHT WINDING. DO NOT FORM COIL ENDS. APPLY EPOXY, INDEX 14.
  - D. CONTINUE WINDING COMPLETE COIL AS DESCRIBED IN WINDING NOTE 3B, MAKING SURE TO APPLY EPOXY, INDEX 14, TO COVER ALL TURNS AND TO FILL ALL VOIDS THROUGH THE ENTIRE WINDING. THIS WILL REQUIRE BRUSHING EPOXY ON ALL LAYERS. FORM COIL SIDES WHILE WINDING TO PRODUCE FLAT SIDES. WIND EACH COIL WITH 160 TURNS, 10 TURNS PER LAYER, 4 COILS.
  - E. APPLY SLEEVING, INDEX 13, TO ENDING LEAD OF EACH COIL. SELECT START LEAD OF ARBITRARY COIL AND CONNECT COILS IN SERIES, HOMOGENOUS WELD, AND USE PARALLEL SPLICE, INDEX 16.
  - F. CONNECT LEADS, INDEX 12, TO REMAINING TWO LEADS, SOLDER USING SOLDER, INDEX 17.
4. BAKE COMPLETED ROTOR FOR A MIN. OF 24 HOURS AT 325° F to 35° F.
5. HEAT HUB, INDEX 3, TO 400° F THEN SHRINK FIT ON SHAFT, INDEX 1, TO SHOULDER.
6. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT. USING WHITE ENAMEL PAINT.  
 30554 ASSY 70-4509  
 MFG (MFG CODE)
7. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS I AND P.

Figure 7-4. 50/60 Hertz generator, main rotor rewind data  
 (sheet 2 of 2)

Legend to figure 7-4:

- |                        |                     |                         |
|------------------------|---------------------|-------------------------|
| 1. Shaft               | 8. Key              | 13. Insulation sleeving |
| 2. Rotor core          | 9. Key              | 0.234 ID                |
| 3. Drive hub coupling  | 10. Magnet wire HPT | 14. Epoxy compound      |
| 4. Pole insulation (8) | 0.085 X 0.200       | 15. Insulation sleeving |
| 5. Pole insulation (8) | 11. Pin (16)        | 16. Splice (3)          |
| 6. Pole insulation (8) | 12. Lead (2)        | 17. Solder              |
| 7. Pole insulation (8) |                     |                         |

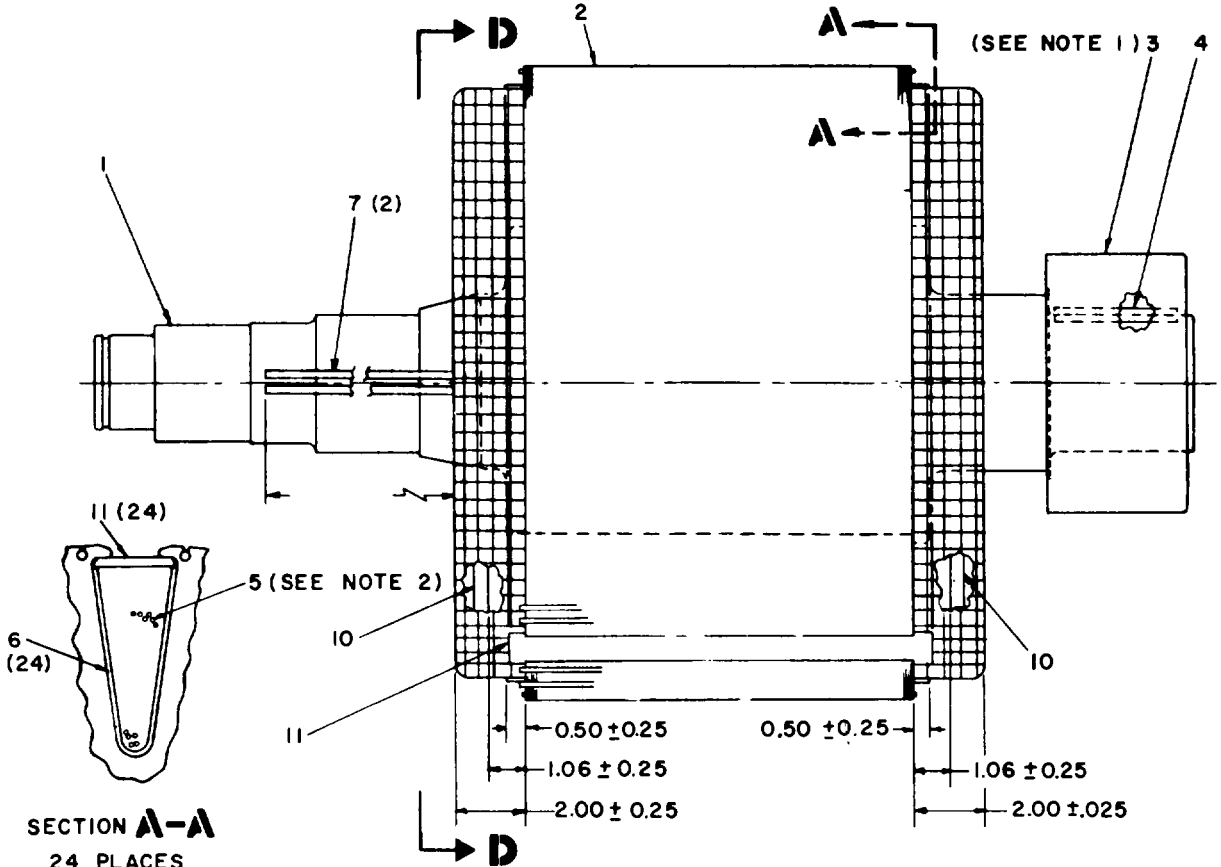
Form an appropriate five inch loop in outputs leads between insulation bushing (85) and clamps. Make sure leads are in proper position and tighten nuts (70).

WARNING

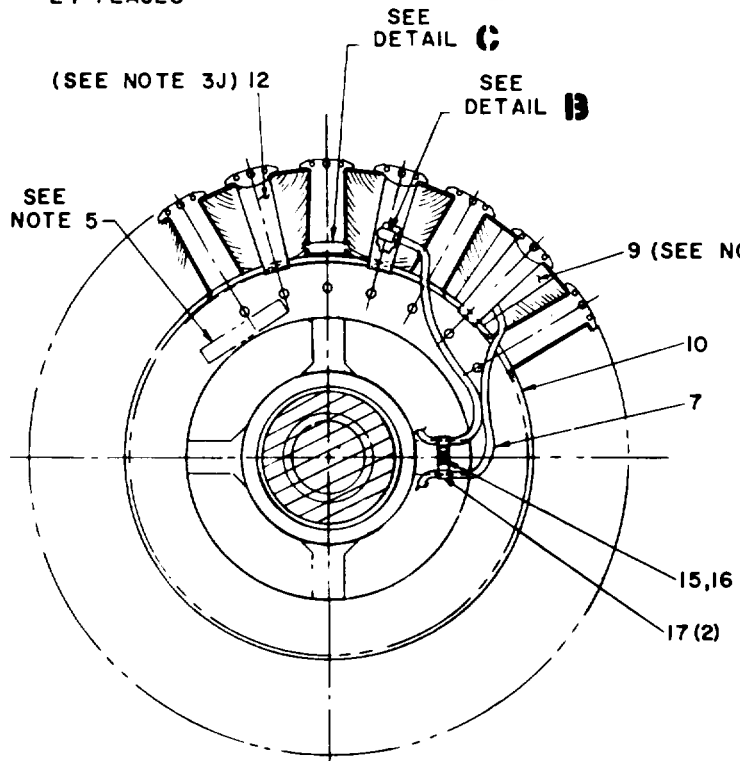
Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

- g. Insert exciter stator assembly (68)

leads in connector (64) opening. Install exciter stator assembly into end bell (69), pulling leads through opening as exciter stator is installed. Cut exciter stator assembly leads to permit connection to connector (64), when connector is approximately one inch from end bell (69). Strip lead insulation back approximately 0.375 inch and solder lead F1 to connector pin C and lead F2 to connector pin B. Install connector (64) with key on top.



SECTION A-A  
24 PLACES



SECTION D-D

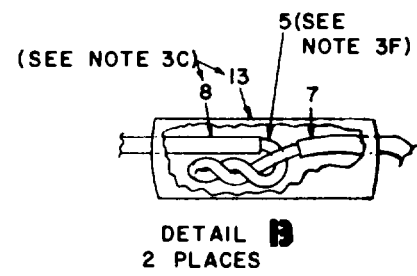
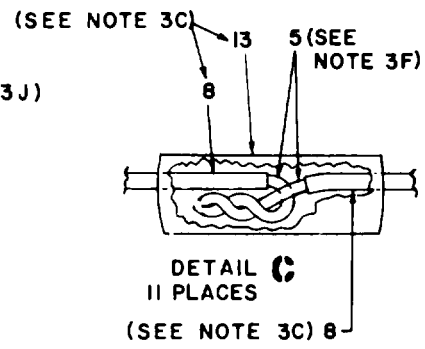


Figure 7-5. 400 Hertz generator, main rot or rewind data  
(sheet 1 of 2)

NOTES:

1. IF HUB WAS REMOVED, HEAT HUB, INDEX 3, TO 450° F, THEN SHRINK-FIT ON SHAFT, INDEX 1, TO SHOULDER.
2. COIL DATA:
  - A. WIRE SIZE: 0.040 DIA (#18 GA) CLASS 155, TYPE L2.
  - B. NO. OF WIRES PER TURN: 16
  - C. NO. OF TURNS PER COIL: 29
  - D. COIL GROUPING: 1 GROUP OF 12 COILS.
3. WINDING PROCEDURE:
  - A. WIND COILS TO PROPER SHAPE, SPECIFIED DIMENSIONS AND NUMBER OF TURNS.
  - B. HOLD COILS TOGETHER WITH TAPE, INDEX 9.
  - C. APPLY INSULATION SLEEVING, INDEX 8. AND INDEX 13 (LOOSE).
  - D. SELECT AN ARBITRARY SLOT ON CORE, INDEX 2, AND INSERT FIRST COIL WITH START LEAD IN THE BOTTOM OF SLOT NO. 1 AND THE ENDING LEAD IN THE BOTTOM OF SLOT NO. 2.
  - E. REPEAT SEQUENCE UNTIL WINDING IS COMPLETE.

WARNING

WELDING OPERATIONS PRODUCE HEAT, HIGHLY TOXIC FUMES, INJURIOUS RADIATION, METAL SLAG AND AIRBORN PARTICLES. WELDING GOGGLES, WITH PROPER TINTED LENSES, APRON OR JACKET AND WELDER'S BOOTS ARE REQUIRED.

  - F. CONNECT ENDING LEAD OF ARBITRARY COIL TO STARTING LEAD OF ADJACENT COIL. CONTINUE CONNECTING COIL ENDING LEAD TO ADJACENT COIL STARTING LEAD FOR ALL COILS UNTIL ONLY TWO LEADS REMAIN. HOMOGENEOUS WELD ALL CONNECTIONS.
  - G. CONNECT LEADS, INDEX 7, TO REMAINING TWO COIL LEADS AND HOMOGENEOUS WELD.
  - H. WRAP WINDING WITH TAPE, INDEX 9.
  - J. INSTALL RETAINER. INDEX 10. USING TAPE. INDEX 12.
4. VARNISH AS FOLLOWS:
  - STEP 1: PREBAKING -  
 PUT INTO OVEN AT 110° C (230° F). HOLD AT TEMPERATURE FOR 4 HOURS. COOL TO APPROXIMATELY 50°c (122° F).
  - STEP 2: DIPPING  
 IMMERSER IN VARNISH. 70-4560, UNTIL BUBBLING CEASES. VISCOSITY SHALL BE HELD 20 ZAHN SECONDS USING A NO. 2 CUP. THIN WITH SOLVENT, MIL-N-15178, TYPE A/B TO MAINTAIN VISCOSITY.
  - STEP 3: DRAINING -  
 DRAIN AND AIR DRY FOR 1 HOUR. ROTATE WOUND APPARATUS TO PREVENT POCKETING THE VARNISH.
  - STEP 4: WIPING  
 AFTER DRAINING BUT BEFORE BAKING, THE METAL SURFACES OF THE ARMATURE, THE BORE OF THE ROTOR AND THE POLE FACES SHALL BE WIPED WITH A CLOTH MOISTENED WITH SOLVENT, MIL-M-15178, TYPE A/B.
  - STEP 5: B A K I N G -  
 PUT INTO A CIRCULATING TYPE, FORCED EXHAUST, BAKING OVEN AT TEMPERATURE OF 80°C (176° F) FOR 3 HOURS, INCREASE TEMPERATURE TO 165°C (329° F) AND CONTINUE TO BAKE AN ADDITIONAL 7 HOURS.
  - STEP 6: COOLING -  
 REMOVE FROM OVEN AND COOL TO APPROXIMATELY 50°C (122° F).
  - STEP 7: SECOND TREATMENT (DIP IN OPPOSITE DIRECTION) - REPEAT STEPS 2 (IMMERSE FOR 1 MINUTE) 3,4, 5, AND 6.
  - STEP 8: THIRD TREATMENT (DIP IN ORIGINAL DIRECTION) - REPEAT STEPS 2 (IMMERSE FOR 1 MINUTE) 3,4, 5, AND 6.
5. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT  
 30554 ASSY 70-4518  
 MFG (MFG CODE)
6. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS I AND P.

Figure 7-5. 400 Hertz generator, main rotor rewind data  
 (sheet 2 of 2)

Legend to figure 7-5:

- |                              |                         |                         |
|------------------------------|-------------------------|-------------------------|
| 1. Shaft                     | 8. Insulation sleeving  | 13. Insulation sleeving |
| 2. Rotor core                | 0.294 ID                | 0.330 ID                |
| 3. Drive hub coupling        | 9. Untreated glass tape | 14. Varnish             |
| 4. Key                       | 0.010X0.75              | 15. Yellow locking      |
| 5. Magnet wire               | 10. Retainer (2)        | compound GRB            |
| 0.40 DIA (#18)               | 11. Insulation          | 16. Screw               |
| 6. Slot cell insulation (24) | wedge (24)              | 17. Cable clamp (2)     |
| 7. Lead (2)                  | 12. Banding tape        |                         |

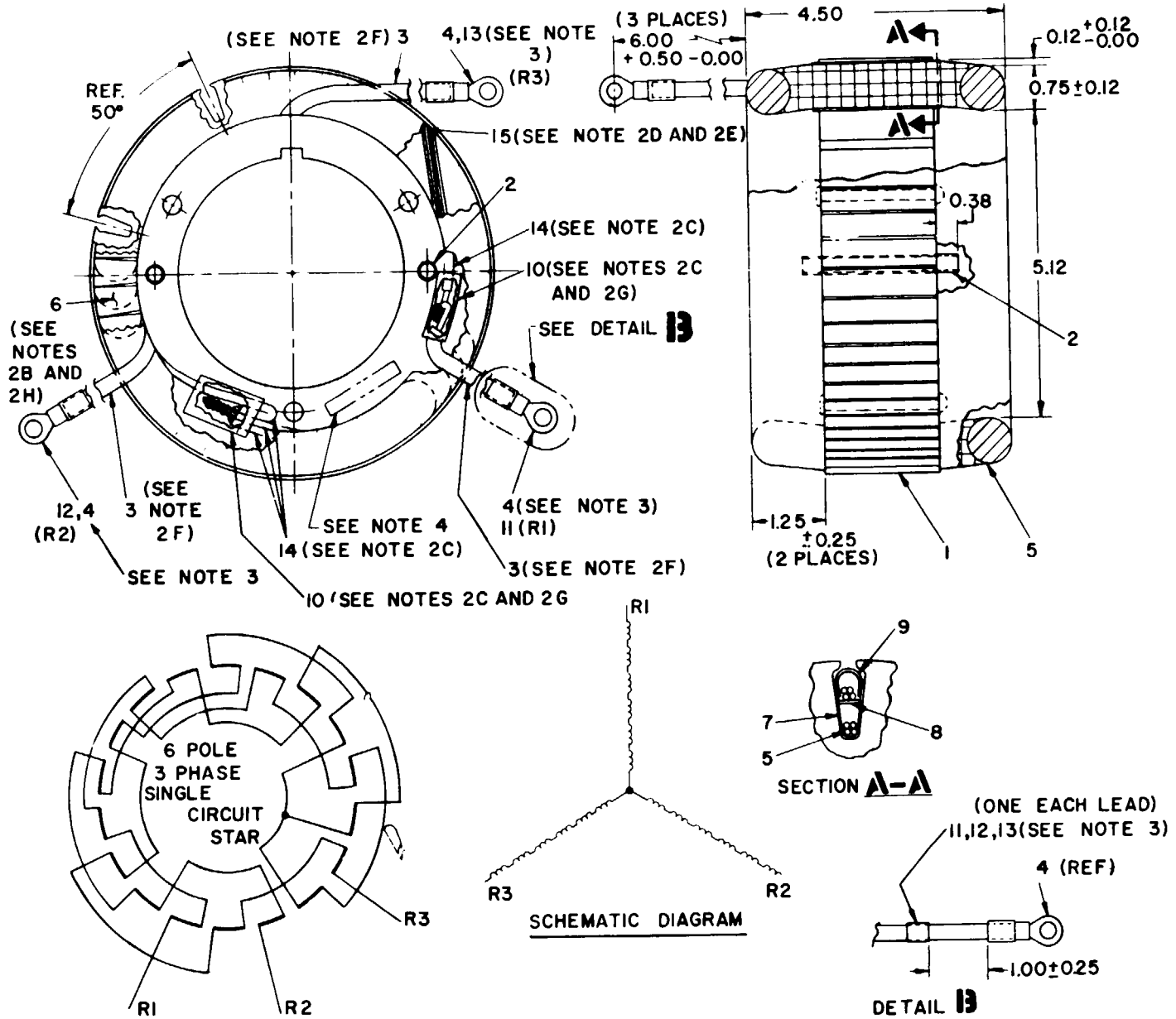


Figure 7-6. 50/60 Hertz generator, exciter rotor rewind data (sheet 1 of 2)

NOTES:

1. COIL DATA:
  - A. WIRE SIZE: 0.040 DIA (#18 GA) CLASS 155, TYPE L2.
  - B. NUMBER OF WIRES PER TURN: 6
  - c. NUMBER OF TURNS PER COIL: 3
  - D. NUMBER OF WIRES PER COIL: 18
  - E. COIL GROUPING: 18 GROUPS OF 2 COILS.
  - F. COIL SPAN: SLOTS 1 & 6.
2. ROTOR WINDING PROCEDURE :
  - A. WIND COILS TO PROPER SHAPE, SPECIFIED DIMENSIONS AND NUMBER OF TURNS.
  - B. HOLD COILS TOGETHER WITH TAPE, INDEX 6.
  - C. APPLY SLEEVING, INDEX NO. 14 & INDEX 10 (LOOSE).
  - D. SELECT AN ARBITRARY SLOT ON CORE, INDEX 1, AND INSERT FIRST COIL GROUP WITH START LEAD IN THE BOTTOM OF SLOT NO. 1 AND THE ENDING LEAD IN THE TOP OF SLOT NO. 6. (COIL SPAN 1 & 6).
  - E. INSERT THE NEXT COIL GROUP PER ABOVE GROUPING SEQUENCE . INSERT PHASE INSULATION, INDEX 15, DURING PLACING OF COILS. REPEAT SEQUENCE UNTIL WINDING IS COMPLETE.
  - F. MAKE PHASE CONNECTION AND CONNECT LEADS, INDEX 3 PER CONNECTION DIAGRAM, (HOMOGENEOUS WELD) .
  - G. APPLY SLEEVING, INDEX 10, OVER LEAD, INDEX 3 CONNECTIONS AND PHASE CONNECTION.
  - H. WRAP WINDING WITH TAPE, INDEX 6.
  - J. VARNISH, REFER TO FIGURE 7-5 NOTE 4.
3. CUT LEADS, INDEX 3, AND INSTALL TERMINALS, INDEX 4, & WIRE MARKERS, INDEX 11, 12, & 13, TO DIMENSIONS SHOWN. CRIMPING OF TERMINALS TO MEET THE REQUIREMENTS & TESTS OF MIL-T-7928. HEAT WIRE MARKERS, INDEX 11, 12 & 13 TO 20°C FOR 5 SECONDS.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT.  
30554 ASSY 70-4511  
MFG (ADD MFG CODE)
5. AFTER REWINDING, PREFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS M AND Q.

Figure 7-6. 50/60 Hertz generator, exciter rotor rewind data  
(sheet 2 of 2)

Legend to figure 7-6:

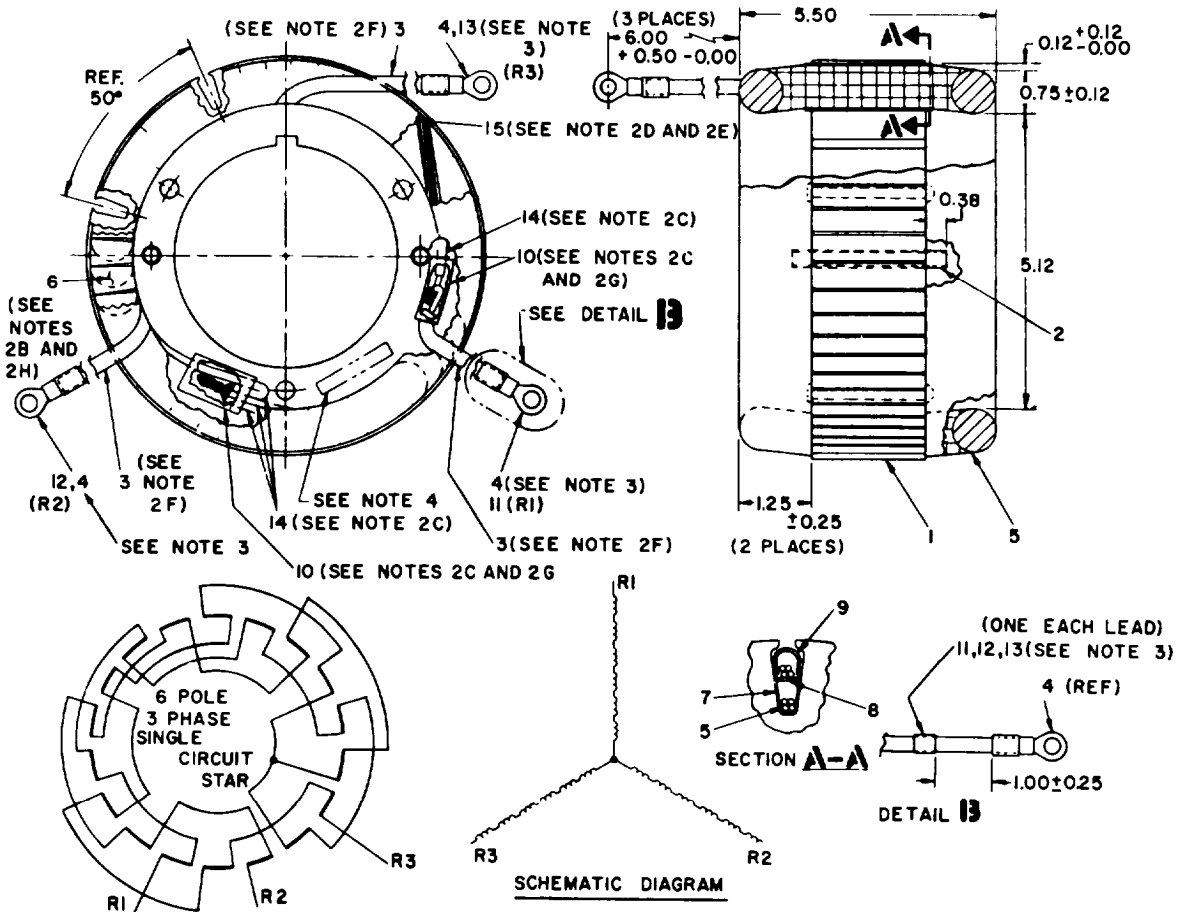
- |                                      |                                  |
|--------------------------------------|----------------------------------|
| 1. Rotor core                        | 9. Wedge (36)                    |
| 2. Insulation (2)                    | 10. Insulation sleeving 0.330 ID |
| 3. Lead (3)                          | 11. Wire marker                  |
| 4. Terminal lug (3)                  | 12. Wire marker                  |
| 5. Magnet wire 0.040 DIA (#18)       | 13. Wire marker                  |
| 6. Untreated glass tape 0.010 x 0.75 | 14. Insulation sleeving 0.06 ID  |
| 7. Slot cell insulation (36)         | 15. Phase insulation             |
| 8. Center spacer 0.032 THK           | 16. Varnish                      |

h. Install end bell and exciter stator assembly (61 ) on main stator and frame assembly (43) with connector (64) positioned at three o'clock looking from rear of generator.

i. Install key (38) on shaft (42) and using a suitable press, press shaft (42) into

main rotor subassembly (37) until main rotor subassembly (37) is against shoulder on shaft (42).

j. Install key (36) on shaft (42). Heat hub (35) in a suitable oven to 450°F and install hub (35) on shaft (42) until it bottoms on shaft shoulder.



NOTES:

1. COIL DATA:
  - A. WIRE SIZE: 0.040 DIA (#18 GA), CLASS 155, TYPE L2.
  - B. NUMBER OF WIRES PER TURN: 6
  - C. NUMBER OF TURNS PER COIL: 3
  - D. NUMBER OF WIRES PER COIL: 18
  - E. COIL GROUPING: 18 GROUPS OF 2 COILS
  - F. COIL SPAN: SPAN 1 AND 6.
2. ROTOR WINDING PROCEDURE :
  - A. WIND COILS TO PROPER SHAPE, SPECIFIED DIMENSIONS AND NUMBER OF TURNS.
  - B. HOLD COILS TOGETHER WITH TAPE, INDEX 6.
  - C. APPLY INSULATION SLEEVING, INDEX 14 AND 10 (LOOSE).
  - D. SELECT AN ARBITRARY SLOT ON CORE, INDEX 1, AND INSERT FIRST COIL GROUP WITH START LEAD IN THE BOTTOM OF SLOT NO. 1 AND 'hi E' ENDING LEAD IN THE TOP OF SLOT NO. 6 (COIL SPAN 1 AND 6).
  - E. INSERT THE NEXT COIL GROUP PER GROUPING SEQUENCE. INSERT PHASE INSULATION, INDEX 15, DURING PLACING OF COILS. REPEAT SEQUENCE UNTIL WINDING IS COMPLETE.
  - F. MAKE PHASE CONNECTION AND CONNECT LEADS, INDEX 3, PER CONNECTION DIAGRAM, (HOMOGENEOUS WELD).  
 APPLY SLEEVING, INDEX 10, OVER LEADS, INDEX 3, CONNECTIONS AND PHASE CONNECTION.
  - H. WRAP WINDING WITH TAPE, INDEX 6.
  - J. VARNISH. REFER TO FIGURE 7-5 NOTE 4.
3. CUT LEADS, INDEX 3, AND INSTALL TERMINALS, INDEX 4, AND WIRE MARKERS, INDEX 11, 12, AND 13, TO DIMENSIONS SHOWN. CRIMPING OF TERMINALS TO MEET THE REQUIREMENTS AND TESTS OF MIL-T-7928. HEAT WIRE MARKERS, INDEX 11, 12, AND 13, TO 200° F FOR 5 SECONDS.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT  
 30554 ASSY 70-4519  
 MFG (MFG CODE)
5. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS M AND Q,

Figure 7-7. 400 Hertz generator, exciter rotor rewind data



Legend to figure 7-7:

- |                                |                         |                         |
|--------------------------------|-------------------------|-------------------------|
| 1. Rotor core                  | 7. Slot cell insulation | 12. Wire marker         |
| 2. Insulation (2)              | 8. Center spacer        | 13. Wire marker         |
| 3. Lead (3)                    | 0.032 thick             | 14. Insulation sleeving |
| 4. Terminal lug (3)            | 9. Wedge (36)           | O. 106 ID               |
| 5. Magnet wire 0.040 DIA (#18) | 10. Insulation sleeving | 15. Phase insulation    |
| 6. Untreated glass tape        | 0.330 ID                | 16. Varnish             |
| 0.010 x 0.75                   | 11. Wire marker         |                         |

k. Install key (34) and exciter rotor assembly (33) on shaft (42). Using a suitable press, press spacer (32) into place.

l. Assemble rectifier assembly (12) and position on shaft (42). Align setscrew (11) hole with hole in shaft (42).

m. Install setscrew (11 and 31) and tighten to 20 foot-pounds torque.

**WARNING**

Varnish, Insulating, is flammable and extremely toxic. Avoid eye and skin contact or breathing of vapors. Good general ventilation is normally adequate.

n. Apply insulation sleeving to main rotor subassembly (37) leads R4 and R5. Position lead R5 at three o'clock and lead R4 at nine o'clock on shaft (42) looking from bearing end of shaft. Tape leads to shaft at two evenly spaced positions between the main rotor subassembly (37) and exciter rotor assembly (33). Brush coat tape with varnish. Position leads R4 and R5 through two holes provided in exciter rotor assembly (33) and insulator (30). Cut leads long enough to connect a rectifier assembly (12). Strip lead insulation back 0.375 inch and install terminal lugs on leads. Connect leads R4 and R5 to rectifier assembly.

o. Position leads R1, R2, and R3 from exciter rotor assembly (33) through insulator (30) holes and cut leads long enough to connect to rectifier assembly (12). Strip

lead insulation back 0.375 inch and install terminal lugs and connect leads R1, R2, and R3 to rectifier assembly (12).

p. Using a suitable press, press bearing (8) against shoulder on shaft (42). Install snap ring (7) on shaft (42).

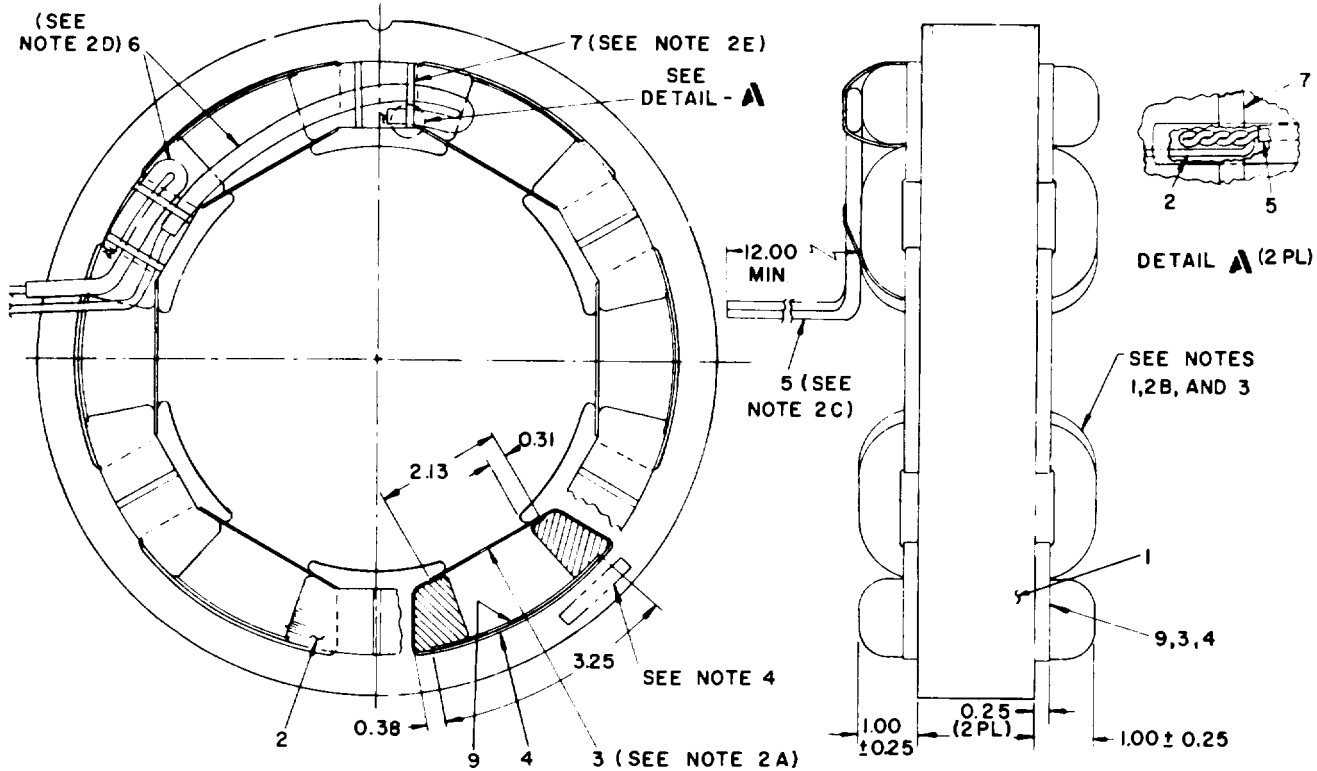
q. Place assembled shaft in a suitable dynamic balancing machine. Balance assembled shaft in two planes. Rotate shaft at 600 to 800 RPM and balance shaft on 50/60 hertz generators to 3.5 inch-ounce and on 400 hertz generators to 10 inch-ounce using balance weights (41). To install balance weight, place weight in proper position on rotor and transfer two drill 0.2570 inch holes, one inch deep for each weight. Tap hole for 5/16 - 18 UNC - 2B thread. Secure weights with screws (39) and lock washer (40). Trim balance to 0.5 inch-ounce by removing metal from steel core of main rotor subassembly (37).

r. Place rotor and shaft assembly (1) on a bench resting main rotor subassembly (37) on a cushion material to prevent damage. Allow hub (35) to hang over side of bench.

**NOTE**

Securing fan to shaft couplings is only to protect fan from damage and for ease of handling.

s. Position fan (6) on shaft couplings (5) and secure fan to shaft couplings with two suitable screws and nuts 180 degrees apart. Install fan (6), shaft couplings (5), retainer



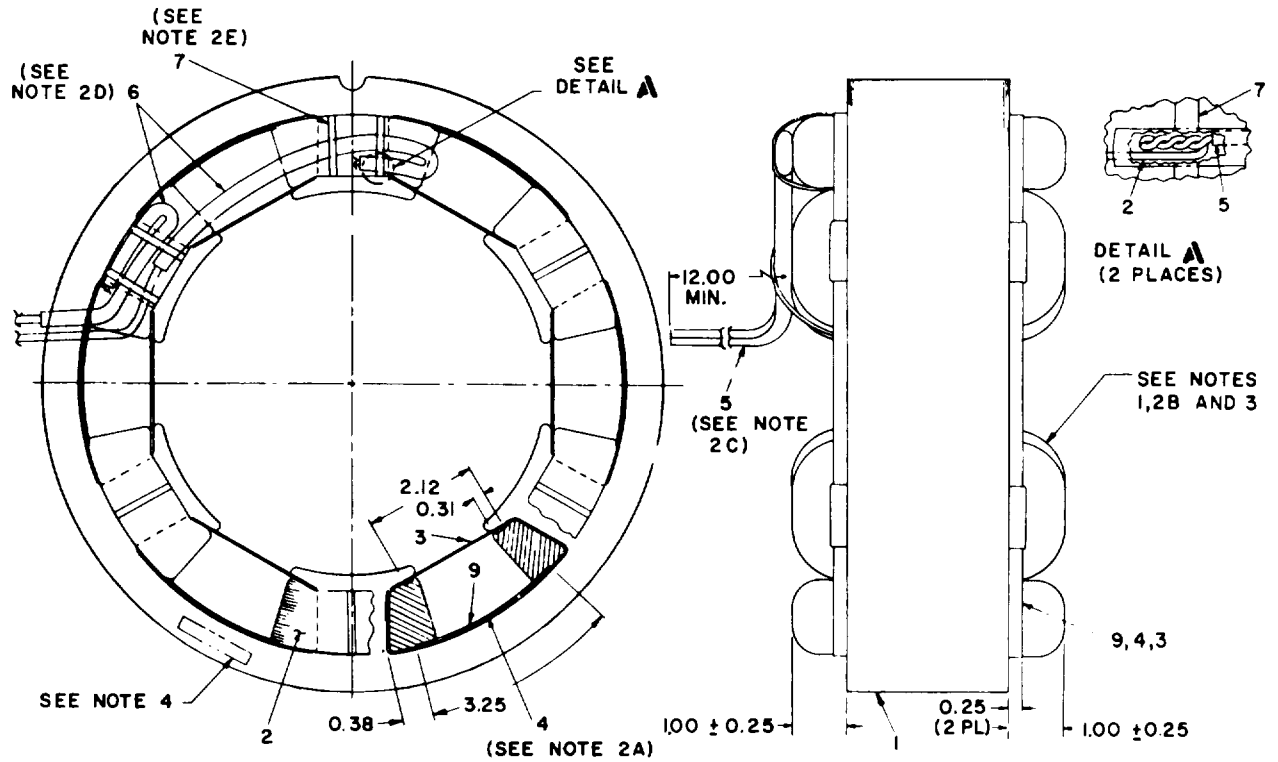
NOTES:

1. COIL DATA:
  - A. WIRE SIZE: 0.057 DIA (#15GA), CLASS 155, TYPE L2.
  - B. NUMBER OF POLES: 6
  - C. NUMBER OF TURNS PER COIL: 85
2. STATOR WINDING PROCEDURE:
  - A. INSULATE STATOR CORE, INDEX 1, COMPLETE USING INSULATION PLATE, INDEX 3, AND SLOT CELL INSULATION, INDEX 4 AND INDEX 9.
  - B. WIND STATOR COMPLETE, 6 COILS CONNECTED IN SERIES.
  - C. CONNECT LEADS, INDEX 5, TO COILS, SEE DETAIL A, HOMOGENEOUS WELD.
  - D. APPLY SLEEVING, INDEX 6.
  - E. TIE LEADS AND ENDLOOPS WITH TAPE, INDEX 7.
3. VARNISH, REFER TO FIGURE 7-2 NOTE 3.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT  
 30554 ASSY 70-4514  
 MFG (MFG CODE)
5. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS N AND R.

Figure 7-8. 50/60 Hertz generator, exciter stator rewind data

Legend to figure 7-8:

- |                                   |                                    |                                       |
|-----------------------------------|------------------------------------|---------------------------------------|
| 1. Stator core                    | 4. Slot cell insulation (6)        | 7. Untreated glass tape<br>0.010X0.75 |
| 2. Magnet wire<br>0.057 DIA (#15) | 5. Lead (2)                        | 8. Varnish                            |
| 3. Insulation plate (6)           | 6. Insulation sleeving<br>0.330 ID | 9. Slot cell insulation (6)           |



NOTES:

1. COIL DATA:
  - A. WIRE SIZE: 0.057 DIA (#15GA), CLASS 155, TYPE L2.
  - B. NUMBER OF POLES: 6
  - C. NUMBER OF TURNS PER COIL: 85
2. STATOR WINDING PROCEDURE:
  - A. INSULATE STATOR CORE, INDEX 1, COMPLETE USING INSULATION PLATE, INDEX 3 AND SLOT CELL INSULATION INDEX 4 AND INDEX 9.
  - B. WIND STATOR COMPLETE, 6 COILS CONNECTED IN SERIES.
  - C. CONNECT LEADS, INDEX 5, TO COILS, SEE DETAIL A, HOMOGENEOUS WELD.
  - D. APPLY SLEEVING, INDEX 6.
  - E. TIE LEADS AND ENDLOOPS WITH TAPE, INDEX 7.
3. VARNISH, REFER TO FIGURE 7-2 NOTE 3.
4. STAMP PART NUMBER AS SHOWN BELOW PER MIL-STD-130, 0.12 MIN HEIGHT, USING WHITE ENAMEL PAINT  
 30554 ASSY 70-4522  
 MFG (MFG CODE)
5. AFTER REWINDING, PERFORM INSPECTION SPECIFIED IN PARAGRAPH 7-5, STEPS N AND R.

Figure 7-9. 400 Hertz generator, exciter stator rewind data

Legend to figure 7-9:

- |                                   |                             |   |
|-----------------------------------|-----------------------------|---|
| 1. Stator core                    | 4. Slot cell insulation (6) | 7. Untreated glass tape<br>0.010 x 0.75 |
| 2. Magnet wire<br>0.057 DIA (#15) | 5. Lead (2)                 | 8. Varnish                              |
| 3. Insulation plate (6)           | 6. Insulation sleeving      | 9. Slot cell insulation (6)             |

(4), and clip locks (3) on shaft (42) and secure with screws (2), leaving two screws (2) 180 degrees apart out. Tighten screws to 50 foot-pounds torque. Insert two suitable lifting eyebolts into shaft hub.

t. Using a suitable lifting device and cable hook, position main stator and frame assembly (43) in a vertical position resting the end bell (67) on wooden blocks. Place blocks under the generator mounting plates (84) to prevent generator from tipping over.

#### CAUTION

Exercise extreme care when installing main rotor and shaft assembly into main stator and frame assembly to prevent damage to windings.

u. Connect suitable lifting device to lifting eyebolts in main rotor and shaft assembly (1) into main stator and frame assembly (43). Remove lifting device and lifting eyebolts. Install two remaining screws (2) and tighten screws to 50 foot-pounds torque. Bend up all corners of clip locks (3) to prevent screws from turning.

v. Connect a suitable block across engine mounting end of generator to hold main rotor and shaft assembly in center position and to prevent assembly from sliding out of frame when moving generator.

w. Lower generator to horizontal position. Place tag on generator stating fan is mounted to shaft coupling with shipping screws and nuts only. Remove screws and nuts prior to installation.

#### 7-8. HIGH POTENTIAL TEST.

Perform the high potential test as follows:

#### CAUTION

This test is applicable to new or rewound components only.

a. Isolate the generator and exciter armature and field windings from all external circuits including rotating rectifiers. Be sure generator frame and test apparatus are properly grounded to an external ground (in addition to unit frame). Connect one end of each armature winding together to form a single circuit for testing.

#### CAUTION

Ground generator and exciter field windings securely when testing generator armature windings.

b. Connect the high voltage lead from the test apparatus to the generator armature winding. Bring the voltage up to 1480 volts in not less than 10 seconds nor more than 30 seconds. Apply this voltage for one minute then gradually reduce to zero in not less than 5 seconds. Ground high voltage lead before removing to discharge winding.

#### CAUTION

Ground generator armature and exciter windings securely when testing generator field windings, Ground generator field and generator armature windings securely when testing exciter windings.

c. Repeat step b. for the generator field and exciter windings, except that the maximum voltage shall be between 1500 to 3500 volts.

d. Electrical windings shall be able to withstand the following 60 hertz voltages

applied for one minute between the windings 7-9. INSTALLATION.  
and ground.

Generator armature windings -1480 volts  
Generator field and exciter windings -  
1500 to 3500 Volta

Install the generator as specified  
in paragraph 2-7. ■



## CHAPTER 8

### ENGINE GROUP REPAIR INSTRUCTIONS

#### Section I. ENGINE COMPONENTS

##### 8-1. GENERAL.

The engine is a six cylinder, 4 cycle, turbo charged, overhead valve diesel. Components covered in this chapter, in addition to the basic engine, are those which are mounted on the engine block.

##### 8-2. REMOVAL.

Refer to paragraph 2-8 and remove the engine group.

##### 8-3. DISASSEMBLY.

a. Tag and remove all hydraulic and fuel lines from engine. Cap lines and plug all openings.

b. Refer to Operator and Organizational Maintenance Manual and remove the following.

1. Alternator and fan drive belts
2. Alternator assembly
3. Fuel day tank
4. Manual speed controls
5. Fuel filter and pump assembly, threaded spacers and adapter.
6. Starter motor

7. Lubricating oil filters
8. Secondary fuel filter and relief valve
9. Breather assembly
10. Hydraulic filter (precise sets only)
11. Atomizer tube, atomizer and bushing.
  - c. Remove oil pan shutoff cock.
  - d. Remove four screws and lockwashers securing two flywheel housing supports.
  - e. Remove components and disassemble engine as specified in subsequent sections of this chapter.

##### 8-4. REASSEMBLY.

- a. Replace components and reassemble engine as specified in subsequent sections of this chapter.
- b. Install two flywheel housing supports and secure with four screws and lockwashers.
- c. Install oil pan shutoff cock.
- d. Refer to Operator and Organizational Maintenance Manual and install the following.

1. Atomizer tube, atomizer and bushing.
2. Hydraulic filter (precise sets only).
3. Breather assembly.
4. Secondary fuel filter and relief valve.
5. Lubricating oil filters.
6. Starter motor.
7. Fuel filter and pump assembly, threaded spacers and adapter.
8. Manual speed controls.
9. Fuel day tank

## Section II. ENGINE HARNESS GROUP

### 8-6. GENERAL.

The engine wiring harness provides for electrical interconnection between the engine accessories and mode I or mode II relay box. The harness is connected to connector J5 of the mode I or mode H relay box (A27), J14 of high coolant temperature switch, J33 of day tank float switch, J35 of air cleaner indicator switch, J36 of day tank solenoid valve, J37 of speed switch, J38 of ether starting aid primer, J39 of DC control circuit breaker, J42 of low oil pressure switch, J43 of alternator, two oil pressure transmitters, coolant temperature transmitter, fuel level transmitter, fuel transfer pumps, engine shutdown solenoid valve, starter, and starter solenoid.

### 8-7. REMOVAL.

Refer to Operator and Organizational

10. Alternator assembly.
11. Alternator and fan drive belts.

e. Connect all hydraulic and fuel lines to engine.

f. Refer to Operator and Organizational Maintenance Manual and adjust fan and alternator belts, valve lash, and utility governor linkage. Service the engine and components.

### 8-5. INSTALLATION.

#### NOTE

If a complete overhaul or any major repair has been performed on the engine, refer to Section XXXI for engine test after overhaul.

Refer to paragraph 2-8 and install the engine group.

Maintenance Manual and remove the engine wiring harness.

### 8-8. CLEANING.

a. Clean wires with a clean lint free cloth.

#### WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

b. Remove dirt from connector pins using low pressure compressed air.

### 8-9. INSPECTION.

a. Inspect wiring for defective insulation, continuity, and proper connection.



b. Inspect electrical connectors for damaged threads; bent, loose, or missing pins; and for shorts to case and surrounding pins.

c. Inspect terminal lugs for security and condition.

d. Check each wire for continuity, refer to figure 8-1.

8-10. REBUILD.

Refer to figure 8-1 and rebuild engine wiring harness.

8-11. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install the engine wire harness.

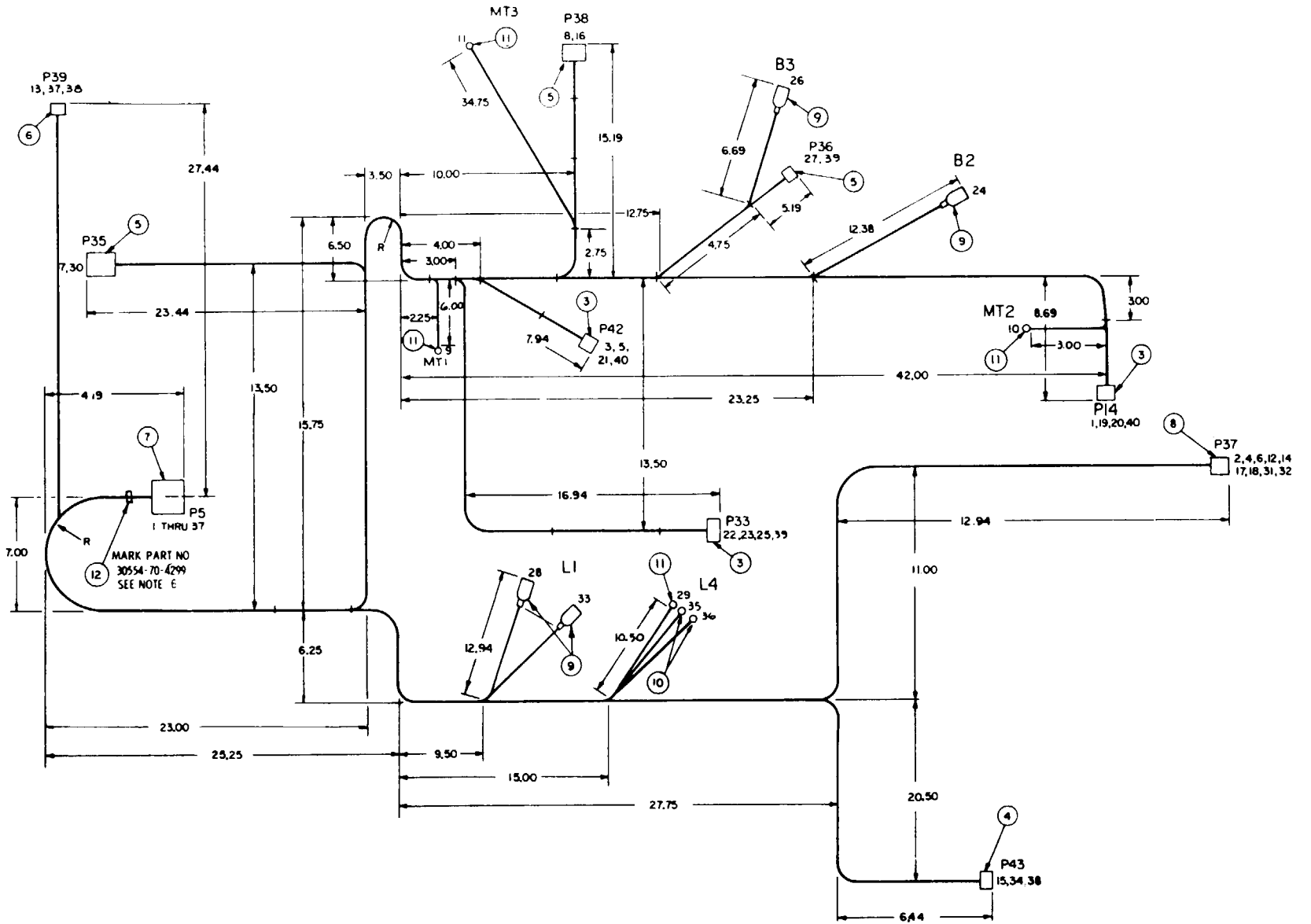


Figure 8-1. Engine wire harness (sheet 1 of 2)

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	RED	P207C16	P5-A	7	P14-B	3	105.00
2	RED	P202C16	P5-B		P37-J	8	87.50
3	RED	P201C16	P5-C		P42-D	3	67.00
4	RED	P44J16	P5-D		P37-A	8	85.50
5	RED	P58A16	P5-E		P42-C	3	70.00
6	RED	P81E16	P5-F		P37-D	8	86.00
7	RED	P198D16	P5-G		P35-A	5	68.00
8	RED	P46D16	P5-H		P38-A	5	76.00
9	RED	E39D16	P5-I		MT1	11	62.00
10	RED	E38D16	P5-J		MT2	11	103.00
11	RED	E37D16	P5-K		MT3	11	100.00
12	RED	P140K16	P5-L		P37-E	8	85.50
13	RED	P40F16	P5-M		P39-A	6	29.00
14	RED	P80H16	P5-P		P37-H	8	87.50
15	RED	P80J16	P5-R		P43-A	4	89.00
16	RED	P55H16	P5-S		P38-B	5	76.00
17	RED	P48A16	P5-U		P37-B	8	86.00
18	RED	P54A16	P5-V		P37-C	8	87.50
19	RED	P200K16	P5-W		P14-C	3	104.00
20	RED	P52A16	P5-Y		P14-D	3	103.00

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
21	RED	P200M16	P5-Z		P42-A	3	67.50
22	RED	P68A16	P5-b		P33-D	3	83.00
23	RED	P50Y16	P5-c		P33-C	3	85.00
24	RED	P51E16	P5-d		B2	9	82.00
25	RED	P50W16	P5-e		P33-A	3	85.50
26	RED	P51H16	P5-f		B3	9	94.50
27	RED	P55T16	P5-g		P36-B	5	76.50
28	RED	P55R16	P5-h		L1-1	9	62.00
29	RED	P41P16	P5-j		L4-1	11	74.00
30	RED	P50LL16	P5-k		P35-B	5	69.50
31	RED	P200R16	P5-m		P37-F	8	87.50
32	RED	P47K16	P5-n		P37-G	8	88.00
33	RED	P80K16	P5-p	7	L1-2	9	64.50
34	RED	P55N12	P5-t	7	P43-C	4	91.50
35	RED	P55D12	P5-u	7	B1	10	66.00
36	RED	P140D12	P5-w	7	L4-3	10	66.00
37	RED	P141B12	P5-z	7	P39-C	6	29.00
38	RED	P141A12	P43-B	4	P39-B	6	112.00
39	RED	P69A16	P33-B	3	P36-A	5	51.00
40	RED	P53A16	P42-B	3	P14-A	3	54.00

15			MS3367-1-9	43	STRAP, TIEDOWN		NYLON
14			SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	NOTE 2
13			MS3367-4-9	63	STRAP, TIEDOWN		NYLON
12			MS39020-2	1	BAND, MARKER		AL ALY
11			MS25036-108	4	TERMINAL, LUG, CRIMP STYLE		
10			MS25036-158	2	TERMINAL, LUG, CRIMP STYLE		
9			MS27144-2	4	CONNECTOR ASSEMBLY, MALE		
8			MS3106R18-1S	1	CONNECTOR, PLUG		
7			MS3106R36-7S	1	CONNECTOR, PLUG		
6			MS3106R16-10S	1	CONNECTOR, PLUG		
5			MS3106R10SL-4S	3	CONNECTOR, PLUG		
4			MS3106R18-5P	1	CONNECTOR, PLUG		
3			MS3106R14S-2S	3	CONNECTOR, PLUG		
2			MS086/2-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
FIND NO.	CODE IDENT	QWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

NOTES

- ALL CONDUCTOR ENDS TO BE STRIPPED BACK 0.25 INCH AND TINNED BEFORE ASSEMBLY.
- USE SOLDER, FIND NO. 14
- CABLE STRAPS, FIND NO. 13 AND 15, SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
- WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088 EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
- A. TRUNK BENDS TO BE 2.00 RADIUS EXCEPT WHERE OTHERWISE SPECIFIED.  
 B. BREAKOUTS TO BE 1.00 RADIUS.
- PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 8-1. Engine wire harness (sheet 2 of 2)

Section III. ALTERNATOR

8-12. GENERAL.

The alternator is a 24 volt, negative ground system incorporating a voltage regulator and voltage protector. It is driven by the fan pulley via the alternator drive belt. The alternator provides power for charging the batteries and operation of direct current components of the generator set.

8-13. REMOVAL.

Refer to Operator and Organizational Maintenance Manual, and remove the alternator.

8-14. DISASSEMBLY.

Refer to figure 8-2, and disassemble alternator in the order of index numbers assigned. Pay particular attention to the following:

NOTE

Tag electrical leads before removing to facilitate reassembly.

CAUTION

To prevent damage to stator windings or laminations, do not insert sharp tools between stator and housing.

a. When removing front and rear bearings (47 and 49) from rotor assembly shaft (42), make sure puller contacts inner bearing race only.

NOTE

Remove retaining ring in front housing. Refer to figure 8-2 view A and B.

CAUTION

To prevent overheating and possible damage to rectifier diodes (37 and 38) when unsoldering, grasp diode connection terminal with long nose pliers, between soldering iron and diode.

b. To prevent rotor shaft assembly (51) from turning when removing nut (40), wrap an oversize belt around pulley. Clamp pulley in vise while removing rotor shaft from pulley.

8-15. CLEANING.

CAUTION

Do not immerse alternator assembly in cleaning solvent of any kind. Do not clean isolation diodes (22) with cleaning solvent. The diodes are coated with a special corrosion resistant paint.

WARNING

Dry cleaning solvent, P-D-680, Type II, is flammable and moderately toxic to the skin, eyes and respiratory tract. Skin, eye and respiratory protection is required.

a. Clean parts with a soft bristle brush moistened with cleaning solvent, Federal Specification P-D-680, Type 11.

WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

b. Dry parts with filtered low pressure compressed air or a clean lint-free cloth .

8-16. INSPECTION.

a. Inspect brush assembly (29, figure 8-2) for excessive wear, replace brush assembly if 3/16 of an inch or less extends beyond bottom of holder.

b. Check brush assembly (29) spring tension with suitable spring scale. Spring tension should be 4 to 6 ounces.

c. Test rectifier diodes (37 and 38) in heat sinks connecting one of multimeter leads to the heat sink and the other multimeter lead to the diode stem, and note the reading. Then reverse the multimeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading.

d. Test isolation diode assembly (22) by connecting one of the multimeter test leads to the output terminal stud of the diode, the other to the exposed metal area on heat sink, and note reading. Then reverse the lead connections and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading.

e. Test stator assembly (39) for grounds and opens as follows:

NOTE

These tests may be made with the stator leads disconnected from the diodes, or with the stator leads connected to the diodes provided all the diodes are in good condition. Scrape enough insulation from the leads to insure good contact with the test prods.

1. Connect the multimeter to two pairs of stator leads. Use a multimeter and set to the lowest range scale on the multimeter. If either reading is very high (infinite) the stator winding is open.

2. To test the stator for grounds, connect the multimeter from any stator lead to the ground screw or the shell, and note the reading. Then reverse the multimeter lead connections, and note the reading. If both readings are very low, the stator is grounded.

f. Test rotor assembly (51) or grounded slip ring, using a multimeter. No circuit from either slip ring to shaft is correct condition.

g. Perform resistance check on rotor assembly (51) windings using a multimeter. Resistance should be between 11 to 14 ohms.

h. Test voltage regulator (25) by connecting multimeter leads to regulator leads as follows: (See figure 8-3).

1. Multimeter lead (+) to regulator lead yellow, multimeter lead (-) to regulator lead red. Multimeter should indicate 300 to 350 ohms.

2. Multimeter lead (+) to regulator lead red, multimeter lead (-) to regulator lead yellow, multimeter should indicate open circuit.

3. If above readings are not obtained, replace regulator.

i. Inspect fan (43) for cracked or broken fins. Check fan bore for wear.

j. Inspect pulley (42) for worn drive surfaces and condition of key groove. Check pulley bore for wear.

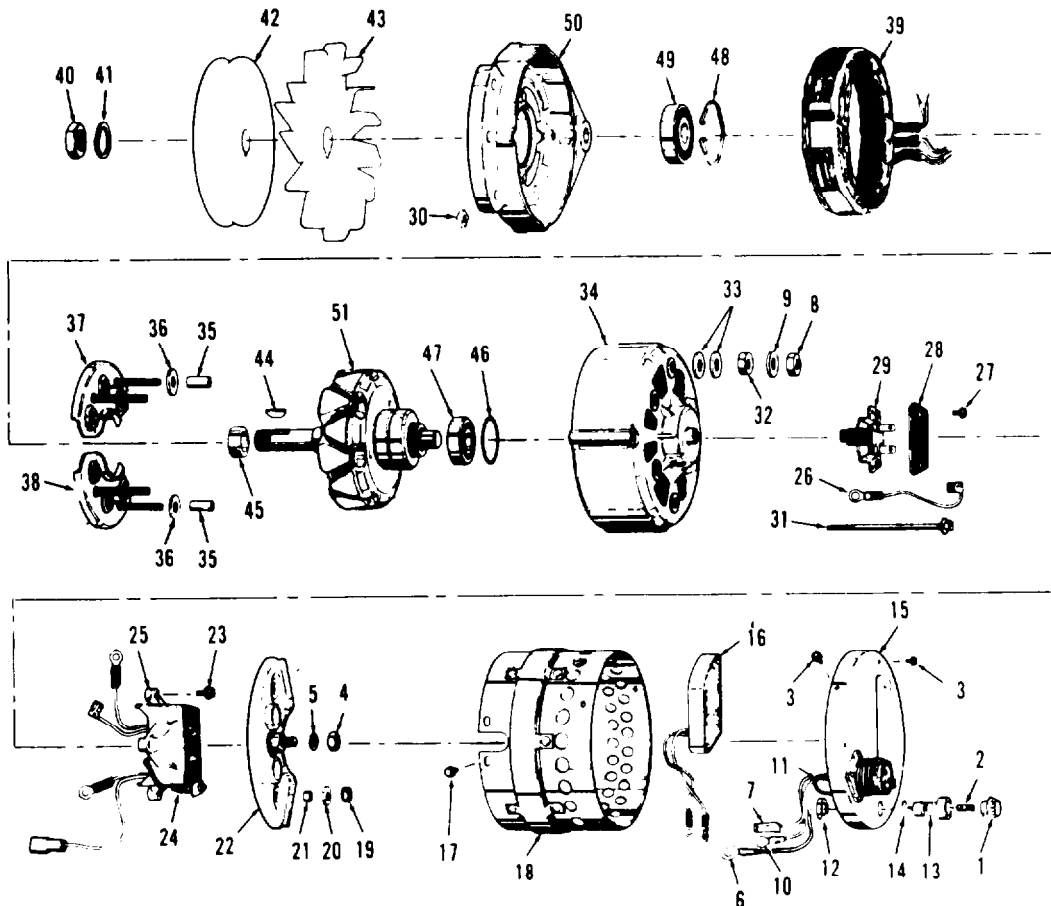


Figure 8-2. Alternator assembly, exploded view (sheet 1 of 2)

- |                                  |                              |   |
|----------------------------------|------------------------------|---|
| 1. Cap                           | 19. Nut (2)                  | 36. Washer (4)                          |
| 2. Fuse (40 amp)                 | 20. Washer (2)               | 37. Rectifier diode assembly (positive) |
| 3. Screw (5)                     | 21. Sleeve (2)               | 38. Rectifier diode assembly (negative) |
| 4. Nut                           | 22. Isolation diode assembly | 39. Stator assembly                     |
| 5. Washer                        | 23. Screw (3)                | 40. Nut                                 |
| 6. Connector (red)               | 24. Voltage adjust rheostat  | 41. Lock washer                         |
| 7. Connector (yellow)            | 25. Voltage regulator        | 42. Pulley                              |
| 8. Nut (2)                       | 26. Cable                    | 43. Fan                                 |
| 9. Washer (2)                    | 27. Screw (2)                | 44. Key                                 |
| 10. Connector (black)            | 28. Cover                    | 45. Spacer                              |
| 11. Connector (black)            | 29. Brush assembly           | 46. Retaining ring                      |
| 12. Nut                          | 30. Nut (4)                  | 47. Rear bearing                        |
| 13. Receptacle                   | 31. Bolt (4)                 | 48. Retaining ring                      |
| 14. Gasket                       | 32. Nut (4)                  | 49. Front bearing                       |
| 15. Cover and connector assembly | 33. Washer (8)               | 50. Front bearing                       |
| 16. Circuit protector            | 34. Rear housing             | 51. Rotor assembly                      |
| 17. Screw (8)                    | 35. Sleeve (4)               |   |
| 18. Housing shield assembly      |                              |   |

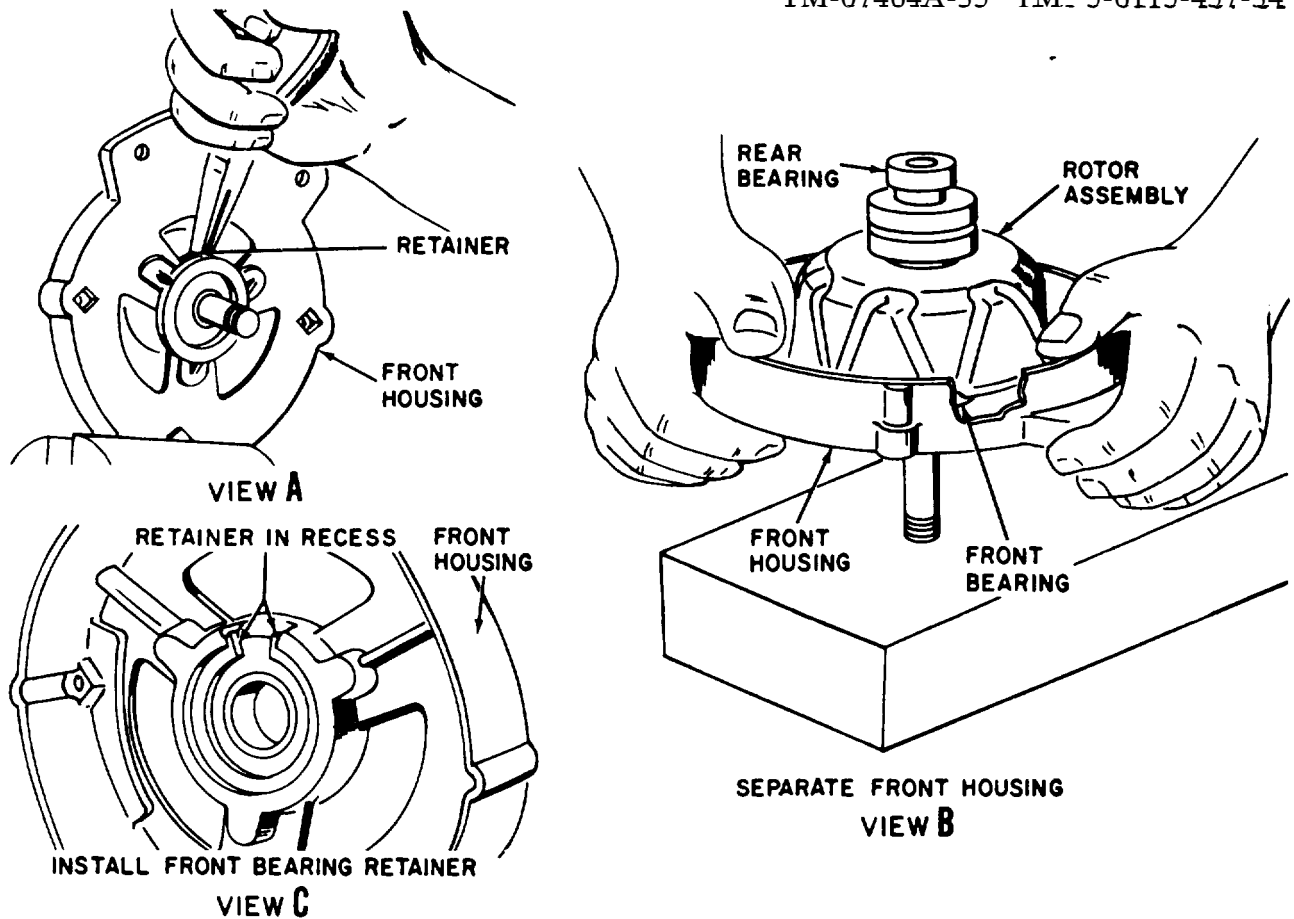


Figure 8-2. Alternator assembly, exploded view (sheet 2 of 2)

k. Inspect front bearing cavity for evidence of wear. Check condition of retainer recess.

l. Check slip rings for pitting, roughness or burned spots. If surface is worn beyond repair, replace entire rotor assembly (42).

m. Inspect rotor shaft for key slot wear, worn bearing surfaces, scuff marks on pole fingers, and condition of threads on pulley nut.

n. Inspect bearings (47 and 49) for scored, pitted, scratched, cracked or chipped races.

#### 8-17. REPAIR.

#### CAUTION

Do not attempt to turn slip ring in a lathe.

a. Slip rings may be cleaned up by cleaning contacting surfaces with a fine crocus cloth. Carefully wipe dust and residue away after cleaning.

b. Repair minor thread damage on rotor shaft using a suitable thread chaser.

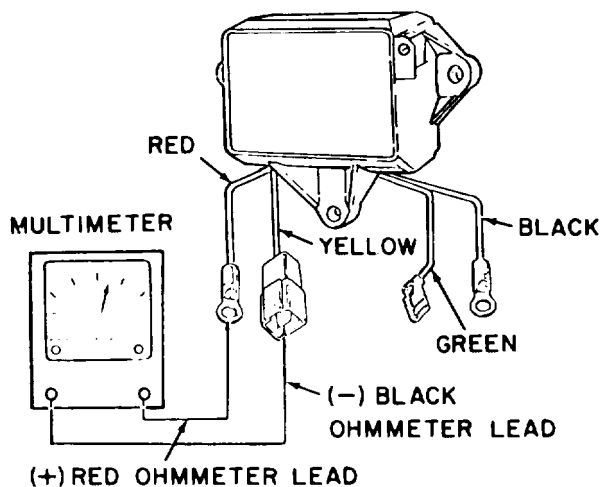


Figure 8-3. Voltage regulator excitation circuit test

8-18. REASSEMBLY.

Refer to figure 8-2 and reassemble alternator in the reverse order of index numbers assigned. Pay particular attention to the following:

**NOTE**

Refer to schematic wiring diagram figure 8-4 when connecting electrical leads.

**CAUTION**

To prevent overheating and possible damage to rectifier (37 and 38) diodes when soldering, grasp diode connection terminal with long nose pliers between soldering iron and diode.

a. When installing rear and front bearings (47 and 49) on shaft, use hollow sleeve the same diameter of inner races and press bearings on rotor assembly shaft (51). Install front bearing retainer (48, VIEW c).

b. Tighten through bolts (31) evenly.

c. Spin rotor by hand and check freedom of rotation.

d. Tighten pulley nut (40) from 35 to 50 foot pounds torque.

8-19. TEST AND ADJUSTMENT.

a. Voltage Regulator Setting Test.

1. Equipment required

(a) Variable speed drive (2000 to 3000 RPM).

(b) Resistor (1/4 ohm 500 watt).

(c) DC voltmeter (0 to 50 volt scale).

(d) Two 12 volt batteries.

(e) Jumper 12 inches long, No. 8 wire with two alligator clips.

(f) Mating plug for alternator receptacle, to be wired as shown in figure 8-4.

2. Connect circuit as shown in figure 8-5.

**CAUTION**

Alternator must be driven in direction of arrow on rear cover (15, figure 8-2).

3. Connect alternator to variable speed drive by means of a suitable belt and pulley combination.

4. Run alternator up to a speed between 2000 to 3000 RPM. Connect jumper wire across 1/4 ohm resistor. Run alternator under these conditions for a warm up period of at least 10 minutes.



5. Remove jumper from across 1/4 ohm resistor and record voltage reading. Nominal voltage should be  $28 \pm 3$  volts at 75 °F ambient. If nominal voltage is not indicated, adjust voltage adjust rheostat (19, figure 8-2) on voltage regulator, which is accessible through rear cover (8) of alternator, Increase voltage by rotating in a clockwise direction.

6. If nominal voltage can not be obtained, shut down alternator test. Replace voltage regulator and repeat test.

b. Alternator Output Test.

1. Equipment required in addition to equipment listed in step a.

(a) Carbon pile (0 to 600 ampere load capacity).

(b) Ammeter (0 to 50 ampere scale).

(c) Jumper lead and 1/4 ohm resistor not used in this test.

2. Connect circuit as shown in figure 8-6.

CAUTION

Alternator must be driven in direction of arrow (shown on rear cover 15, figure 8-2).

NOTE

Make sure drive belt has a midway deflection of 9/16 to 13/16 of an inch.

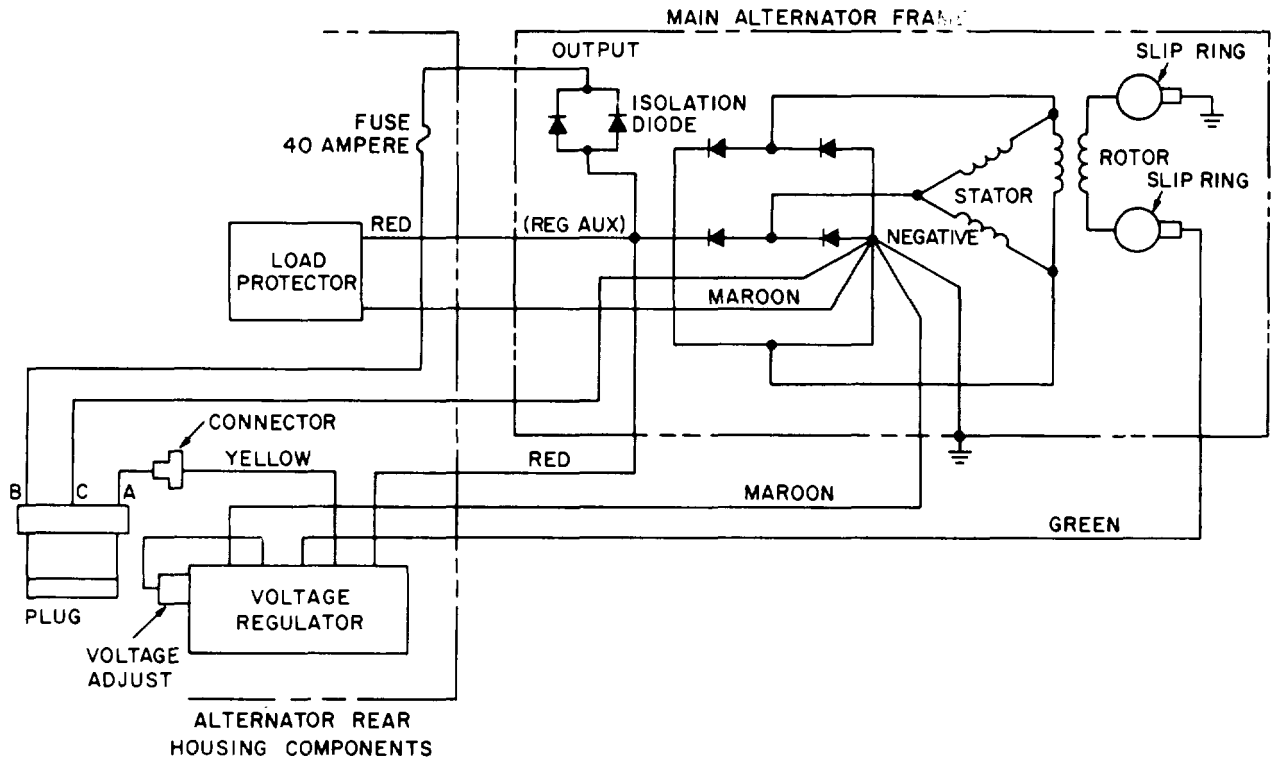
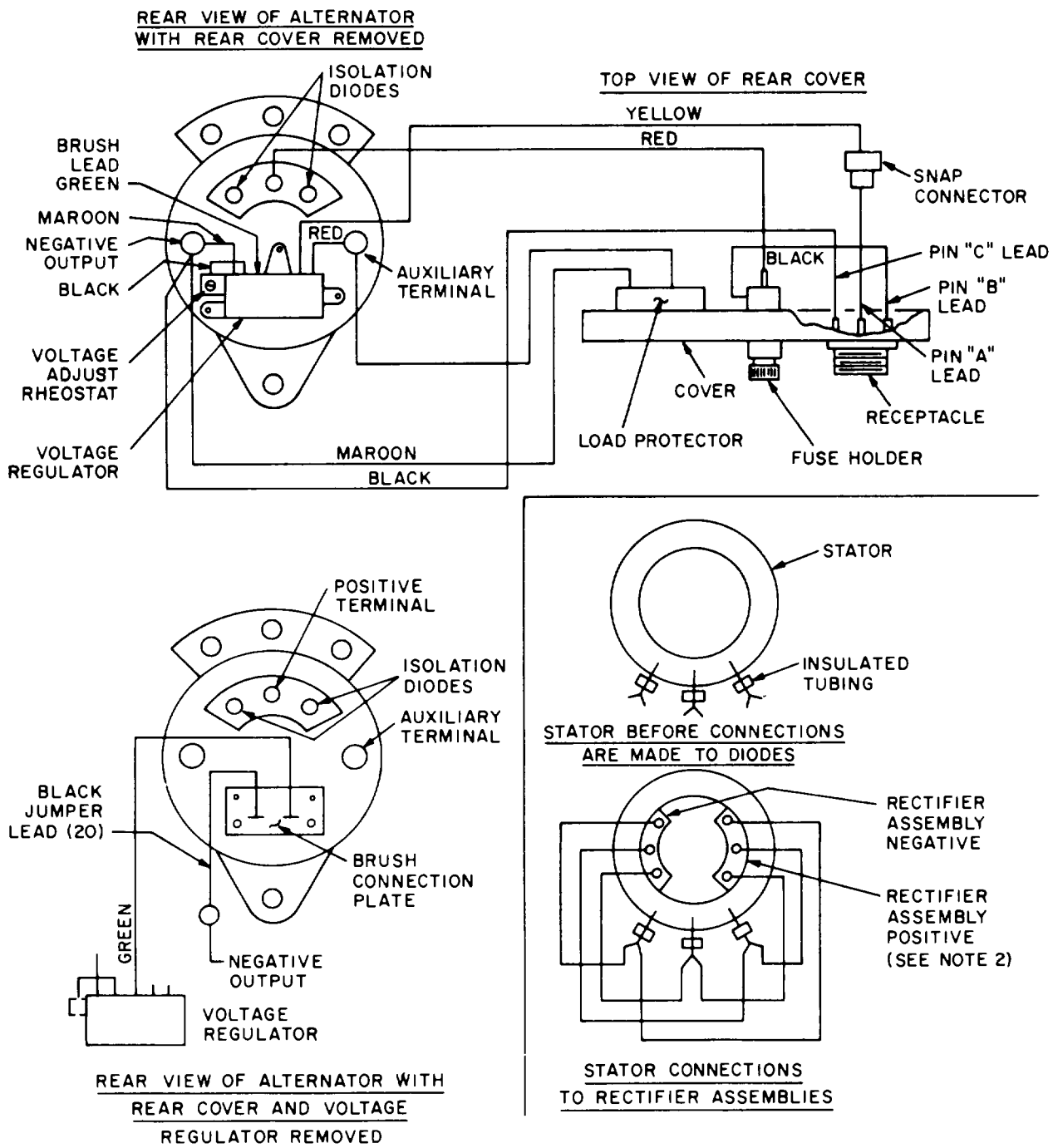


Figure 8-4. Alternator schematic and wiring diagram (sheet 1 of 2)



NOTE :

1. THESE TWO LEADS MAYBE CONNECTED TO ANY DIODE ON A RECTIFIER ASSEMBLY PROVIDING ONE DIODE IS ON THE POSITIVE HEATSINK AND THE OTHER DIODE IS ON THE NEGATIVE HEATSINK. THE SAME APPLIES TO THE OTHER TWO SETS OF LEADS.

2. POSITIVE RECTIFIER ASSEMBLY CAN BE IDENTIFIED BY RED LETTERING ON UNDERSIDE OF THE THREE DIODES.

Figure 8-4. Alternator schematic and wiring diagram (sheet 2 of 2)

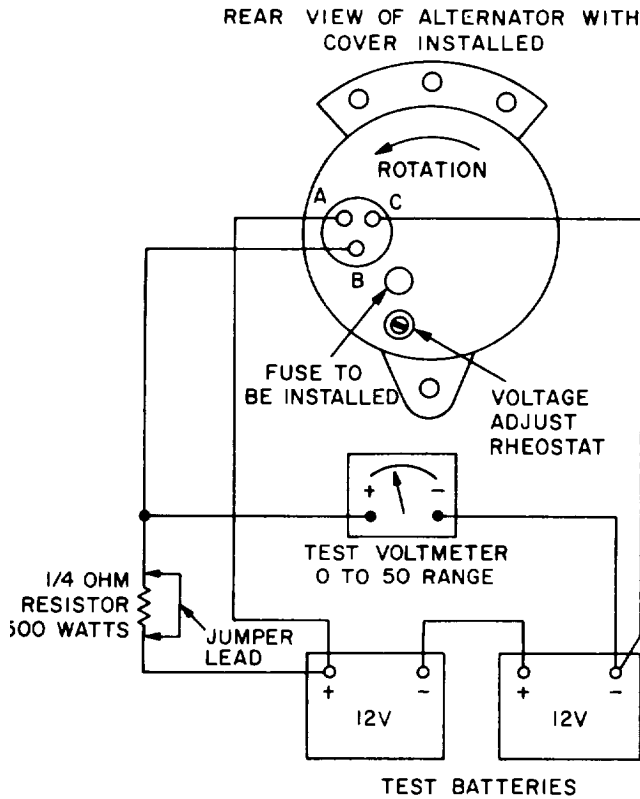


Figure 8-5. Voltage regulator setting test

3. Run alternator up to a speed of approximately 1500 RPM. Adjust carbon pile by slowly applying load across battery until test ammeter indicates a 10 ampere charging current. Allow alternator to run at this speed for at least 5 minutes to stabilize component temperatures.

4. Increase variable drive speed to 2500 RPM. Increase carbon pile load on battery causing alternator to deliver its maximum current capacity indicated on test ammeter.

5. Record maximum current obtained. Record voltmeter reading at maximum current condition.

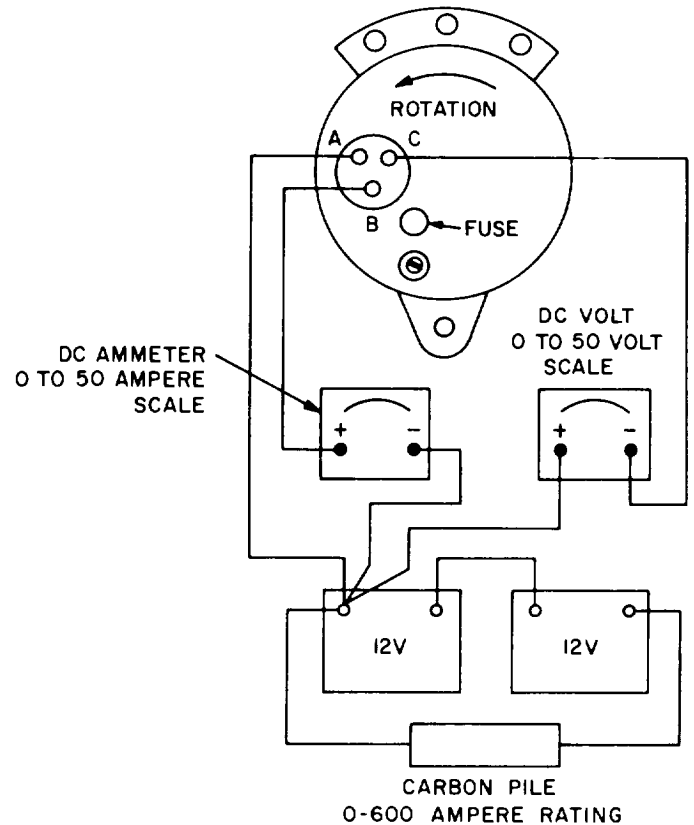


Figure 8-6. Alternator output test

6. Shut down alternator and disconnect carbon pile from across batteries immediately to prevent discharging batteries.

7. Nominal output current should be 20 to 25 amperes at 75° F ambient. This current output of 20 to 25 amperes should be obtained with test voltmeter indicating 26 to 30 volts.

8. If nominal current of 20 to 25 amperes can not be obtained, check drive belt for proper tension. If drive belt has a midway deflection of 9/16 to 13/16 of an inch, then disassemble alternator and inspect (para 8-16).

## 8-20. INSTALLATION

Refer to Operator and Organizational Maintenance Manual, and install the alternator.

#### Section IV. STARTING MOTOR

##### 8-21. GENERAL.

The starting motor is mounted to the flywheel housing. It consists of a frame and field assembly, armature head assembly, intermediate housing assembly, brush assembly starter drive, pinion housing assembly, and a solenoid switch. The starting motor is a heavy-duty type that is completely sealed with gaskets, preformed packings and an oil seal. The solenoid is mounted on the outside of the frame with the solenoid plunger and pinion engagement mechanism totally enclosed. The starting motor converts electric al energy from the batteries into mechanical energy to turn the engine over for starting.

##### 8-22. REMOVAL.

Refer to Operator and Organizational Maintenance Manual, and remove the starting motor.

##### 8-23. DISASSEMBLY.

Refer to figure 8-7 and disassemble starting motor in the order of index numbers assigned. Pay particular attention to the following:

- a. Before separating the intermediate housing (34) and pinion housing (2), scribe or center punch locating marks to insure proper reassembly.
- b. Bearings (3, 36, and 49) are press fitted.
- c. Scribe or center punch locating mark before separating head assembly (48) and frame on field assembly (53).

##### 8-24. CLEANING .

###### CAUTION

To prevent damage to brushes, do not allow dry cleaning solvent to come in contact with brushes.

- a. Clean brushes with a clean, dry cloth only.
- b. Clean electrical components with a clean lint free cloth moistened with an approved cleaning solvent and dry thoroughly.
- c. Clean metal parts with a clean cloth moistened with an approved cleaning solvent and dry thoroughly.

###### WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

###### CAUTION

Do not use emery cloth to clean commutator.

- d. Remove loose particles from armature with compressed air and wipe with a clean lint free cloth moistened with dry cleaning solvent. Clean commutator lightly with No. 00 sandpaper and remove all traces of dust using low-pressure compressed air.

##### 8-25. INSPECTION.

- a. Refer to table 1-1 and inspect parts for dimensional tolerances.
- b. Inspect housings and commutator end head, pinion teeth and splines for scratches, burrs, nicks and cracks.
- c. Inspect bearings for discoloration, rough spots, score marks, scratches and nicks.

d. Inspect threaded parts for thread damage.

e. Inspect commutator on armature (40, figure 8-7) for rough spots, discoloration, pitting, scoring, and high mica.

f. Inspect armature shaft (40) for pitting, scoring, or excessive wear. Inspect starter drive (27) for broken teeth on pinion. Check to see that starter drive (27) clutch assembly moves on armature shaft (40) to see if splines fit properly.

g. Inspect solenoid switch (19) parts. Check condition of moving core and sealing boot. Check connector (17) and terminal studs to see if they are burned, eroded, or pitted excessively.

h. Using a suitable spring scale, check brush springs (58) tension. Tension should be 50 to 60 ounces.

i. Refer to Appendix A for Electric Motor and Generator Repair Manual, and check armature and field coils for shorts, open circuits, and grounds. Check armature for shorts using a suitable growler.

#### 8-26. REPAIR.

a. Refer to Appendix A for Electric Motor and Generator Repair Manual for general repair instructions.

b. Remove minor nicks and burrs from housings, commutator end head, pinion teeth and splines using a suitable hone.

c. Replace discolored, spotted or scored bearings. Remove minor nicks and scratches from bearings using crocus cloth dipped in an approved cleaning solvent.

d. Repair minor thread damage using a suitable thread chaser.

#### NOTE

Armature must be replaced if commutator diameter is not within limits specified in table 1-1 after repair.

e. Repair commutator on armature (40, figure 8-7) by turning it down using a suitable lathe. Take light cuts until all defects are removed. Remove all burrs by holding No. 00 sandpaper lightly against commutator. Undercut mica to a depth of 1/32 of an inch using a suitable mica under-cutter.

f. Replace parts that are not within dimensional tolerances specified in table 1-1.

#### 8-27. REASSEMBLY.

Refer to figure 8-7 and reassemble starting motor in the reverse order of index numbers assigned. Pay particular attention to the following:

a. When installing new bearings (3, 36 and 49), always use proper bearing arbor to obtain a proper fit. Remove wick from pinion housing (2), intermediate housing (34), and head assembly (48) reservoirs before installing a new bearings (3) (36), and (49). After new bearing installation, saturate felt wicks with SAE 10 oil, install wicks in reservoirs and fill reservoirs with SAE 10 oil.

b. Lubricate packings (5 and 37) with a film of light grease MIL-G-23827 to prevent damage during reassembly.

c. Lubricate armature (40) bearing surfaces on shaft with SAE 10 oil. Lubricate shaft and splines under starter drive (27) with grease that conforms to Military Specification MIL-G-23827.

d. Install armature (40) and seat brushes (56) as follows:

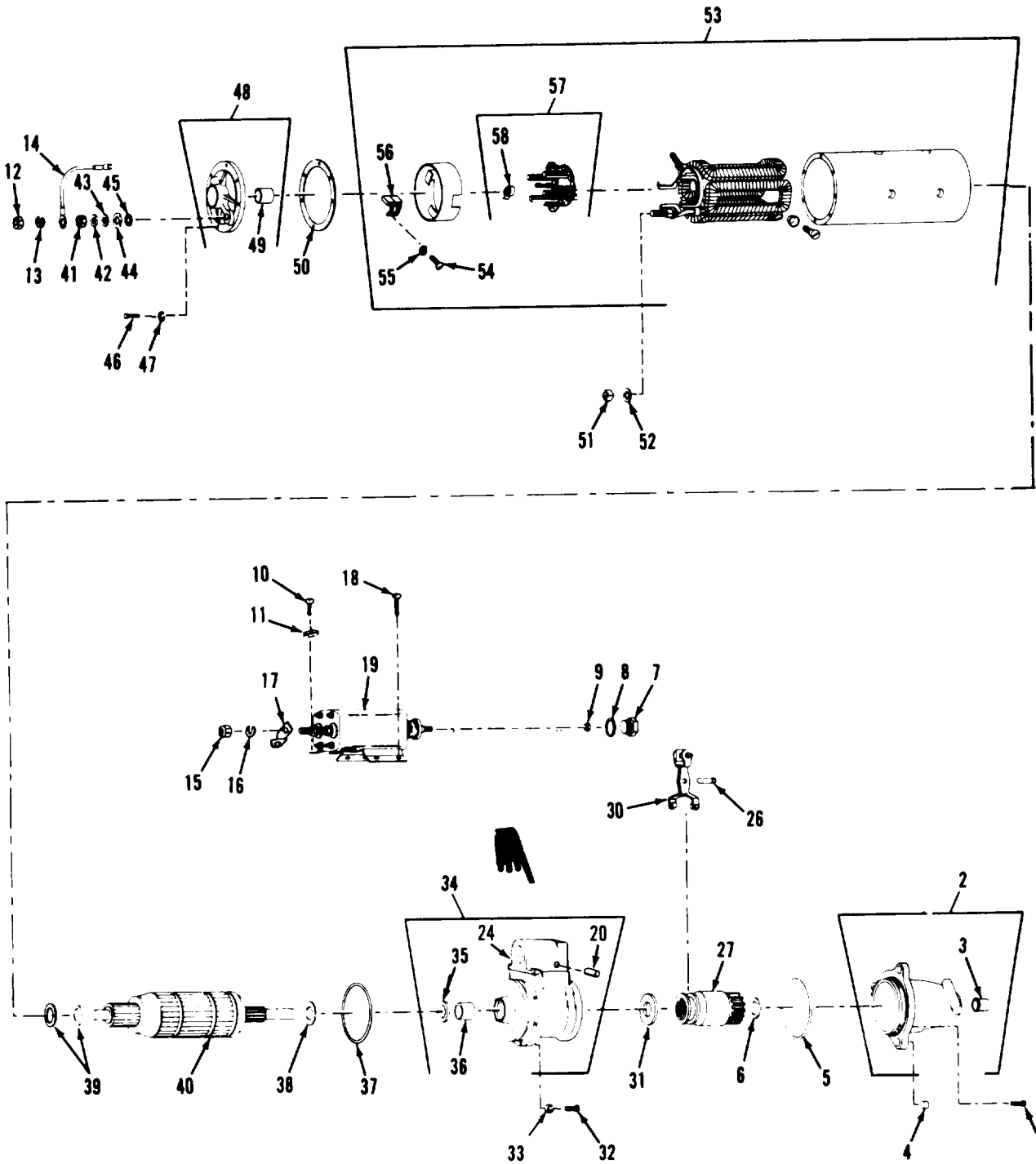


Figure 8-7. Starter motor, exploded view

Legend to figure 8-7:

- |                     |                              |
|---------------------|------------------------------|
| 1. Screw (6)        | 30. Yoke assembly            |
| 2. Pinion housing   | 31. Washer                   |
| 3. Bearing          | 32. Screw (7)                |
| 4. Plug (6)         | 33. Lock (7)                 |
| 5. Packing          | 34. Intermediate housing     |
| 6. Thrust washer    | 35. Seal                     |
| 7. Plug             | 36. Bearing                  |
| 8. Gasket           | 37. Seal                     |
| 9. Nut              | 38. Thrust washer            |
| 10. Screw           | 39. Thrust washer (4)        |
| 11. Clip            | 40. Armature                 |
| 12. Nut             | 41. Nut                      |
| 13. Lock washer     | 42. Washer                   |
| 14. Lead assembly   | 43. Insulating washer        |
| 15. Nut             | 44. Cap washer               |
| 16. Lock washer     | 45. Washer                   |
| 17. Connector       | 46. Screw (7)                |
| 18. Bolt (4)        | 47. Lock (7)                 |
| 19. Solenoid switch | 48. Head assembly            |
| 20. Pin             | 49. Bearing                  |
| 21. Deleted         | 50. Gasket                   |
| 22. Deleted         | 51. Bushing                  |
| 23. Deleted         | 52. Insulating washer        |
| 24. Yoke cover      | 53. Frame and field assembly |
| 25. Deleted         | 54. Screw (3)                |
| 26. Pin             | 55. Washer (3)               |
| 27. Starter drive   | 56. Brush (8)                |
| 28. Deleted         | 57. Brush plate (8)          |
| 29. Deleted         | 58. Spring                   |

1. Install armature (40) in frame and field assembly (53) until armature (40) commutator contacts brushes (56).

2. Raise brushes (56), until brushes are seated on armature (40) commutator.

3. Cut a strip of No. 00 sandpaper the width of the armature (40) commutator. Install sandpaper on armature (38) commutator with sand side out by raising brushes (56) and slipping sandpaper between armature (40) commutator and brushes (56).

Brushes (56) must lie flat against sandpaper on armature (40) commutator to obtain desired brush (56) seat contour.

4. Install armature (40) head assembly (48) on frame field assembly (53).

5. Carefully rotate armature (40) in a counterclockwise direction three to five revolutions to properly seat all brushes (56).

6. Remove head assembly (48). Lift all brushes (56) and inspect seat contour

to determine whether or not sanding operation is satisfactory. A satisfactorily seated brush (56) should show evidence of contact on at least 85 percent of its length and 100 percent of its thickness.

7. Lift brushes (56) and remove sandpaper from armature (40) commutator.

WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

8. Remove armature (40) from frame and field assembly (53). Clean armature (40), brushes (56) and frame and field assembly (53). Blow out sanding dust using compressed air.

9. Coat shaft and splines on armature (40) with grease MIL-G-23827. Install armature (40) (steps 1. and 2. above).

e. When assembling intermediate and pinion housing assemblies (2 and 34), torque hex head screws (1) to 8 foot pounds. Make sure locating marks are aligned.

WARNING

Sealant, Glytal is moderately toxic to eyes, skin and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

f. After assembly, the insulation on both terminal studs on frame and field assembly (53) should be coated with glytal sealant. Keep sealant off of contact surfaces of terminal studs and nuts.

8-28. TESTING. (See figure 8-8).

a. The following equipment will be required to perform the starter tests:

1. Two 12 volt batteries - 4 batteries will be required if stall torque is to be performed.
2. D.C. voltmeter (0 to 50 volt scale).

3. D.C. ammeter (0 to 500 amp scale).
4. Carbon pile (0 to 600 amp capacity).
5. Spring scale (0 to 50 lb scale).
6. Pony brake arm 12 inch long.
7. Hand held tachometer -0-10,000 RPM.

CAUTION

Never operate the starter motor more than 30 seconds at a time during test. Allow the motor to cool for at least 2 minutes between each crank cycle.

b. No load test.

1. Connect no load current test setup as shown in view A.

2. Adjust carbon pile to obtain a voltage of 22 volts. Current drain should be 90 amperes (maximum) at 7000 RPM.

3. Apply rubber tip of hand held tachometer to end of shaft in drive housings to read RPM.

4. If current is too high, check bearing alignment end play. Two or three sharp raps with a rawhide hammer while motoring will often help align bearings and free armature.

c. SOLENOID WINDING TEST.

1. Make solenoid winding test setup as shown in view B.

2. Test current draw and make ground and open test on winding. Series winding values at 70°F should be 23.2 to 26.6 amperes at 12.9 volts. Shunt winding values at 70° F should be 4.1 to 4.8 amperes at 12.9 volts. Adjust carbon pile to obtain 12.9 volts.



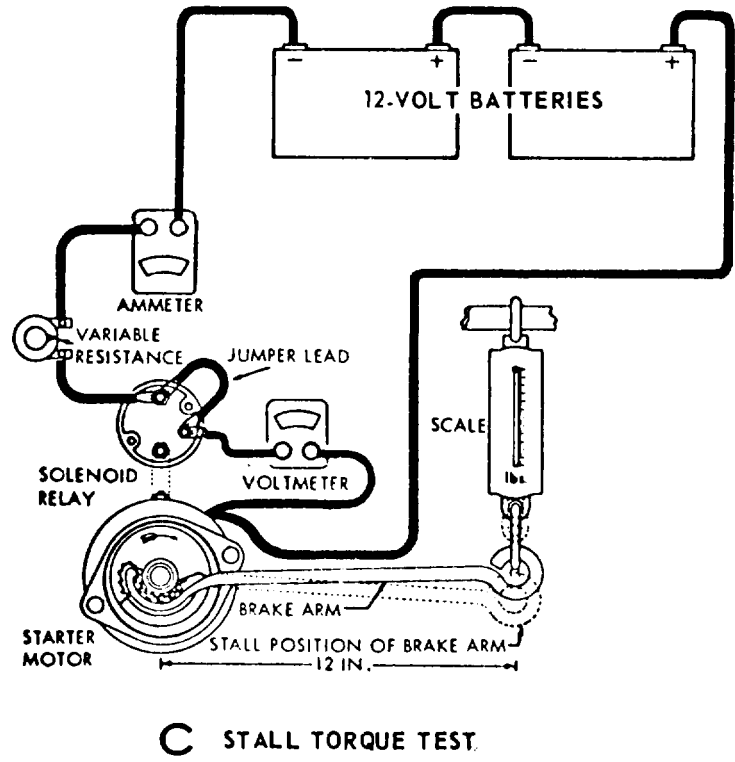
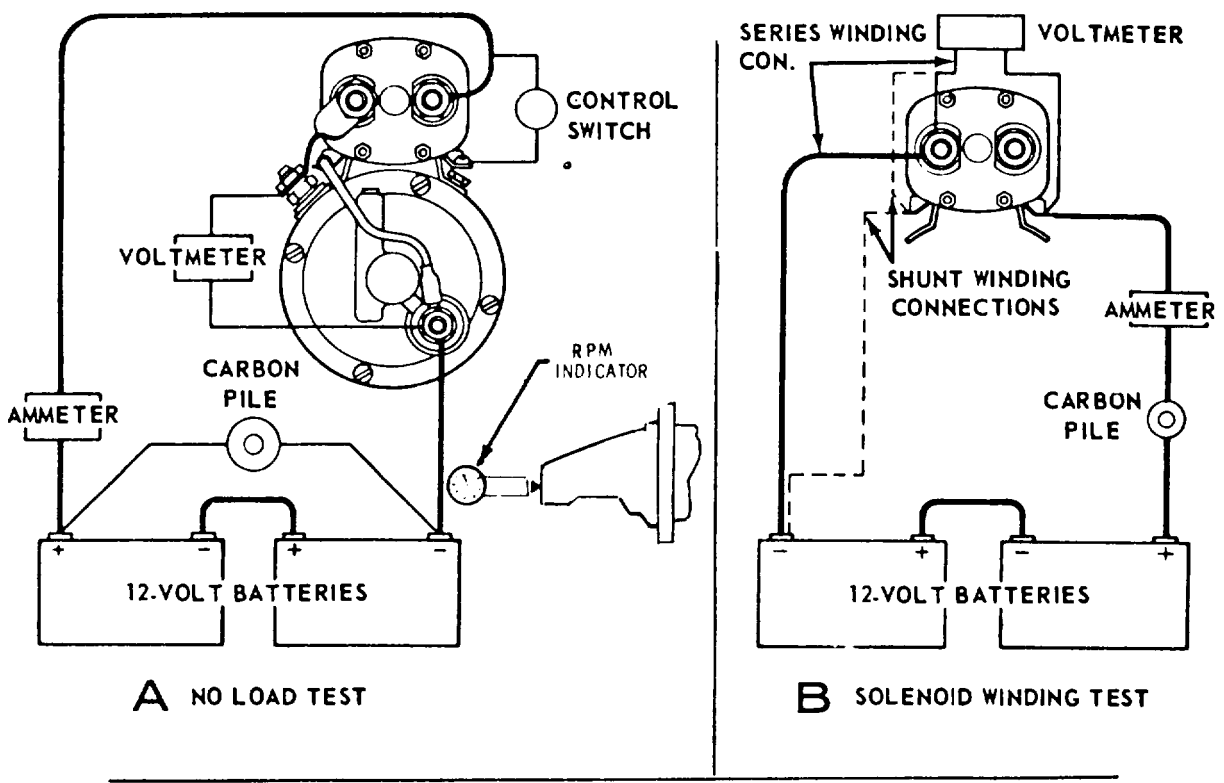


Figure 8-8. Starting motor, test setup

d. STALL TORQUE TEST.

1. Make stall torque test setup as shown in view C.

2. The solenoid winding shall be activated with a separate battery.

3. Stall torque test values should be 4.9 volts, 400 amperes (maximum), and 22.0 foot pounds (minimum). Adjust variable resistance to obtain 4.9 volts at 400 amperes,

4. If stall torque values are too low, check armature, brush spring tension, contact area, and switch contacts. If these components are not at fault, replace entire starting motor.

e. ARMATURE END PLAY ADJUSTMENT. Adjust end play to 0.005 to 0.030 inches by adding or removing thrust washers on commutator end of armature shaft.

f. PINION POSITION ADJUSTMENT (See figure 8-9). This adjustment assures correct relation between solenoid and indexing drive assembly. If adjustment is not correct, damage may result to drive gear and/or flywheel ring gear.

WARNING

When connecting lead-acid batteries connect positive terminal first.

1. Connect a 12-volt battery as shown in view A.

2. Momentarily touch the jumper lead between terminal stud of solenoid and terminal stud in commutator and head. This will shift solenoid and drive solenoid and drive assembly into cranking position until battery is disconnected,

3. Push drive assembly toward commutator end of motor to eliminate any Slack movement in linkage.

WARNING

When disconnecting batteries (lead-acid) disconnect negative terminal first.

4. Measure distance between outside edge of drive sleeve and thrust washer as shown in view B. This distance should be 0.020 to 0.050 inches. If measurement is not correct, remove plug and washer from shift linkage cover and adjust nut as required to obtain proper measurement. Disconnect battery.

5. Make test setup as shown in view C. Leave switch open.

6. Place suitable interference block with 0.983 inch side against drive gear as shown in view D.

CAUTION

Because of high amount of current being passed through solenoid winding, these tests should be made as brief as possible.

7. Close switch in battery circuit. The 12-volt lamp should not light. Be sure interference block is against drive gear and not against drive sleeve. If lamp does not light, proceed to step 8. If lamp lights, solenoid is defective. Replace solenoid, then repeat test.

8. If test lamp does not light, open switch and connect a carbon pile and voltmeter into test circuit as shown in view E.

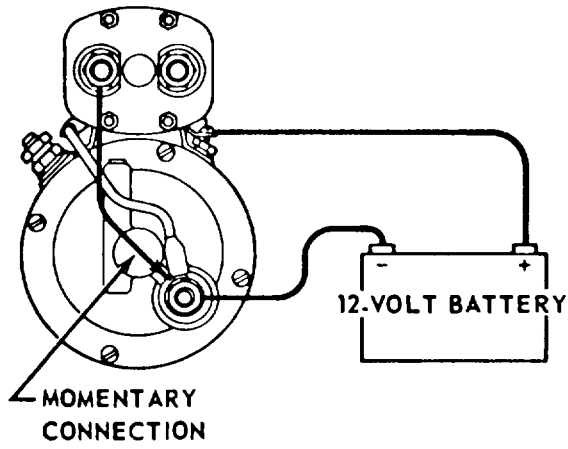
9. Place suitable interference block with 1/2-inch side against drive gear, Close switch and be sure interference block is against drive gear and not against drive sleeve.

10. Adjust carbon pile and observe voltmeter. The test lamp must light before the voltmeter reads 16 volts. If lamp does not light, adjust nut view B until proper setting is obtained.

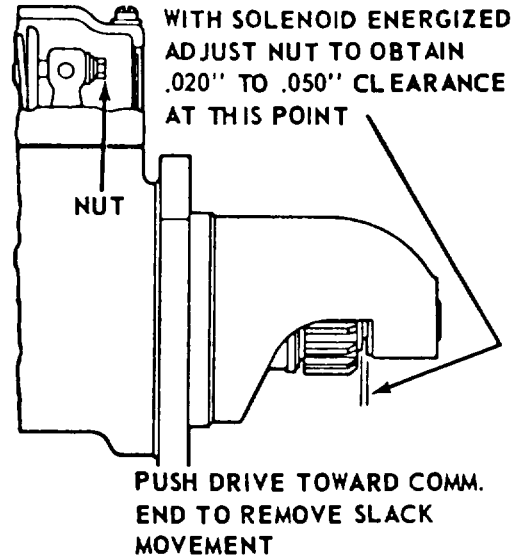
11. Reinstall plug and washer in shift linkage cover.

8-29. INSTALLATION.

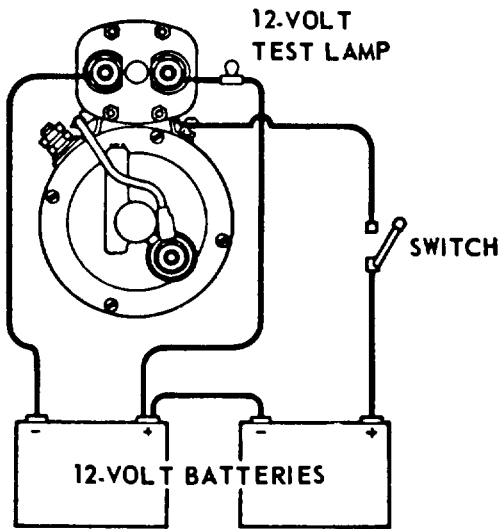
Refer to Operator and Organizational Maintenance Manual and install starting motor.



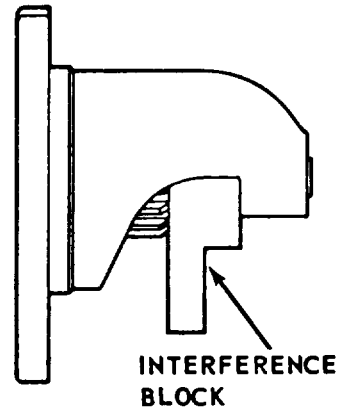
A



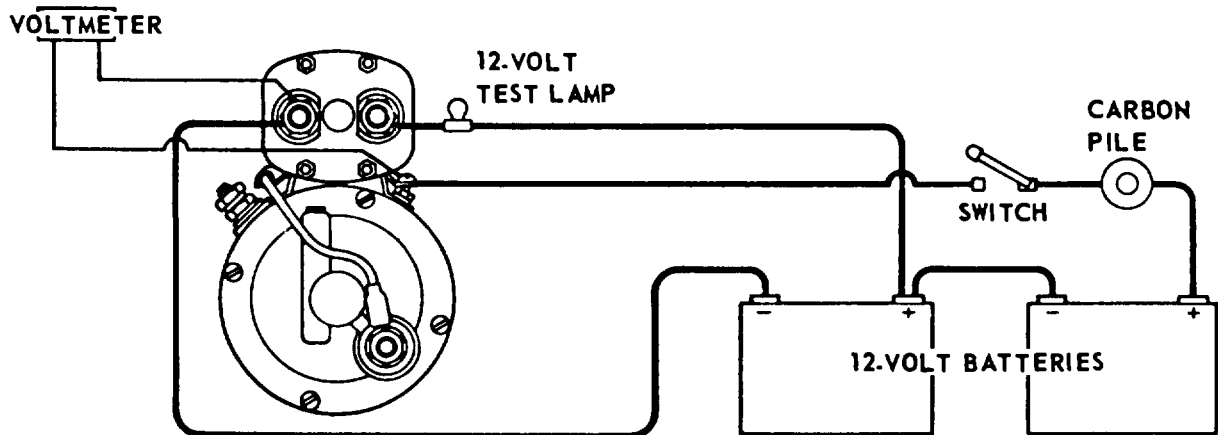
B



C



D



E

Figure 8-9. Starting motor pinion position, test setup

Section V. FAN MOUNTING GROUP

8-30. GENERAL.

The fan mounting group is mounted at the front of the engine. It consists of a fan, drive pulley, brackets, and mounting hardware. The fan and pulley are driven by the crankshaft pulley via the fan drive belts. The fan forces cooling air through the radiator.

8-31. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove alternator belts, fan drive belts, fan guard and orifice ring on radiator shroud.

CAUTION

Do not allow fan to hit radiator core after it is removed from fan hub.

b. Refer to figure 8-10 and remove fan and fan drive in the order of index numbers assigned.

8-32. DISASSEMBLY .

Refer to figure 8-11 and disassemble fan drive assembly in the order of index numbers assigned.

8-33. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

CAUTION

Do not spin dry bearings.

a. Wash parts in an approved cleaning solvent and dry thoroughly. Bearings should be dried with compressed air.

b. Clean pulley cavity of old grease. Flush with cleaning solvent and air dry.

8-34. INSPECTION.

a. Inspect bearings for roughness of rotation. Replace bearing if its rotation is rough after lubrication.

b. Inspect bearings for scoring, pitting, scratches, cracks and discoloration. Replace defective bearing.

c. Inspect spindle and bracket assembly bearing surface for grooves, or galled conditions. Replace defective spindle and bracket assembly.

d. Inspect fan for distorted blades, worn pilot hole or elongated mounting holes. Replace defective fan.

e. Inspect pulley for worn grooves, nicks or cracks. Replace worn or cracked pulley.

f. Inspect threaded holes for thread damage.

g. Discard gasket and seal.

8-35. REPAIR.

a. Minor nicks and burrs on fan and pulley may be removed using a suitable stone.

b. Repair minor thread damage using a suitable thread chaser.

8-36. REASSEMBLY.

Refer to figure 8-11, and reassemble fan drive assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

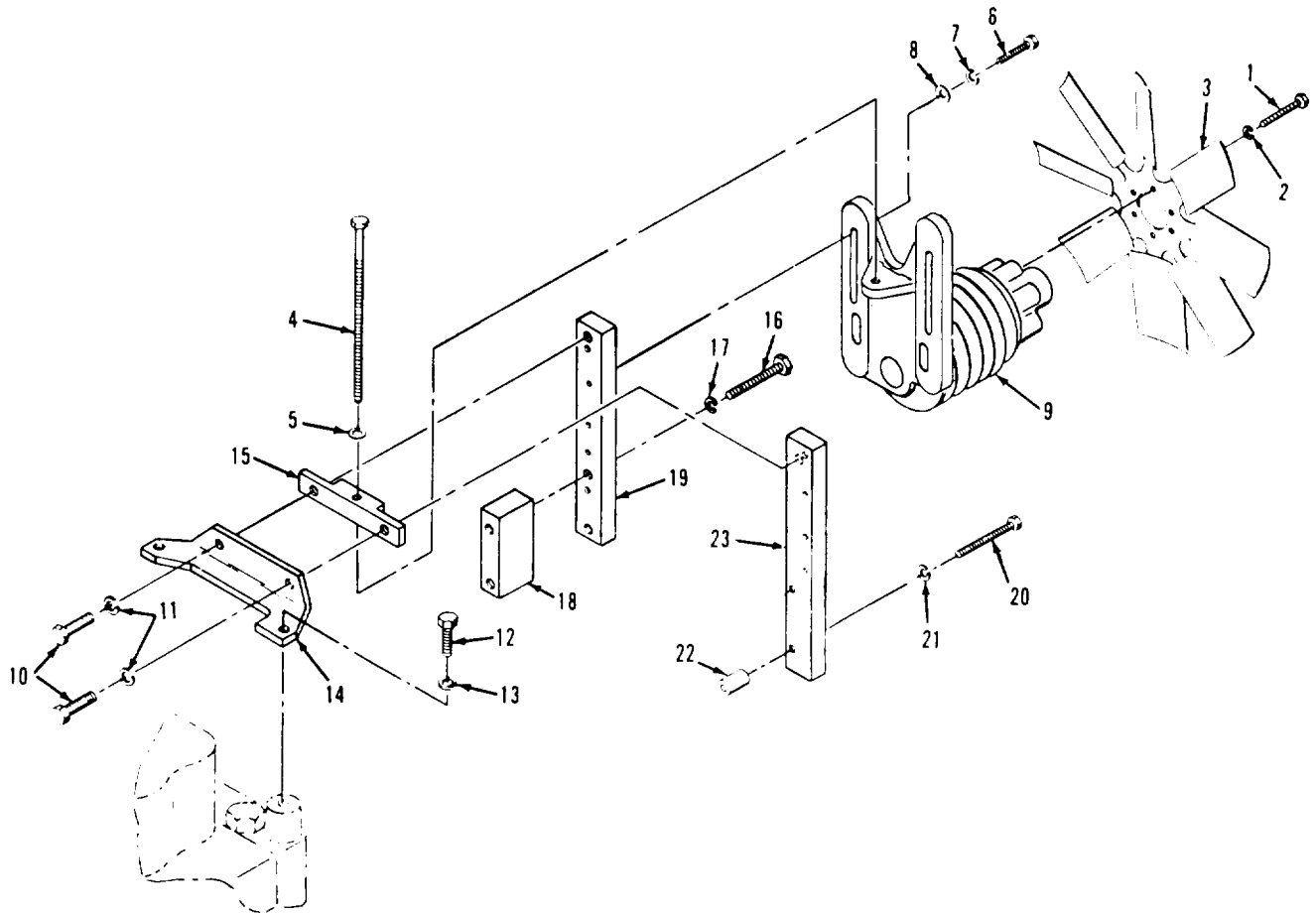


Figure 8-10. Fan and fan drive group, removal and installation

Legend to figure 8-10:

- |                       |                     |
|-----------------------|---------------------|
| 1. Bolt (5)           | 13. Lock washer (2) |
| 2. Lock washer (5)    | 14. Bracket         |
| 3. Fan                | 15. Adjustment bar  |
| 4. Adjusting bolt     | 16. Bolt (2)        |
| 5. Lock washer        | 17. Lock washer (2) |
| 6. Bolts (4)          | 18. Mounting block  |
| 7. Lock washer (4)    | 19. Support         |
| 8. Washer (4)         | 20. Bolt (2)        |
| 9. Fan drive assembly | 21. Lock washer (2) |
| 10. Bolt (2)          | 22. Spacer          |
| 11. Lock washer (2)   | 23. Support         |
| 12. Bolt (2)          |                     |

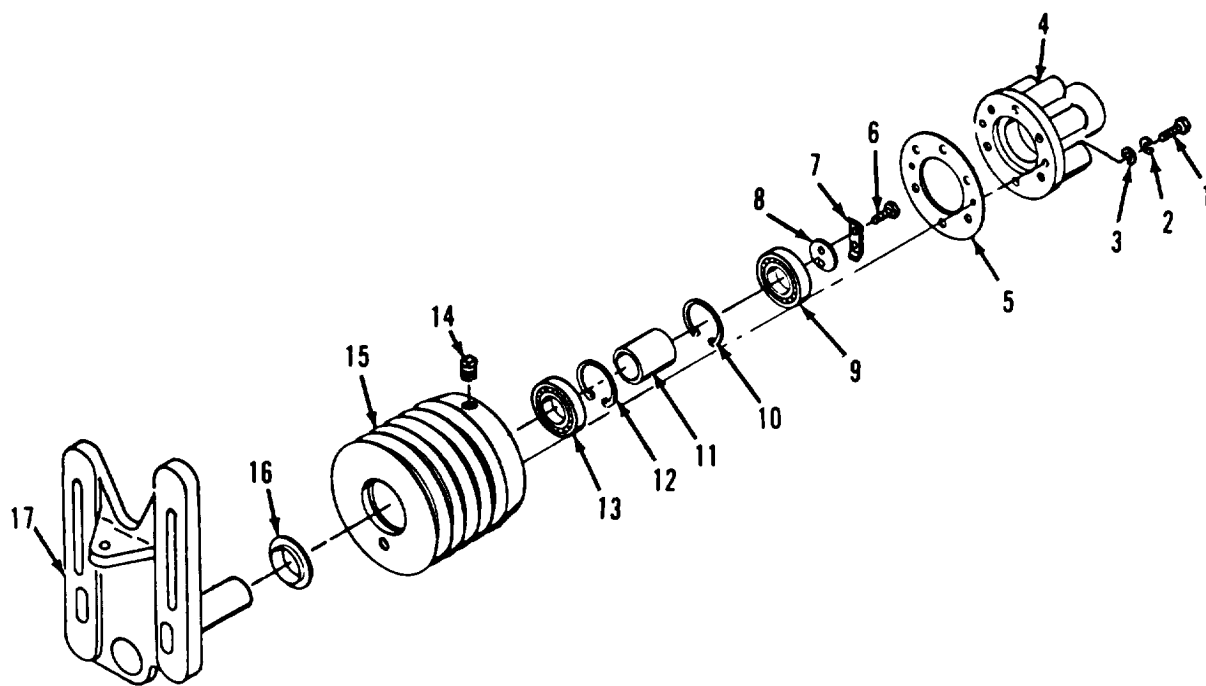


Figure 8-11. Fan drive assembly, exploded view

Legend to figure 8-11:

- |                     |                    |                                     |
|---------------------|--------------------|-------------------------------------|
| 1. Bolt (2)         | 7. Lockplate       | 13. Bearing                         |
| 2. Lock washer (2)  | 8. Plate           | 14. Plug                            |
| 3. Washer (2)       | 9. Bearing         | 15. Pulley assembly                 |
| 4. Fan mounting hub | 10. Retaining ring | 16. Seal                            |
| 5. Gasket           | 11. Spacer         | 17. Spindle and<br>bracket assembly |
| 6. Screw (2)        | 12. Retaining ring |                                     |

a. Install seal (16) with lip away from bearing (13). Lubricate sealing lip (16) lightly with engine oil.

#### WARNING

Grease, (MIL-G-23827) is moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Hand pack bearings (9 and 13) with grease MIL-G-23827 before reassembly.

c. Completely fill cavity between bearings (9 and 13) with grease MIL-G-23827.

#### 8-37. INSTALLATION.

Refer to figure 8-10 and install fan drive group in reverse order of index numbers assigned. Pay particular attention to the following.

a. Before installing fan drive assembly (9, figure 8-10), place fan belts and alternator belt on crankshaft pulley and fan drive pulley.

b. Refer to Operator and Organizational Maintenance Manual and tighten fan and alternator drive belts. Install fan guard and orifice ring on radiator shroud.

## Section VI. DAY TANK ASSEMBLY

8-38. GENERAL.

The day tank is mounted on the unit lifting frame and is located on the left side of the engine. It provides a gravity head of fuel to the fuel injection pump. The day tank is non-pressurized and is equipped with a fuel level switch, a drain cock, a vent, a fuel inlet port, a fuel outlet port, and an excessive fuel return port. The fuel level switch is one of the dual float type: the upper float, senses fuel level and prevents the overflow of fuel in day tank: the lower float senses fuel level and opens a circuit breaker to stop the engine after the fuel supply to the day tank has been shut off for 4 minutes. The drain cock is provided to completely drain the day tank, and the vent prevents the system from becoming air bound. The day tank has a usable fuel capacity sufficient for a minimum of 5 minutes operation at rated load, after the fuel supply to the day tank has been shut off.

8-39. REMOVAL AND DISASSEMBLY.

Refer to Operator and Organizational Maintenance Manual. Remove and disassemble day tank assembly.

8-40. CLEANING .WARNING

1,1,1 Trichloroethane (Methyl Chloroform) is moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- a. Clean fuel level switch with 1,1,1 Trichloroethane MIL-T-81533.

WARNING

Fuel Oil if flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- b. Clean the day tank using clean fuel oil. Be sure that any sediment in the bottom of the tank is flushed out. After cleaning, dry tank thoroughly.

8-41. INSPECTION.

- a. Refer to Operator and Organizational Maintenance Manual, and test fuel level switch.

- b. Block openings in day tank and apply 1 psi of air pressure to tank. Submerge the tank in water, leaks will be indicative by air bubbles.

- c. Inspect all threaded holes for damaged threads.

8-42. REPAIR.

- a. Replace defective fuel level switch.

WARNING

Make sure inside of day tank is free of fuel fumes and all tank ports are open before welding.

- Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- b. Repair leaks in day tank by welding.
- c. Recheck day tank for leaks after welding (para 8-41 b.)
- d. Repair minor thread damage, using a suitable chaser.

#### 8-43. REASSEMBLY AND INSTALLATION.

Refer to Operator and Organizational Maintenance Manual. Reassemble and install day tank assembly.

### Section VII. OVERSPEED SWITCH

#### 8-44. GENERAL.

The overspeed switch is mounted on the tachometer drive and operates at one half engine speed. It is a three element switch. Switch 1, disconnects starter and initiates field flashing of generator. Switch 2, permits 24 VDC to energize precise governor. Switch 3, initiates shutdown sequence of generator set in the event engine speed increases to 2400-2450 RPM. Switch 3 must be manually reset when tripped, by depressing the reset button.

- d. Remove rotor assembly (9) by releasing retaining ring (8) which secures rotor assembly to body assembly (11). Retaining ring will come out with rotor assembly.

#### 8-47. CLEANING.

##### CAUTION

Do not immerse overspeed switch in cleaning solvent.

- a. Wipe outside of overspeed switch with a clean cloth moistened with an approved cleaning solvent and dry thoroughly.

#### 8-45. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove overspeed switch.

##### WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

#### 8-46. DISASSEMBLY.

Refer to figure 8-12 and disassemble overspeed switch in the order of index numbers assigned. Pay particular attention to the following:

- b. Low pressure compressed air may be used to remove any dust or dirt deposits in switch assembly.

- a. Remove lockwire (1) and remove three screws (2). Mark three hole center location on cap and cover assembly (6) with scribe marks.

#### 8-48. INSPECTION.

- b. Separate cap and cover assembly (6) from body assembly (11).

- a. Inspect cap and cover assembly, and body assembly for cracks and loose hardware.

- c. Remove cap and cover retaining screws (12) and lift cover from cover assembly (6).

- b. Inspect rotor assembly (9) bearing for freedom of rotation. Replace rotor assembly if bearing is frozen.



c. Inspect switch assembly inside of cap and cover assembly (6) for quality of solder connections on switch terminals. Check for corrosion on switch terminals.

d. Inspect for freedom of movement of switch contact actuator plate. Depress actuator plate with thumb on center of actuator plate. There should be a total of three separate clicks as each micro switch

is actuated while the actuator plate is depressed to its lower limit. If third click is not indicated, reset manual reset button. Replace cover assembly (6) if switch/or switches are defective.

e. Inspect inside of body assembly for signs of moisture or corrosion.



f. Inspect governor weights for freedom of movement.

g. Inspect electrical wires inside of cap and cover assembly (6) for insulation, continuity and proper connection. Replace defective wires.

h. Inspect electrical connector for damaged threads, bent, loose or missing pins; and for shorts. Replace defective connector.

i. Discard packing,

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

8-49. REPAIR.

a. If electrical connector (16) is defective, remove connector from cover by removing screws (13), nuts (14) and washers (15). Tag electrical leads and unsolder wires from connector.

b. Install new electrical connector (16) to cover and secure with screws (13), nuts (14) and washers (15). Solder wires to connector.

8-50. REASSEMBLY.

Refer to figure 8-12 and reassemble overspeed switch in the reverse order of index numbers assigned. Pay particular attention to the following.

a. Position rotor assembly (9) into body assembly (11) and secure with retaining ring (8).

b. Position cap onto cover assembly (6) and secure with screws (12).

c. Align cap and cover assembly (6) to body assembly so the three slots match up with screw holes in body assembly (11).

Install screws (2) and washers (3), and align assemblies with hole center location scribe marks. Do not lockwire screws (2) at this time,

8-51. ADJUSTMENT.

a. MAJOR SPEED ADJUSTMENT.

NOTE

If speed switch has been disassembled, steps a. and b. both must be performed. If switch has not been disassembled and only a minor adjustment is required, perform step b. only.

1. Remove minor speed adjustment access screws on top of cap which provide access to adjusting screws. Insert a 1/16 inch hex Allen wrench into adjusting screws.

NOTE

Do not allow screw to be disengaged from lock nut assembly.

2. Turn switch 1 adjusting screw all the way counterclockwise.

3. Turn switch 2 adjusting screw approximately halfway between its minimum and maximum adjustment range.

4. Turn switch 3 adjusting screw in a clockwise direction until adjustment screw is flush with top of lock nut.

5. Rotate cap and cover assembly (6) counterclockwise to maximum extended position.

6. Connect overspeed switch to test setup as shown in figure 8-13.

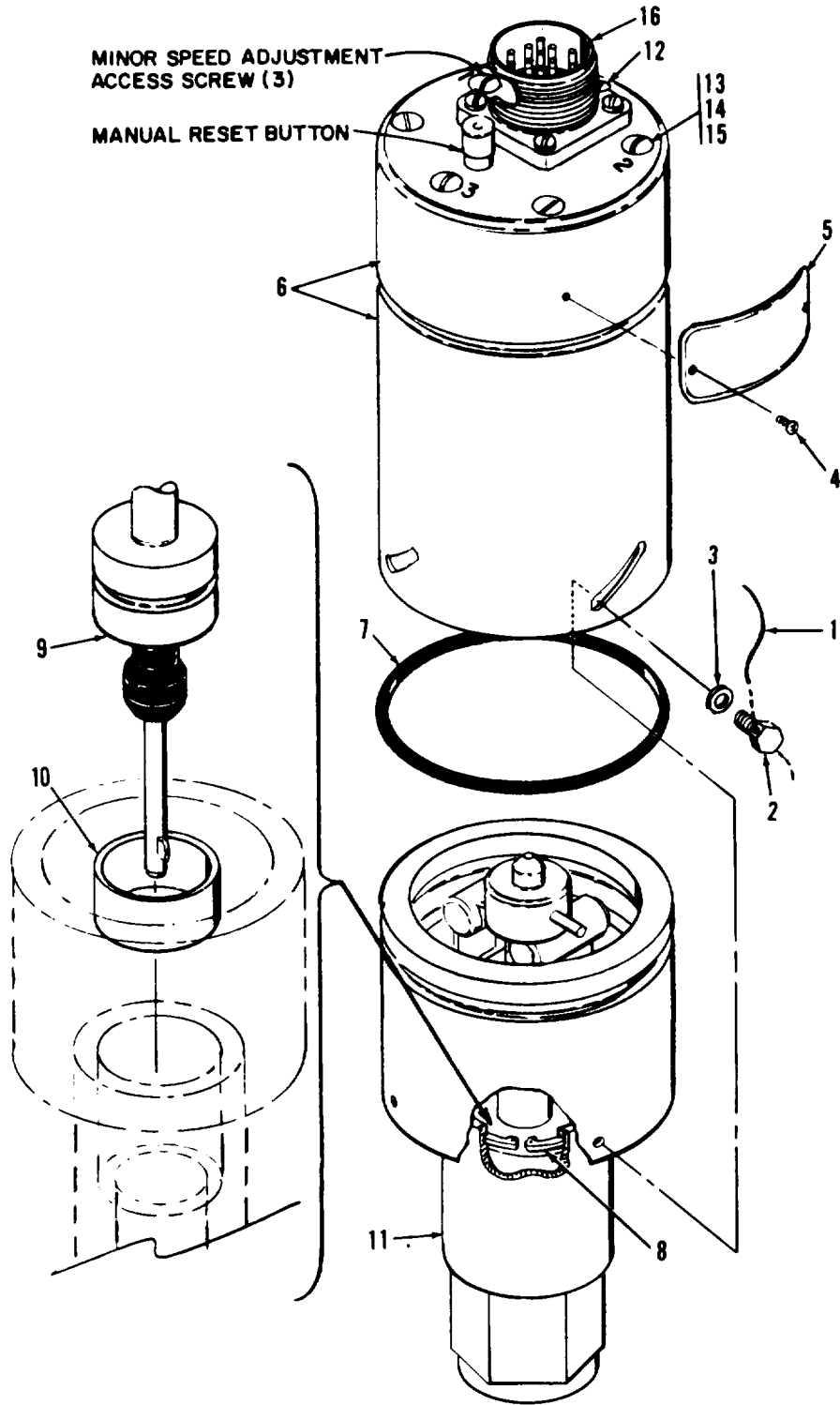


Figure 8-12. Overspeed switch, exploded view

Legend to figure 8-12:

- |                           |                   |  |
|---------------------------|-------------------|--|
| 1. LockWire               | 7. Packing        | 12. Cap and cover retaining screws (3) |
| 2. Screw(3)               | 8. Retaining ring | 13. Screw (4)                          |
| 3. Washer(3)              | 9. Rotor assembly | 14. Nut (4)                            |
| 4. Screw(2)               | 10. Spacer        | 15. Washer (4)                         |
| 5. Nameplate              | 11. Body assembly | 16. Connector                          |
| 6. Cap and cover assembly |                   |  |

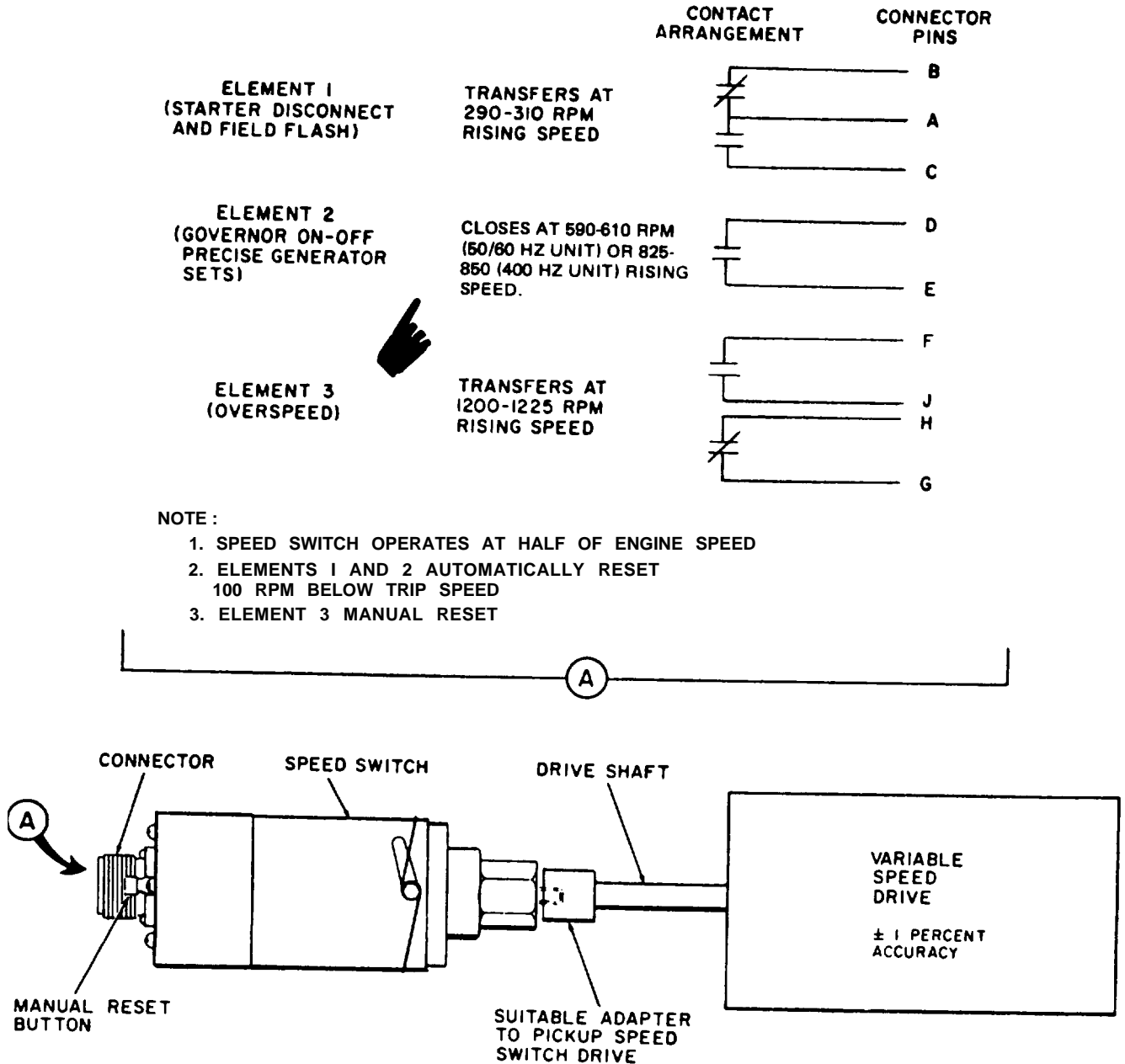


Figure 8-13. Overspend switch, test setup

7. Set variable speed drive at approximately 200 RPM above actuation point of switch 1. Speed of variable drive must be measured with a tachometer of  $\pm 1$  percent accuracy.

8. Rotate cap and cover assembly (6) clockwise until switch 1 actuates. Scribe this position on body assembly (11) and cap and cover assembly (6).

9. Rotate cap and cover assembly (6) clockwise an additional 1/16 of an inch and lock the three screws.

10. Proceed to set trip points of two remaining switches, step b.

b. MINOR SPEED ADJUSTMENT.

CAUTION

Too many counterclockwise turns will remove set screw from lock nut assembly.

NOTE

All three switches may be individually adjusted. Under certain conditions the adjustment of one switch may slightly effect the speed setting of the other two. Compensating adjustments may be required. Switch 1 set screw will be turned clockwise to increase speed to proper trip

while switch 3 set screw will be turned counterclockwise to decrease trip point. Switch 3 set screw should require adjustment either clockwise or counterclockwise (increase or decrease) depending upon where it actuates.

1. Perform step a. , 1. above.

2. Turn adjusting screw clockwise to increase trip point and counterclockwise to decrease trip point. Set switches to speeds indicated below by changing speed setting of the test stand motor to a point midway in the speed band range.

Switch 1- set at 290 to 310 RPM

Switch 2- set at 590-610 RPM for 60 hertz generator sets and 825-850 RPM, for 400 hertz generator sets.

Switch 3- set at 1200 to 1225 RPM

3. Recheck all trip point settings.

4. After all bench adjustments have been made, tighten cover hardware (2 and 3) and install lockwire.

8-52. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install overspeed switch. Check to be sure reset button has not tripped during installation.

## Section VIII. TACHOMETER DRIVE GROUP

### 8-53. GENERAL.

The tachometer drive group is mounted and driven off the fuel pump. The tachometer drive senses engine speed and actuates the overspeed switch when engine speed is between 2400 to 2450 RPM. When the overspeed switch is actuated, the switch contacts close and signals the STOP-RUN-RELAY to shut down the engine, this operation protects the engine from being damaged due to overspeeding.

### 8-54. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove overspeed switch.

b. Refer to figure 8-14 and remove tachometer drive group by removing bolts (1), lockwashers (2) and clamps (3 and 4).

### 8-55. DISASSEMBLY.

Refer to figure 8-14 and disassemble tachometer drive group in the order of index numbers assigned. Pay particular attention to the following.

Bearings (8, 15 and 21) are press fitted. If necessary, remove bearings using suitable removal tools.

### 8-56. CLEANING..

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

a. Clean parts with an approved cleaning solvent. Scrub parts thoroughly using a stiff bristle brush.

b. Dry parts with filtered low pressure compressed air or a clean lint-free cloth.

### 8-57. INSPECTION.

a. Inspect bearings (8, 15 and 21) for scoring, pitting, scratches and cracks. Replace defective bearings.

b. Inspect housing for cracks. Replace cracked housing.

c. Inspect gear teeth for nicks, burrs, cracks and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear.

d. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.

e. Inspect gear shafts for nicks, burrs and scratches.

f. Discard seal.

### 8-58. REPAIR.

a. Remove minor nicks and burrs from gear teeth and gear shafts using a smooth file or hone.

b. If gears must be replaced, press gears from shaft using a suitable arbor press. Apply an approved adhesive to gear diameter of shaft and press gear onto shaft. Press fit must withstand 10 ft-lbs torque.

### 8-59, REASSEMBLY.

Refer to figure 8-14, and reassemble tachometer drive group in the reverse order of index numbers assigned. Pay particular attention to the following:

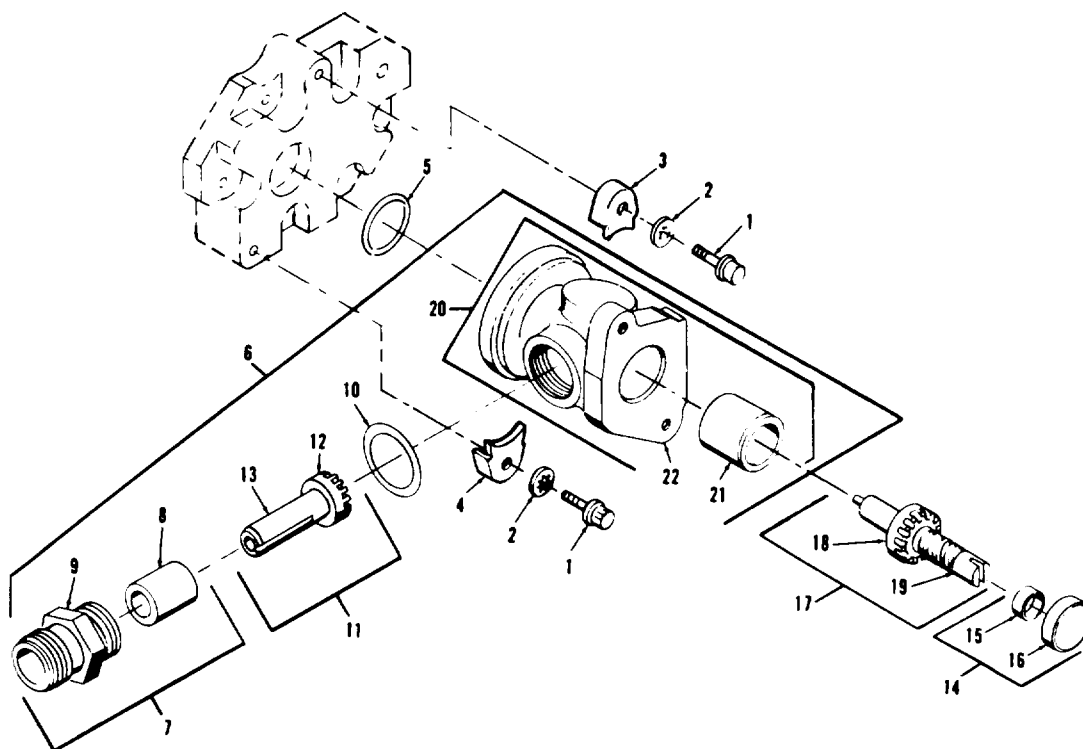


Figure 8-14. Tachometer drive group, exploded view

Legend to figure 8-14:

- |                     |                      |
|---------------------|----------------------|
| 1. Bolt (2)         | 12. Gear             |
| 2. Lock washer (2)  | 13. Shaft            |
| 3. Clamp            | 14. Plug assembly    |
| 4. Clamp            | 15. Bearing          |
| 5. Seal             | 16. Plug             |
| 6. Tachometer drive | 17. Shaft assembly   |
| 7. Housing assembly | 18. Gear             |
| 8. Bearing          | 19. Shaft            |
| 9. Housing          | 20. Housing assembly |
| 10. Shim (14)       | 21. Bearing          |
| 11. Shaft assembly  | 22. Housing          |



a. If bearings (8, 15 and 21) were removed, install new bearings. Bearings are press fitted.

b. Pack housing assembly (22) cavity with 7 cc's of approved lubricant.

c. Use required number of shims to produce 0.001 to 0.005 inch end play on shaft (11).

## 8-60. INSTALLATION.

a. Refer to figure 8-14 and install tachometer drive group, secure with bolts (1), lockwashers (2) and clamps (3 and 4). Torque bolts (1) from 6 to 10 foot pounds.

b. Refer to Operator and Organizational Maintenance Manual and install overspeed switch.

## Section IX. FUEL PUMP GROUP

### 8-61. GENERAL.

The fuel pump is mounted to the accessory drive group, the pump is driven by a gear on the accessory drive shaft. The fuel pump consists of a gear driven shaft, sleeve bearings, fuel propelling gears, and seals. The pump causes fuel to flow from the day tank into the fuel injection pump housing.

### 8-62. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove over speed switch.

b. Refer to Operator and Organizational Maintenance Manual and remove fuel hose from fuel pump.

c. Remove tachometer drive group (para 8-54).

d. Refer to figure 8-15 and remove fuel pump by removing bolts (4), lock washers (5) and gasket (7).

### 8-63. DISASSEMBLY.

Refer to figure 8-15 and disassemble fuel pump group in the order of index numbers assigned. Pay particular attention to the following:

#### NOTE

Pump body (30) and cover (22) should be carefully separated due to the sealant that was used during assembly.

If necessary, remove gear (24) from shaft (25), using a suitable puller and step plate.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

### 8-64. CLEANING .

Clean parts with an approved cleaning solvent and dry parts with low pressure compressed air.

### 8-65. INSPECTION .

a. Refer to table 1-1 and inspect fuel pump group for dimensional tolerances. Replace all parts that exceed maximum allowable wear and clearance.

b. Inspect pump cover for nicks, scoring and cracks. Replace defective cover.

c. Inspect gear teeth for nicks, burrs, cracks and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear.

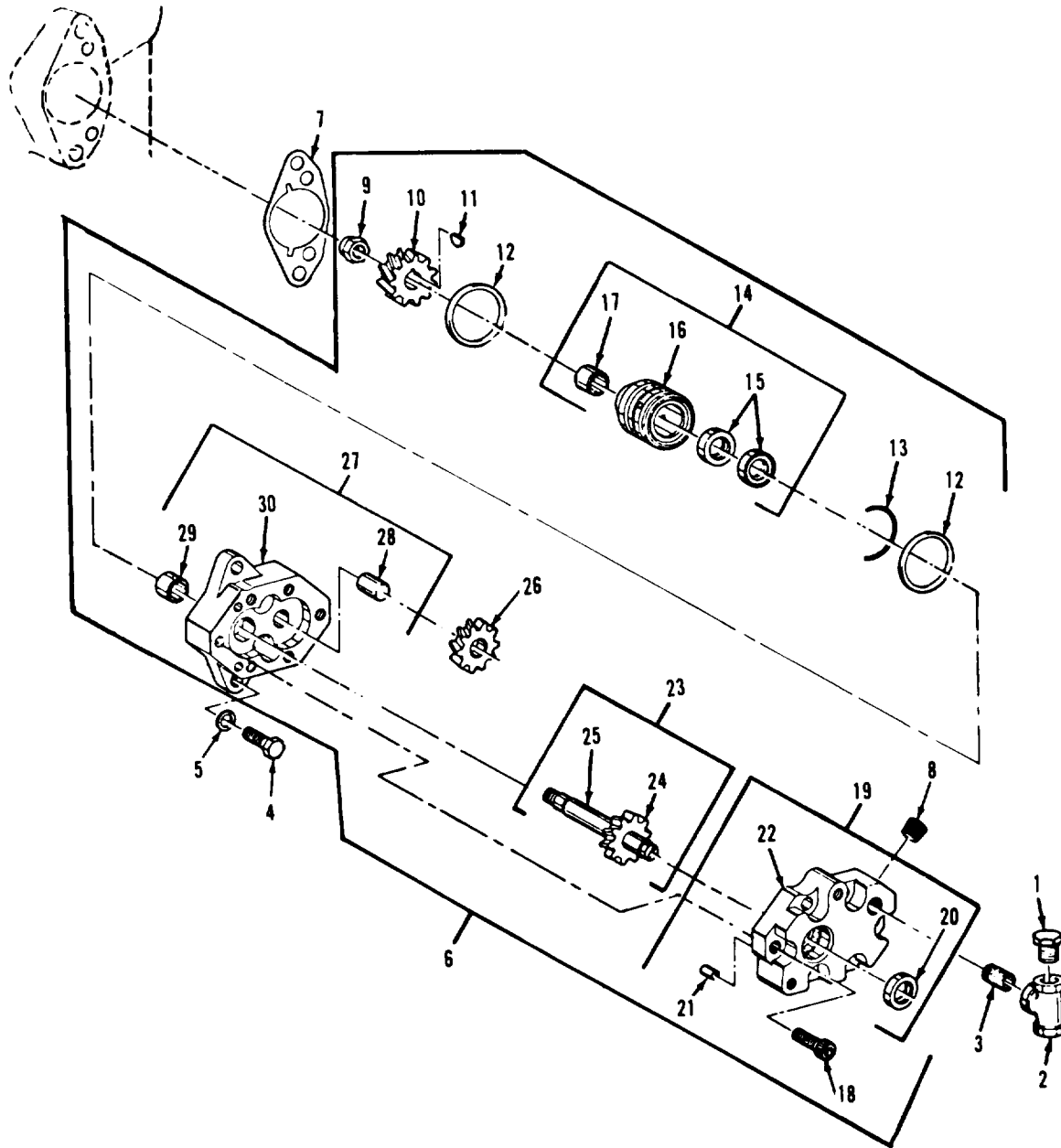


Figure 8-15. Fuel pump group, exploded view

Legend to figure 8-15:

- |                    |                    |
|--------------------|--------------------|
| 1. Plug            | 16. Bearing        |
| 2. Tee             | 17. Gauge          |
| 3. Nipple          | 18. Screw (6)      |
| 4. Bolt (2)        | 19. Cover assembly |
| 5. Lock washer (2) | 20. Seal           |
| 6. Fuel pump       | 21. Ferrule        |
| 7. Gasket          | 22. Cover          |
| 8. Plug            | 23. Shaft assembly |
| 9. Nut             | 24. Gear           |
| 10. Gear           | 25. Shaft          |
| 11. Key            | 26. Gear           |
| 12. Seal (2)       | 27. Body assembly  |
| 13. Ring           | 28. Shaft          |
| 14. Gauge assembly | 29. Bearing        |
| 15. Seal (2)       | 30. Body assembly  |

d. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.

e. Inspect gear shafts for nicks, burrs and scratches.

f. Inspect bearings for scoring, pitting, scratches and cracks.

g. Inspect a defective bearing's housing for grooved, burred or galled conditions that would indicate that the bearing has been turning in its housing.

#### 8-66. REPAIR.

Remove minor nicks and burrs from gear teeth and gear shafts using a smooth file or hone.

#### 8-67. REASSEMBLY .

Refer to figure 8-15 and reassemble fuel pump group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Before installation, lightly lubricate seals (12, 15 and 20) with clean engine oil.

#### CAUTION

Do not allow permatex to enter pump assembly.

b. Apply a thin coat of permatex between body assembly (30) and cover (22).

c. Rotate pump shaft by hand to ensure that pump parts rotate freely. If binding exists, tap corner of pump cover with a hammer to relieve binding.

d. Torque nut (9) from 17 to 27 foot pounds .

#### 8-68. INSTALLATION.

a. Refer to figure 8-15 and install fuel pump, secure with bolts (4), lock washers (5) and gasket (7).

b. Install tachometer drive group (para 8-60).

c. Refer to Operator and Organizational Maintenance Manual and install overspeed switch.

d. Refer to Operator and Organizational Maintenance Manual and connect fuel hose to fuel pump.

## Section X. TURBOCHARGER GROUP

### 8-69. GENERAL.

The turbocharger is mounted on the exhaust manifold. The Turbocharger consists of a turbine wheel and a compressor impeller mounted on a common rotating shaft, a bearing housing, compressor cover, and compressor back plate. The turbocharger, which is driven by the engine exhaust gases, draws in ambient air, compresses the air, and directs it into the engine intake manifold. This process supercharges the engine which results in a greater power output.

### 8-70. REMOVAL.

Refer to Operator and Organizational Maintenance Manual, and remove the turbocharger group.

### 8-71. DISASSEMBLY.

Refer to figure 8-16 and disassemble turbocharger in the order of index numbers assigned. Pay particular attention to the following:

#### WARNING

Solvent, Dry Cleaning P-W680, Type II is flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Cover all turbocharger openings and clean all exterior surfaces using a cleaning solvent that is in accordance with Federal

Specification P-D-680. Dry unit thoroughly and remove opening coverings.

#### NOTE

Before removing wheel (48), mark shaft and wheel assembly (60). Rotating parts should be aligned during reassembly.

b. Before disassembly of parts, measure wheel (48) end clearance. End clearance should be O. 006 to O. 011 inches. If clearance is excessive, or if either the shaft and wheel assembly (60) or wheel (48) has rubbed against housing assembly (65) or shroud (61), the bearings (58) and/or thrust bearing (56) and collar (55) must be replaced.

c. Punch mark housing assembly (41), housing assembly (65) and housing (45) to ensure correct positioning upon reassembly.

d. Fabricate a fixture, fixture adapter supporting screw, wood dowel, and wrench as shown in figure 2-1, These tools are to be used for disassembly of rotating parts.

e. Bolt fixture adapter to fixture, figure 8-17. Attach bearing housing to fixture with shaft and wheel assembly (60) down.

#### CAUTION

Proper installation of supporting screw is important so as to allow an unobstructed pressing action on shaft and still prevent turbine wheel from being damaged by striking against fixture base.

f. Thread supporting screw into base of fixture to contain turbine wheel and shaft when pressed from wheel (48), Leave a space between end of screw and turbine wheel. Approximately 1/2-inch of shaft and turbine wheel movement is required to free them from wheel.

g. When removing wheel (48), remove nut (47) and then position compressor end of housing in a hot oil bath so only wheel is immersed. Heat wheel to 350°F for not longer than 10 minutes. Remove unit from oil bath and press shaft and turbine wheel (60) as a unit from wheel (48).

h. Use the wood dowel to remove thrust plate assembly from center housing. Refer to figure 8-18,

#### 8-72. CLEANING.

##### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

##### CAUTION

Rotating components must be thoroughly cleaned in order to maintain critical balance of turbocharger. Do not use a wire brush or wheel on any parts.

a. Clean all metal parts using an approved cleaning solvent. Dry parts thoroughly. Use a piece of wood to clean carbon and deposits from turbine housing (65, figure 8-16). Discard all seals and packings.

b. The turbine wheel must be cleaned thoroughly to remove all carbon deposits. It may be necessary to soak wheel in solvent for at least one hour to remove hardened carbon deposits. Scrape off loosened particles with a stiff brush or a specially shaped piece of wood, If turbine wheel is covered with soot only, use cleaning solvent and a stiff brush, rinse with clean water, and dry

thoroughly.

c. Clean oil passages in housing assembly using a pipe cleaner. This cleaning should be done only when the housing assembly has been completely disassembled.

#### 8-73. INSPECTION .

a. Refer to table 1-1, and using a suitable micrometer and feeler gauge, inspect parts for dimensional tolerances. Replace parts that do not meet dimensional tolerances.

##### CAUTION

The following step is a critical area of inspection. Any deformation or damage to wheels will cause a serious out-of -balance condition whith will damage turbocharger.

b. Inspect compressor and turbine wheels (48 and 60, figure 8-16) for cracks, wear, chips, or any other defect. Check carefully for any blade distortion. If defective, replace wheel. Do not attempt to straighten blades.

c. Inspect bearings for cracks, distortion, or any other defect,

d. Check runout of shaft. This can be done by one of two methods, Use standard bearings and place shaft in vee blocks or use a partially open vise.

e. Inspect shaft for cracks, roughness, distortion, or any other defect, Check ring grooves for wear, Replace defective shaft.

f. Inspect housing for cracks, breaks, or any other defect. Replace defective housing,

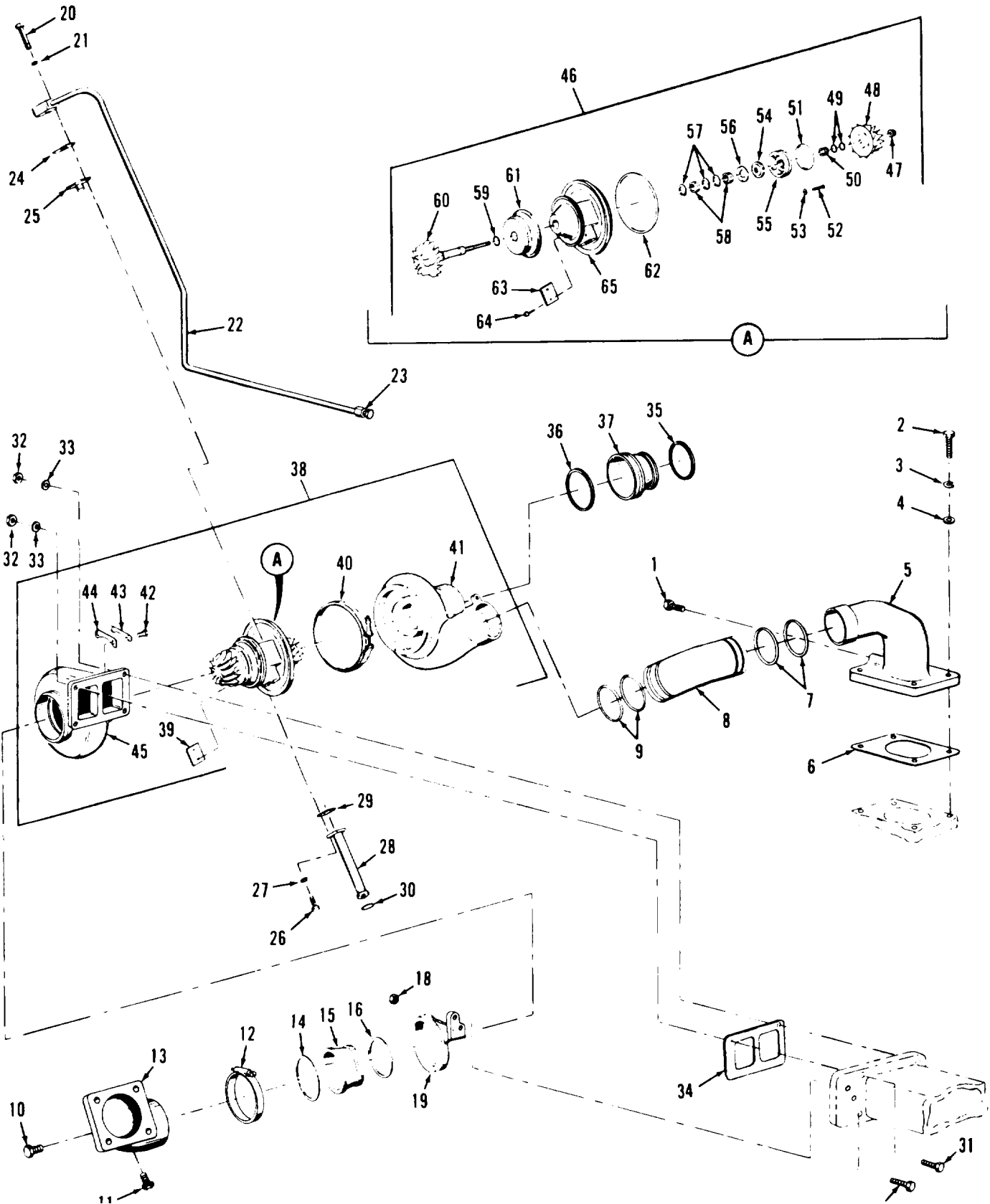


Figure 8-16. Turbocharger group, exploded view

Legend to figure 8-16:

- |                       |                              |
|-----------------------|------------------------------|
| 1. Plug               | 34. Gasket                   |
| 2. Bolt (4)           | 35. Seal                     |
| 3. Lock washer (4)    | 36. Seal                     |
| 4. Washer (4)         | 37. coupling                 |
| 5. E lbow             | 38. Turbocharger assembly    |
| 6. Gasket             | 39. Nameplate                |
| 7. Seal (2)           | 40. clamp                    |
| 8. Pipe               | 41. Housing assembly         |
| 9. Seal (2)           | 42. Bolt (6)                 |
| 10. P lug             | 43. Plate (3)                |
| 11. Plug              | 44. Plate (3)                |
| 12. Clamp             | 45. Housing                  |
| 13. E lbow            | 46. Cartridge assembly       |
| 14. Ring              | 47. Nut                      |
| 15. Coupling          | 48. Wheel                    |
| 16. Ring              | 49• Ring (2)                 |
| 17. Bolt (2)          | 50. Spacer                   |
| 18. Nut (2)           | 51. Seal                     |
| 19. Support           | 52. Screw (3)                |
| 20. Bolt (2)          | 53. Plate (3)                |
| 21. Lock washer (2)   | 54. Plate assembly           |
| 22. Tube assembly     | 55. Collar                   |
| 23. Fitting           | 56. Bearing                  |
| 24. Gasket            | 57. Ring (3)                 |
| 25. Strainer assembly | 58. Bearing (2)              |
| 26. Bolt (2)          | 59. Ring                     |
| 27. Lock washer (2)   | 60. Shaft and wheel assembly |
| 28. Tube assembly     | 61. Shroud                   |
| 29. Gasket            | 62. Seal                     |
| 30. Seal              | 63. Nameplate                |
| 31. Bolt (2)          | 64. Screw (2)                |
| 32. Nut (4)           | 65. Housing assembly         |
| 33. Washer (4)        |                              |

g. Inspect all other parts for cracks, distortion, breaks, excessive wear, or any other defect.

h. Inspect all attaching hardware for damaged threads, distortion, cracks, or any other defect.

#### 8-74. REPAIR.

Repair damaged threaded holes for the oil pressure line flange bolts and for the drain line flange bolts in the housing assembly by retapping holes to clean out burrs and other obstructions.

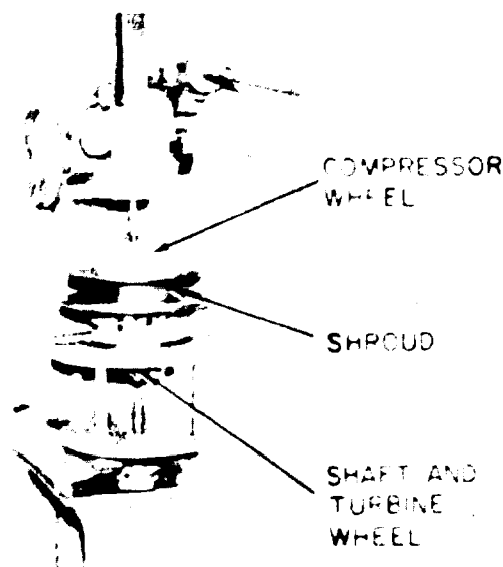


Figure 8-17. Pressing shaft and turbine wheel from compressor wheel

#### 8-75. REASSEMBLY.

Refer to figure 8-16, and reassemble turbocharger group in the reverse order of index numbers assigned. Pay particular attention to the following:

- a. Torque screw (52) from 30 to 40 inch pounds.
- b. Install collar (55) so oil hole aligns with oil hole in housing (65).
- c. Install wheel (48) on shaft and wheel assembly (60) as follows:
  1. Place the shaft and wheel assembly end of center housing (65) in turbine fixture.
  2. Place wheel (48) in an oil bath, heat wheel to a maximum of 350° F for no longer than 10 minutes.

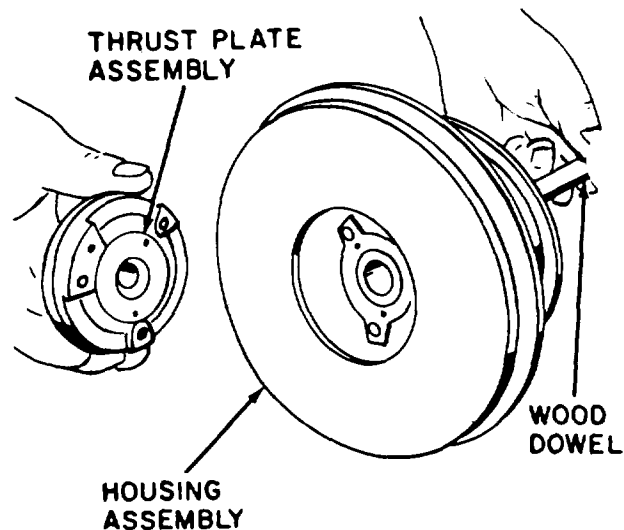


Figure 8-18. Removing thrust Plate

3. Remove wheel (48) from oil bath, and immediately install wheel on shaft, install old nut (47) and tighten to 120 inch pounds torque.

4. Allow wheel to cool to less than 150° F and remove nut (47).

5. Using lubricating oil MIL-L-2104, lightly lubricate the threads of turbine shaft and a new nut (47).

6. Install new nut (47) and tighten to 20 inch pounds torque, then tighten an additional 120 degrees.

7. Coat threads of bolts (2 places) (42) with an approved anti-seize compound. Install both and tighten from 160 to 180 inch pounds torque.

#### 8-76. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual, and install the turbocharger group.



Section XI. OIL COOLER GROUP

8-77. GENERAL.

The oil cooler group is mounted to the engine block. It consists of the oil cooler assembly, a water bonnet, and associated tubing and connections. The oil cooler assembly contains a tube bundle, two bypass valves, and a housing. On cold engine starts, the cool viscous oil does not flow immediately through the oil cooler and oil filter. The cool oil forces bypass valves, located on the oil filter and oil cooler, to open and the oil flows unrestricted through the engine and to the turbocharger. As the temperature of the oil increases, the viscosity and pressure of the oil decreases and the oil filter bypass valves close. Now, only filtered oil is delivered to all of the engine parts. As oil temperature continues to increase, the oil cooler bypass valves close, allowing the oil to flow through the oil cooler prior to entering the oil filters. If an oil filter becomes clogged, that oil filter bypass valve opens and allows the oil to flow directly from the oil cooler into the engine. Water from the engine cooling system flows through the tube bundle section of the oil cooler to reduce the heat of the engine lubricating oil.

8-78. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove oil filter group.

b. Remove three bolts, lockwashers and washers, securing oil filler tube and gasket to cylinder block.

c. Refer to figure 8-19, and remove oil cooler group in the order of index numbers assigned.

8-79. DISASSEMBLY.

Refer to figure 8-20, and disassem-

ble oil cooler group in the order of index numbers assigned.

8-800 CLEANING.

a. If tube bundle is corroded, scale deposits can be removed by either of the following methods:

CAUTION

Care must be taken to avoid damaging sides of tubes.

1. Clean tubes with a suitable 5/32 inch diameter rod long enough to penetrate length of tubes.

WARNING

Wear protective clothing and use extreme caution when mixing acid solution, and when cleaning oil cooler. Always add acid to water when mixing; never add water to acid. Avoid any contact of solution with skin. Keep away from eyes.

2. Clean tubes with a solution of 15 percent hydrochloric acid and 85 percent water. The oil cooler should be immersed in or flushed with the solution until the scale is softened. Wash cooler thoroughly with water to remove scale and solution. Repeat procedure as necessary to achieve proper cleaning.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean metal components with an approved cleaning solvent, and dry thoroughly.

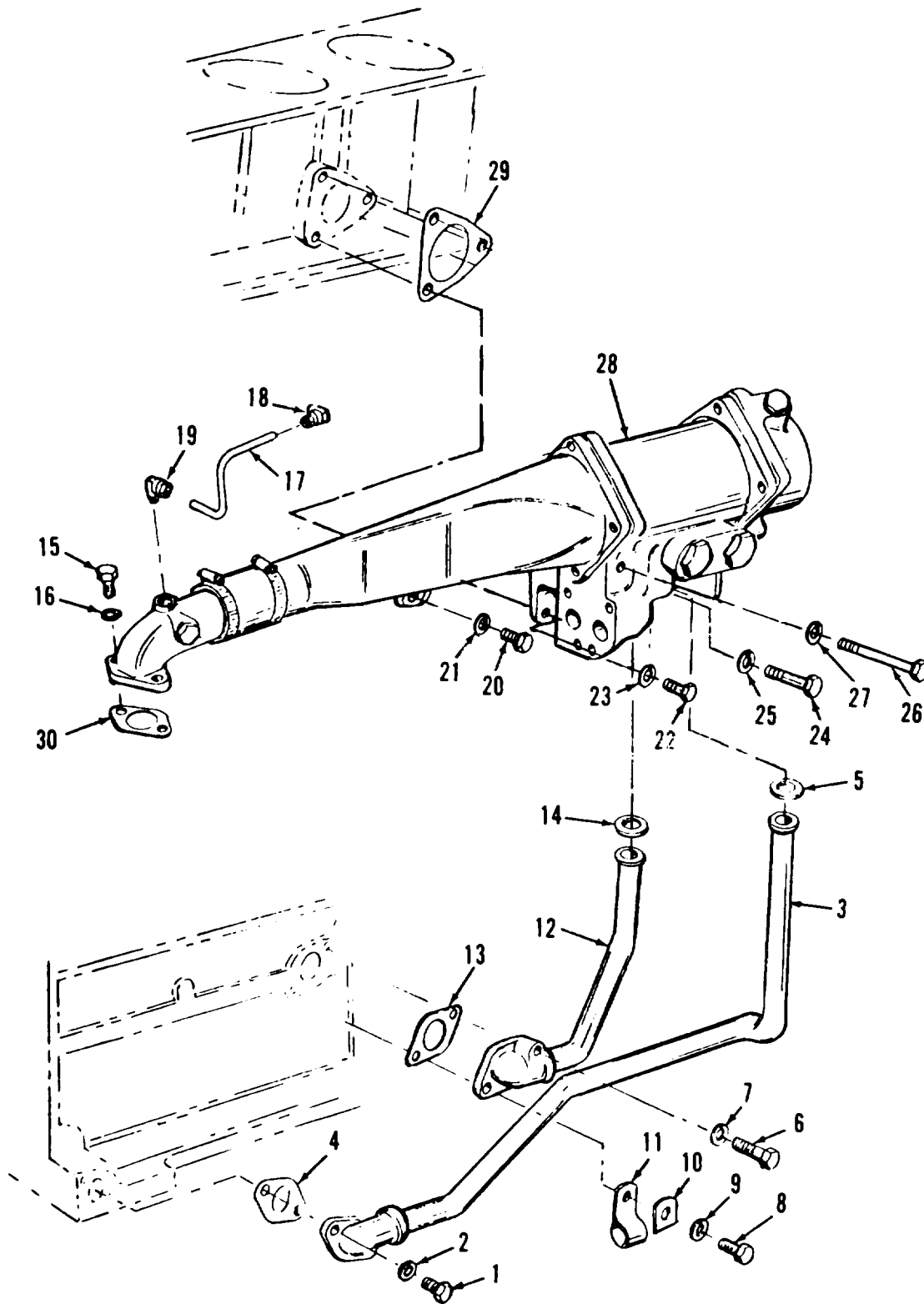


Figure 8-19. Oil cooler group, removal and installation

Legend to figure 8-19:

- |                    |                      |
|--------------------|----------------------|
| 1. Bolt (2)        | 16. Lock washer (2)  |
| 2. Lock washer (2) | 17. Tube             |
| 3. Tube assembly   | 18. Fitting          |
| 4. Gasket          | 19. Fitting          |
| 5. Seal            | 20. Bolt             |
| 6. Bolt            | 21. Lock washer      |
| 7. Lock washer     | 22. Bolt             |
| 8. Bolt            | 23. Lock washer      |
| 9. lock washer     | 24. Bolt             |
| 10. Lug            | 25. Lock washer      |
| 11. Clip           | 26. Bolt             |
| 12. Tube assembly  | 27. Lock washer      |
| 13. Gasket         | 28. Oil cooler group |
| 14. Seal           | 29. Gasket           |
| 15. Bolt (2)       | 30. Gasket           |

#### 8-81. INSPECTION.

a. Inspect tube bundle and end bonnets for cracks, breaks, corrosion that cannot be removed, and any other defects. Replace defective components.

b. Inspect components for dents, cracks, distortion, and damaged threads.

c. Discard gaskets and seals,

d. Using a suitable spring compressor, apply a load of 8.92 lbs. and compress relief valve spring (10, figure 8-20) to a length of 2.5 inches. Replace relief valve spring (10) if free length after test is not 3.61 inches.

#### 8-82. REPAIR.

a. Repair dents and distortion using proper tools.

b. Repair minor thread damage using a suitable thread chaser.

#### 8-83. REASSEMBLY.

Refer to figure 8-20 and reassemble oil cooler group in the reverse order of index numbers assigned.

#### 8-84. INSTALLATION.

a. Refer to figure 8-19, and install oil cooler group in the reverse order of index numbers assigned.

b. Install gasket and oil filler tube to cylinder block and secure with three washers, lock washers and bolts.

c. Refer to Operator and Organizational Maintenance Manual and install oil filter group.

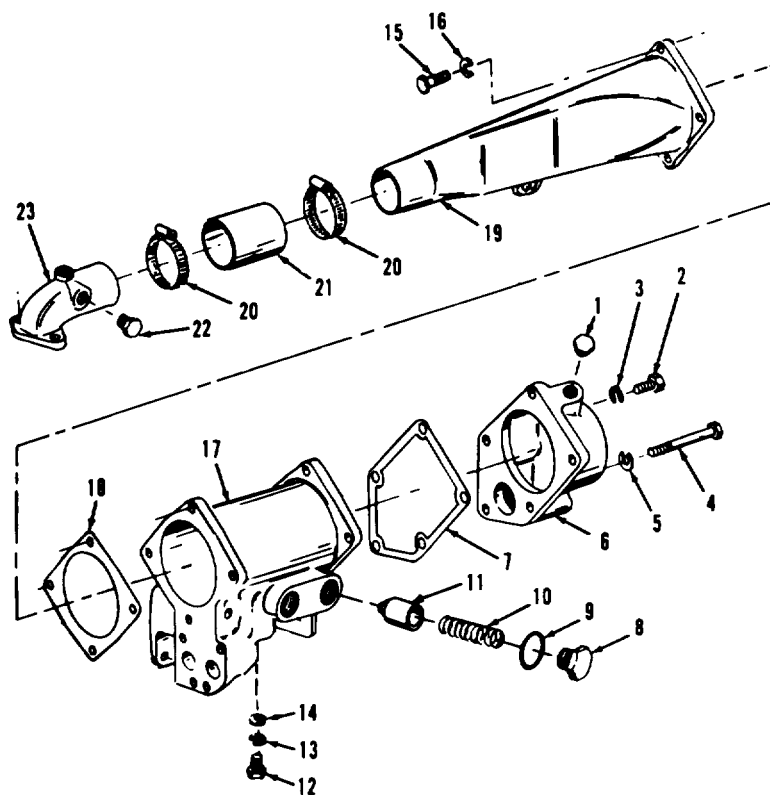


Figure 8-20. Oil cooler group, exploded view

Legend to figure 8-20:

- |                    |                     |
|--------------------|---------------------|
| 1. Plug            | 13. Lock washer     |
| 2. Bolt (4)        | 14. Washer          |
| 3. Lock washer (4) | 15. Bolt (4)        |
| 4. Bolt            | 16. Lock washer (4) |
| 5. Lock washer     | 17. Cooler assembly |
| 6. Bonnet          | 18. Gasket          |
| 7. Gasket          | 19. Bonnet          |
| 8. Plug (2)        | 20. clamp (2)       |
| 9. Gasket (2)      | 21. Hose            |
| 10. Spring (2)     | 22. Plug            |
| 11. Plunger (2)    | 23. Elbow           |
| 12. Bolt           |                     |

## Section XII. HYDRAULIC TANK (PRECISE SETS ONLY)

### 8-85. GENERAL.

The hydraulic tank is located on the left side at the front of the engine. It is mounted to the rear of the front gear cover plate behind the water pump. The hydraulic tank is utilized on precise generator sets only. The function of the hydraulic tank is to provide a positive head of hydraulic fluid for the hydraulic pump. The tank contains a liquid level gauge at the top of the tank. A return line inlet is located below the lowest level of liquid allowed by the liquid level gauge. An outlet connection is located near the bottom of the tank. This location prevents sediment from following into the hydraulic system. A plugged outlet is located at the bottom of the tank for draining sediment. A drain plug at this outlet is of the magnetic me.

### 8-86. REMOVAL.

Refer to figure 8-21 and remove hydraulic tank in the order of index numbers assigned. Pay particular attention to the following:

a. Remove magnetic plug, and drain hydraulic fluid from tank. If hydraulic fluid is to be reused, drain fluid into a clean metal container. Loosen or remove liquid level gauge on top of tank in order to speed draining.

b. Disconnect hose assemblies (1 and 2), and drain fluid into the metal container, Cover container.

c. Install liquid level gauge, if removed.

d. Install magnetic plug.

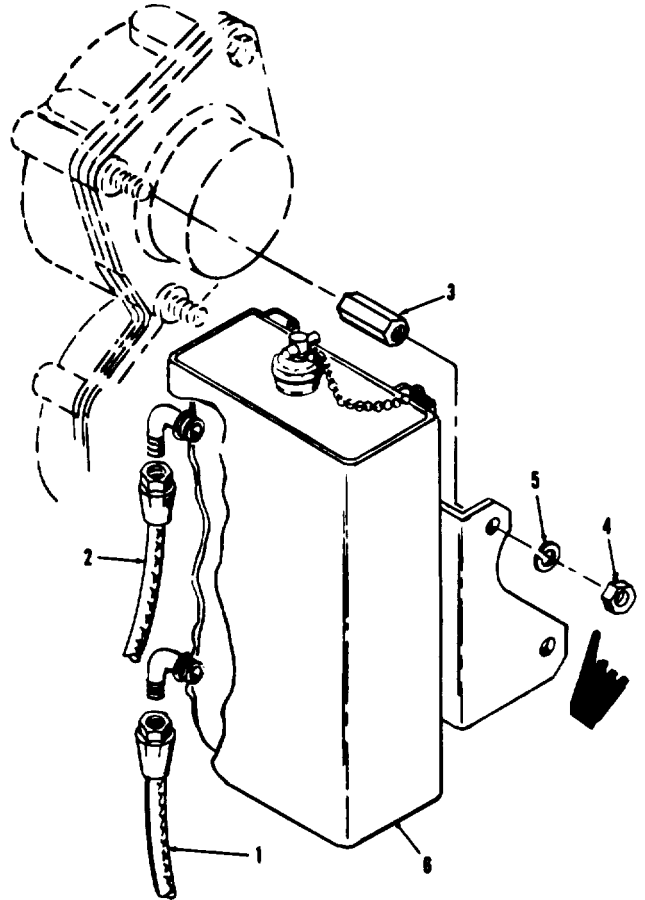


Figure 8-21. Hydraulic tank, removal and installation

Legend to figure 8-21:

1. Hose assembly
2. Hose assembly
3. Threaded spacer (2)
4. Nut (2)
5. Lock washer (2)
6. Hydraulic tank assembly

### 8-87. DISASSEMBLY .

Refer to figure 8-22 and disassemble hydraulic tank in the order of index numbers assigned.

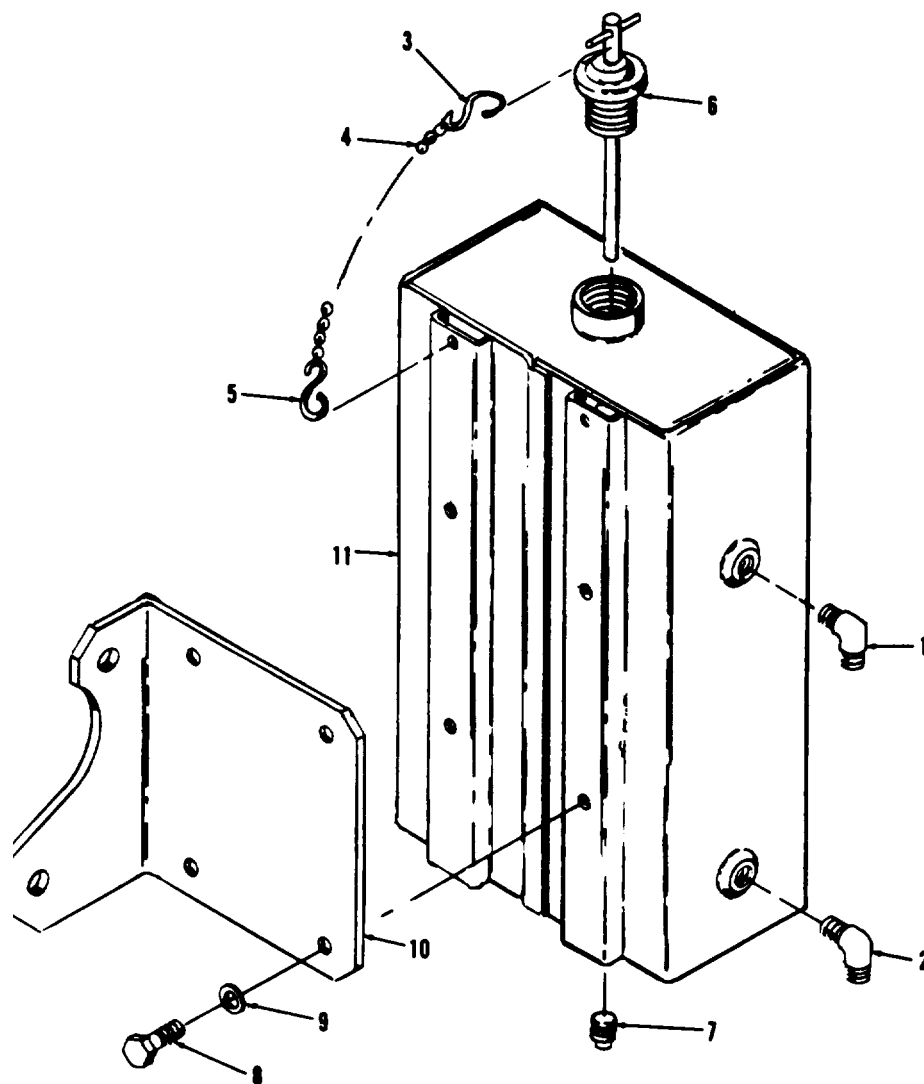


Figure 8-22. Hydraulic tank, exploded view

Legend to figure 8-22:

- |                       |                      |
|-----------------------|----------------------|
| 1. Elbow              | 7. Magnetic plug     |
| 2. Elbow              | 8. Screw (4)         |
| 3. Chain hook         | 9. lock washer (4)   |
| 4. Chain assembly     | 10. Mounting bracket |
| 5. Chain hook         | 11. Hydraulic tank   |
| 6. Liqued level gauge |                      |

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

8-88. **CLEANING.**

Clean components with unapproved cleaning solvent, and dry thoroughly. Ensure that all particles trapped on head of magnetic plug are removed.

8-89. **INSPECTION.**

a. Inspect tank for leakage by air testing as follows:

1. Connect a suitable air supply to tank, and plug all openings.

2. Submerge tank in water, and apply air pressure of 1.5 PSI. Check for air bubbles.

b. Inspect liquid level gauge by holding gauge in hand and twisting handle in a clockwise direction. The rubber seal ring should swell slightly as handle is twisted. If rubber seal ring does not swell, replace liquid level gauge.

c. Inspect magnetic plug for its capability to pick up metal particles. If it has lost its magnetic capability, replace magnetic plug.

d. Inspect threaded holes in tank for damaged threads.

8-90. **REPAIR.**

a. Repair leakage or holes in tank as follows:

1. Steam clean tank.

2. Fill tank with water.

**WARNING**

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and air-borne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

3. Repair tank by welding.

4. Repair tank with large holes by welding metal patches to tank.

5. After welding, drain water from tank.

6. Pressure test tanks for leakage in accordance with paragraph 8-89, step a.

b. Repair damaged threaded holes by retapping holes.

8-91. **REASSEMBLY**

Refer to figure 8-22 and reassemble hydraulic tank in the reverse order of index numbers assigned.

8-92. **INSTALLATION.**

a. Refer to figure 8-21 and install hydraulic tank in the reverse order of index numbers assigned.

b. Refer to Operator and Organizational Maintenance Manual, and service hydraulic tank.

Section XIII. HYDRAULIC PUMP (PRECISE SETS ONLY)

8-93. GENERAL.

The hydraulic pump is mounted to the hydraulic pump drive group and is driven through the camshaft gear. The hydraulic pump is used on precise generator sets only. The hydraulic pump is a positive displacement gear type pump with a built in adjustable relief valve. The pump is coupled to the pump drive group by means of a tang type drive coupling. The pump consists of a shaft, dual gears, sleeve bearing and seal.

8-94. REMOVAL.

Refer to figure 8-23 and remove hydraulic pump in the order of index numbers assigned. Pay particular attention to the following.

a. Disconnect hose assemblies (1 and 2) from pump suction and discharge ports, and plug hose assemblies to prevent fluid spillage.

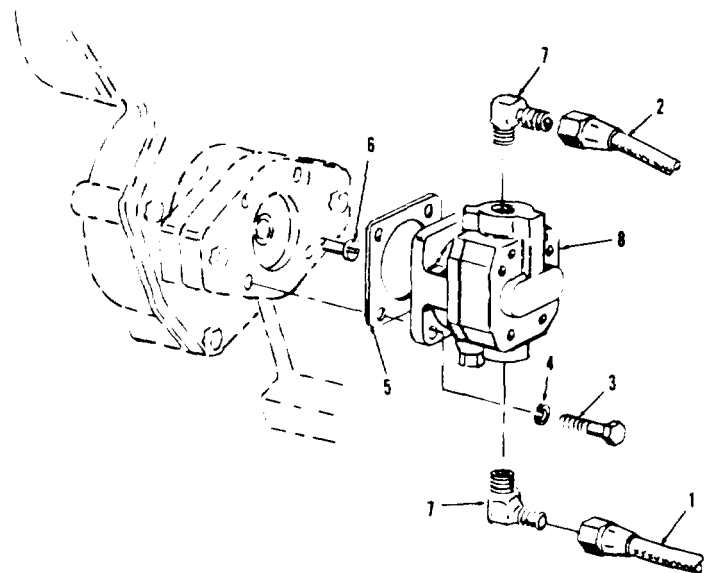


Figure 8-23. Hydraulic pump, exploded view (precise sets only)

Legend to figure 8-23:

- 1. Hose assembly (suction)
- 2. Hose assembly (discharge)

- 3. Bolt (4)
- 4. Washer (4)
- 5. Gasket
- 6. Coupling shaft
- 7. Fitting (2)
- 8. Pump assembly

b. When removing pump assembly (8) from pump drive, hold hand under adapter flange on pump drive to catch coupling shaft (6) when it drops out.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

8-95. CLEANING.

Wash pump assembly in an approved solvent to remove grease, and hydraulic fluid residue. Dry with a lint free cloth.

8-96. INSPECTION.

- a. Check pump shaft for freedom of rotation.
- b. Inspect coupling shaft (6) for nicks and burrs on tang end.
- c. Inspect condition of threaded holes in suction and discharge ports.
- d. Discard gasket.

8-97. REPAIR.

CAUTION

Do not use a grinding wheel on coupling shaft tang.

- a. Remove nicks and burrs on drive tang of coupling shaft using a suitable file.



WARNING

Hydraulic Fluid is highly toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Damaged threads on suction and discharge ports may be retapped with a 1/2 inch N.P.T.F. tap. Flush pump with clean hydraulic fluid to remove cuttings after re-tapping.

8-98. HYDRAULIC PUMP TEST AND ADJUSTMENT (ON PRECISE GENERATOR SETS ONLY).

Test and adjust the hydraulic pump as follows:

NOTE

Rotation of pump is clockwise as viewed from drive end.

a. Connect hydraulic pump drive shaft to suitable vary-drive capable of 0 to 2500 RPM.

b. Connect supply line of suitable hydraulic test stand to IN port of pump. Pump should have fluid reservoir mounted higher than pump inlet.

NOTE

Test stand should have an adjustable restriction valve in return line after flow meter.

c. Connect a suitable 0 to 500 PSI gauge and throttling valve to OUT port of pump. Connect out port of throttling valve to test stand flow meter.

d. Open throttling valve and test stand restriction valve. Start vary-drive and adjust speed to 1500 to 2116 RPM. Slowly close throttling valve and observe gauge reading. With valve fully closed, gauge

should indicate 320 ±10 PSI. If not, remove relief valve cap located next to pump IN port. Adjust relief valve to obtain 320 ±10 PSI. Open throttling valve and permit approximately one gallon to flow through valve. Close valve and check gauge, reading should be 320 ±10 PSI. If not, readjust relief valve. Install relief valve cap after adjustment is made.

e. Open throttling valve. Slowly close test stand restriction valve until a flow of 2 GPM is indicated on flow meter. Check gauge, reading should be 320 ±10 PSI.

f. Remove pump from test equipment. Replace pump that does not provide a minimum of 2 GPM at 320 ±10 PSI.

8-99. INSTALLATION .

Refer to figure 8-23 and reassemble hydraulic pump in reverse order of index numbers assigned. Pay particular attention to the following.

a. Use one wrap of thread sealing tape or thread sealing compound MIL-T-5544 when installing elbows (7) . Apply a liberal amount of grease MIL-G-10924 to the pump shaft, coupling (6) and drive shaft. Grease will prevent coupling from dropping when installing pump and reduce wear during operation.

b. Position pump so that relief valve is pointing down.

c. Rotate shaft with fingers to position tang drive to mate with coupling shaft tang.

CAUTION

Do not force pump onto drive flange.

d. Pump must seat squarely on drive flange.

## Section XIV. HYDRAULIC PUMP DRIVE GROUP

### 8-100. GENERAL.

The hydraulic pump drive group is mounted to the engine front plate and is gear driven from the camshaft gear. It is utilized on precise generator sets only. The hydraulic pump drive group consists of a shaft, a gear, bearings, a seal and gaskets. The hydraulic pump drive group drives the hydraulic pump.

### 8-101. REMOVAL.

a. Refer to paragraph 8-94 and remove hydraulic pump (8) (precise generator sets only).

b. Refer to figure 8-24 and remove the hydraulic pump drive group by removing screws (1 and 4), nuts (2 and 5), lockwashers (3 and 6) and gasket (7).

### 8-102. DISASSEMBLY.

Refer to figure 8-24 and disassemble hydraulic pump drive group in the order of index numbers assigned. Pay particular attention to the following:

- a. When removing adapter (14) note position of drain hole to ensure correct positioning during reassembly.
- b. If necessary, remove gear (21) and bearing (22) from shaft (23) using a suitable arbor press.
- c. Press bearing (20) out of adapter (24), using a suitable arbor press.

### 8-103. CLEANING .

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- z Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

#### CAUTION

Do not spin dry bearings.

Clean all parts with an approved cleaning solvent and air dry. Dry bearings with low pressure compressed air.

### 8-104. INSPECTION.

- a. Check bearings for freedom of rotation. Replace a bearing if its rotation is rough.
- b. Inspect bearings for pits, scratches, cracks or chipped races.
- c. Inspect drive gear teeth for nicks, burrs, cracks and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear.
- d. Inspect drive gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.
- c. Inspect adapters for cracks. Replace cracked adapter.
- f. Inspect adapter mounting surface and shaft for nicks and burrs.
- g. Inspect threaded holes for threaded damage.

h. Discard seal, gasket and lockring.

i. Check tang drive end of shaft. Slot in shaft should be 0.253 to 0.257 inch wide. Replace shaft if slot is not within limits.

#### 8-105, REPAIR.

a. Remove minor nicks and burrs using a suitable file or hone.

b. Repair minor thread damage using a suitable thread chaser.

#### 8-106. REASSEMBLY.

Refer to figure 8-24, and reassemble hydraulic pump drive group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. If removed, install gear (21) and bearing (22) on shaft (23) as follows:

1. Hand pack bearing (22) with an approved grease. Install bearing onto shaft (23) .

2. Preheat gear (21) to a maximum of 600°F .

3. Using a suitable arbor press, press gear (21) onto shaft (23).

b. Hand pack bearing (20) with an approved grease. Press bearing into adapter (14) .

c. Lubricate seal lip of seal (16) with an approved lubricant before installing on shaft (23) .

d. Locate oil drain hole in end adapter (14). Drain hole must be pointed downward when drive is mounted in gear cover.

#### 8-107. INSTALLATION.

a. Refer to figure 8-24 and install the hydraulic pump drive group, secure with bolts (1 and 4), nuts (2 and 5), lock washers (3 and 6) and gasket (7).

b. Refer to paragraph 8-99 and install hydraulic pump (precise generator sets only).

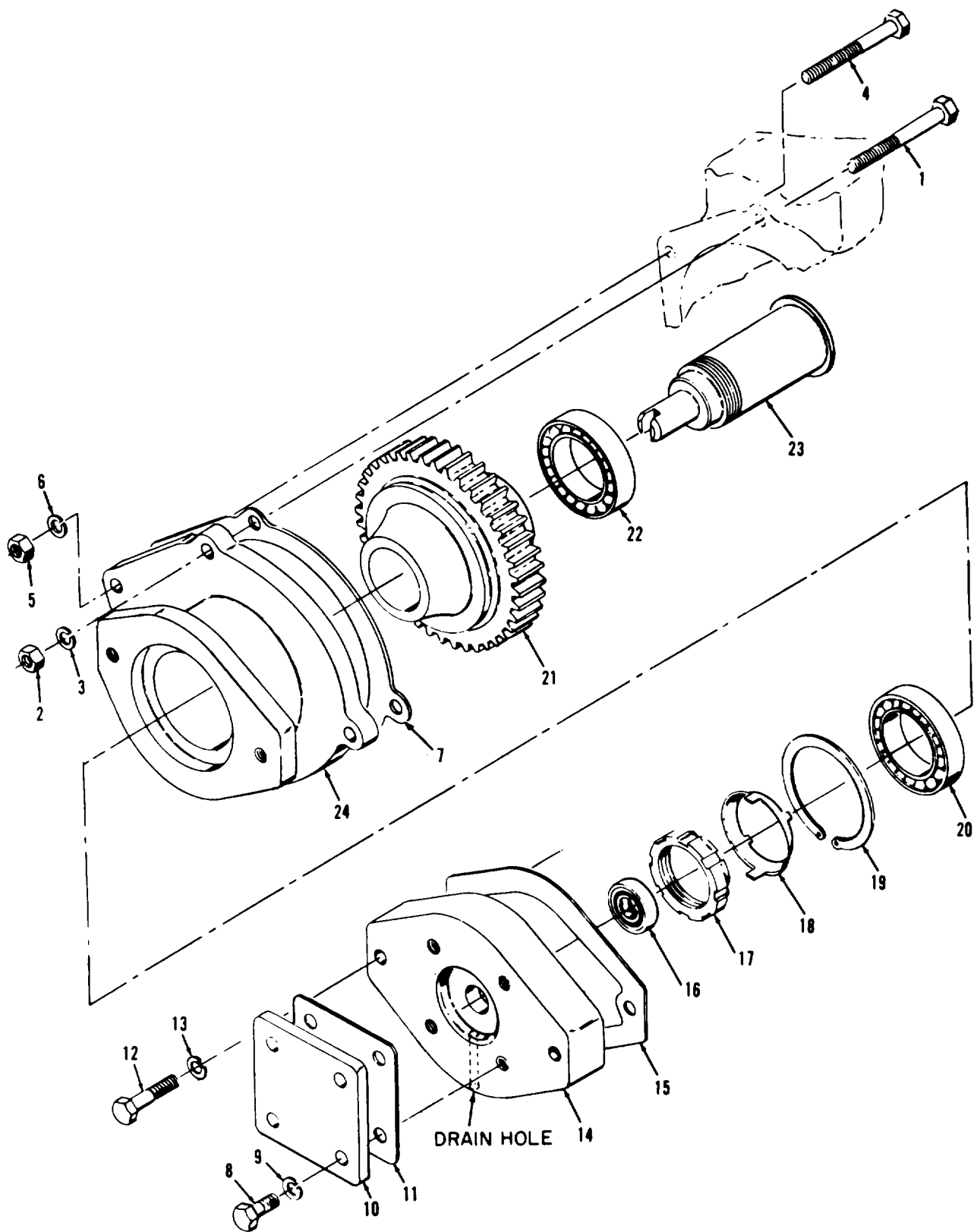


Figure 8-24. Hydraulic pump drive group, exploded view

Legend to figure 8-24:

- |                    |                     |
|--------------------|---------------------|
| 1. Bolt (3)        | 13. Lock washer (3) |
| 2. Nut (3)         | 14. Adapter         |
| 3. Lock washer (3) | 15. Gasket          |
| 4. Bolt            | 16. Seal            |
| 5. Nut             | 17. Nut             |
| 6. Lock washer     | 18. Locknut         |
| 7. Gasket          | 19. Ring            |
| 8. Bolt (4)        | 20. Bearing         |
| 9. Lock washer (4) | 21. Gear            |
| 10. Cover          | 22. Bearing         |
| 11. Gasket         | 23. Shaft           |
| 12. Bolt (2)       | 24. Adapter         |

### Section XV. GOVERNOR ACTUATOR UNIT (PRECISE SET ONLY)

#### 8-108. GENERAL.

The governor actuator unit is located on the right side of engine, mounted on top of the utility governor. The actuating unit is an electro-hydraulic servo motor that receives intelligence from the electric control unit and converts this low level electrical information to proportional high level hydraulic pressures that position the engine throttle by the action of a piston and a floating lever pivot linkage system. The governor actuator unit is composed of control valves, a piston, a linkage assembly and core and armature assembly,

1. Check for 4 to 6 VDC at test points AB and CD of electric governor control unit (A and D are positive), with engine operating. If voltage at either point is approximately 15 volts, the malfunction is a result of an open in an actuator valve coil, or connecting circuit.

2. Check that the throttle linkage is not badly worn or disconnected. A worn linkage can cause sluggish response or drifting frequency. A disconnected or broken linkage can cause overspeed, shutdown, or no response. Also check linkage for binding due to dirt or distortion.

#### 8-109. TEST AND REMOVAL.

a. Symptom and Isolation of malfunction. A malfunction of the hydraulic throttle actuator is usually indicated by engine shutdown or overspeed when the Start-Run-Stop switch is transferred from the START to the RUN position, frequency drift observed on the frequency meters, sluggish response to load changes, or no response in load changes. To isolate the malfunction, proceed as follows:

3. Check condition of hydraulic filter and the level of hydraulic oil. Either a clogged or dirty filter or low oil level can reduce the hydraulic pressure required to operate the actuator.

4. Check pressure output of hydraulic actuator by removing plugs in ports A1 and A2 (figure 8-25) and inserting 0 to 400 PSI range gauges. The pressure at each port should be  $160 \pm 25$  PSI and equal, with engine operating under governor control.

Operating under manual control, the pressure at port A1 should be  $180 \pm 20$  PSI and approximately 50 PSI higher than the pressure at port A2.

5. Check the transducer in the actuator for freedom of movement, Transducer must move freely for good response.

6. If any of the above examinations indicates that the actuator has failed, proceed with removal, disassembly and repair instructions.

b. Removal. Refer to figure 8-25 and remove governor actuator unit in order of

index numbers assigned. Pay particular attention to the following.

1. Disconnect harness plug from governor actuator unit before removing from engine.

2. Plug hydraulic lines after removal.

#### 8-110. DISASSEMBLY.

Refer to figure 8-26 and disassemble governor actuator unit in the order of index numbers assigned. Pay particular attention to the following.

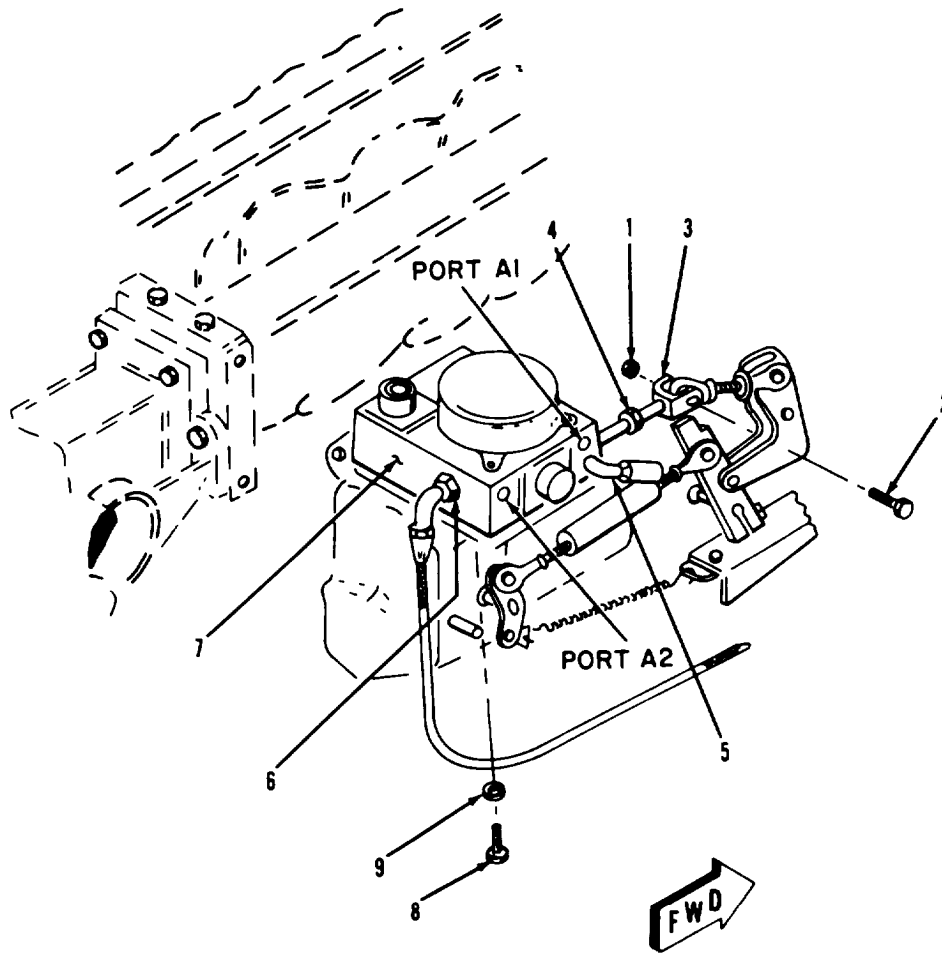


Figure 8-25. Governor actuator unit, removal and installation (precise sets only)

Legend to figure 8-25:

- |                 |                           |
|-----------------|---------------------------|
| 1. Nut          | 6. Hose fitting           |
| 2. Bolt         | 7. Precise actuator assy. |
| 3. Clevis       | 8. Bolt (4)               |
| 4. Nut          | 9. Lock washer (4)        |
| 5. Hose fitting |                           |

a. To remove transducer assembly (40), setscrew (20) must be loosened.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

b. To remove the core and armature assembly(9), leads to receptacle J6 must be unsoldered. Unsolder these leads only if armature and coil assembly are to be replaced.

c. Remove needles (10) from armature and coil assembly to prevent damage while handling armature and coil assembly.

d. Top orifice (11) is removed by pulling directly upward,

8-111. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

CAUTION

Do not immerse armature and coil assembly in solvent.

a. Wash all governor actuator parts except armature and coil assembly in an approved cleaning solvent. Use low pressure compressed air to dry parts or a lint free cloth.

b. Clean armature and coil assembly with a cloth moistened with an approved cleaning solvent and dry with a clean lint free cloth.

c. Clean electrical connector sockets and test jacks with low pressure, compressed air.

8-112. INSPECTION ,

a. Inspect piston (39) for scoring or scuff marks. Inspect for nicks or burrs or edge diameters in the center section of the piston.

b. Inspect top orifice (11), spacer (13) and bottom orifice (15) for nicks and burrs. Inspect 3 cornered valve (14) for nicks and burrs on vertical edges that could cause binding. Inspect depth of needle hole in top of valve. Hole should be at least 0,125 inch in depth. Inspect bottom of valve (end opposite the needle hole) for indications of grooving.

c. Using a suitable feeler gauge, check the air gap on the armature and coil assembly (9) . Air gap should be 0.030 to 0.038 inch for each coil.

d. Inspect the condition of the filter mesh in the filter assembly (27) for breaks or oversize holes in the mesh screen. Inspect the solder joint securing the mesh screen to inlet port body.

e. Inspect receptacles (18 and 23) for broken pins and locating keys. Replace defective receptacle.

f. Inspect all tapped holes in transducer body for nicks or otherwise damaged threads.

g. Roll pin (33) when pressed into transducer body (41) must extend a minimum of 1 3/8 inches from the transducer body (41).

h. Discard all packings and gaskets.

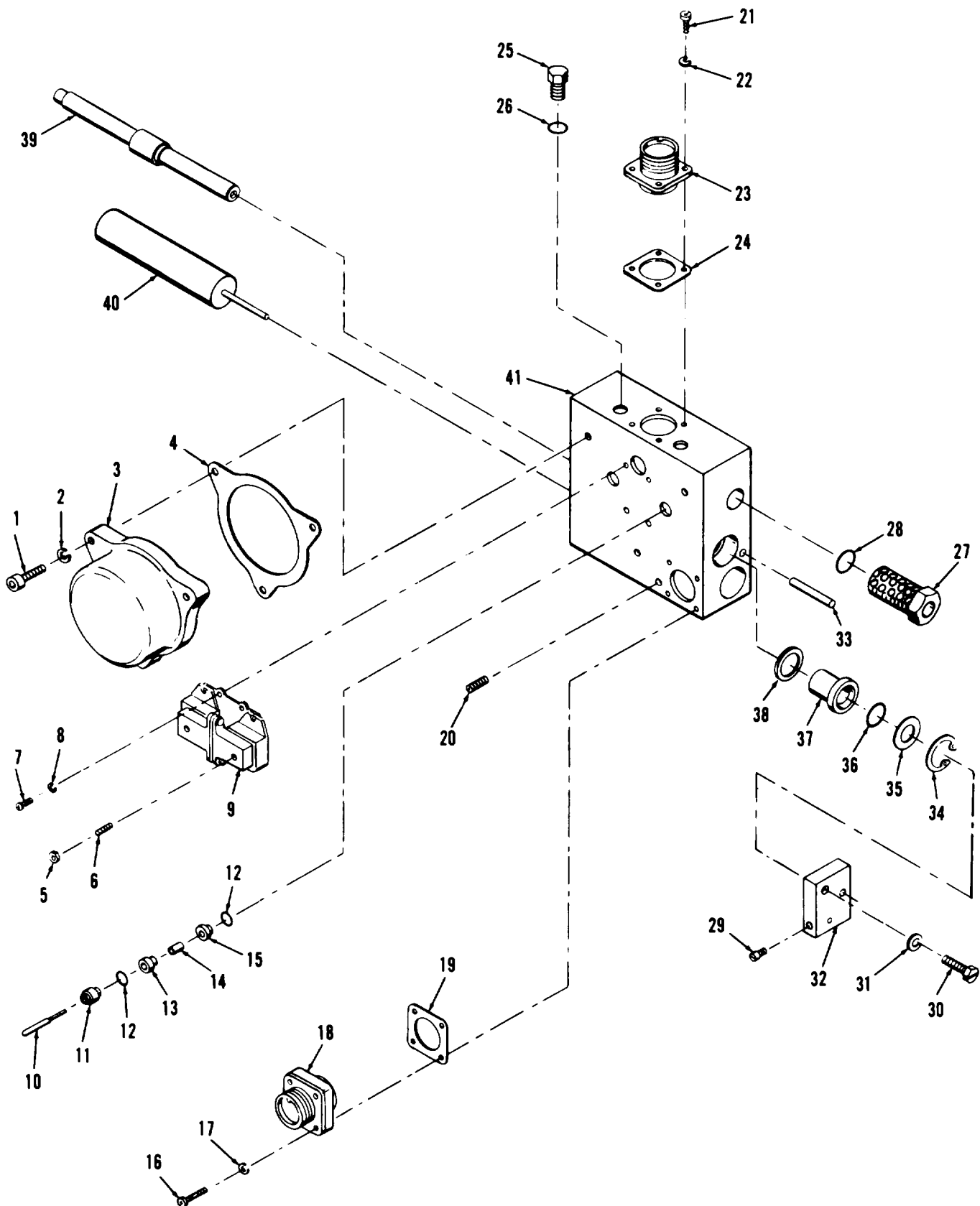


Figure 8-26. Governor actuator unit, exploded view (precise sets only)



Legend to figure 8-26:

- |                               |                           |
|-------------------------------|---------------------------|
| 1. Screw (3)                  | 22. Lock washer (4)       |
| 2. Lock washer (3)            | 23. Receptacle            |
| 3. Cover                      | 24. Gasket                |
| 4. Gasket                     | 25. Plug (2)              |
| 5. Nut (2)                    | 26. Preformed packing (2) |
| 6. Setscrew (2)               | 27. Filter assembly       |
| 7. Screw (2)                  | 28. Preformed packing     |
| 8. Lock washer (2)            | 29. Setscrew              |
| 9. Core and armature assembly | 30. Bolt                  |
| 10. Needle (2)                | 31. Lock washer           |
| 11. Top orifice (2)           | 32. Link                  |
| 12. Preformed packing (4)     | 33. Roll pin              |
| 13. Spacer (2)                | 34. Retaining ring (2)    |
| 14. Valve (2)                 | 35. Washer (2)            |
| 15. Bottom orifice (2)        | 36. Preformed packing (2) |
| 16. Screw (4)                 | 37. Collar (2)            |
| 17. Lock washer (4)           | 38. Quad-ring (2)         |
| 18. Receptacle                | 39. Piston                |
| 19. Gasket                    | 40. Transducer assembly   |
| 20. Setscrew (2)              | 41. Transducer body       |
| 21. Screw (4)                 |                           |

8-113. REPAIR.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Most repair work consists of polishing of parts. Use No. 320 to 500 fine grit emery cloth for polishing all moving parts. Clean after polishing with approved solvent and dry thoroughly ,

b. Damaged threads can recleaned up using the proper size pipe tap to remove burrs.

CAUTION

Under no condition use a file on this valve surface, its length is critical.

c. The valves (14) may be polished to remove nicks and burrs or slight groove marks on the bottom of the valve. If after polishing the lower face the overall length of the valve is less than 0.240 inch, replace the valves (14).

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

d. The filter assembly (27) may be repaired by soldering if screen mesh has broken loose from the port body. Do not attempt to solder up broken areas in the screen mesh.

8-114. REASSEMBLY.

Refer to figure 8-26 and reassemble governor actuator unit in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Coat piston (39) with clean hydraulic oil conforming to Military Specification MIL-H-5606, prior to reassembly.

b. If receptacle (23) had to be removed due to armature and coil assembly (9) replacement, reconnect coil leads to receptacle L1 and L2 coils as shown in figure 8-27 as they are located when transducer

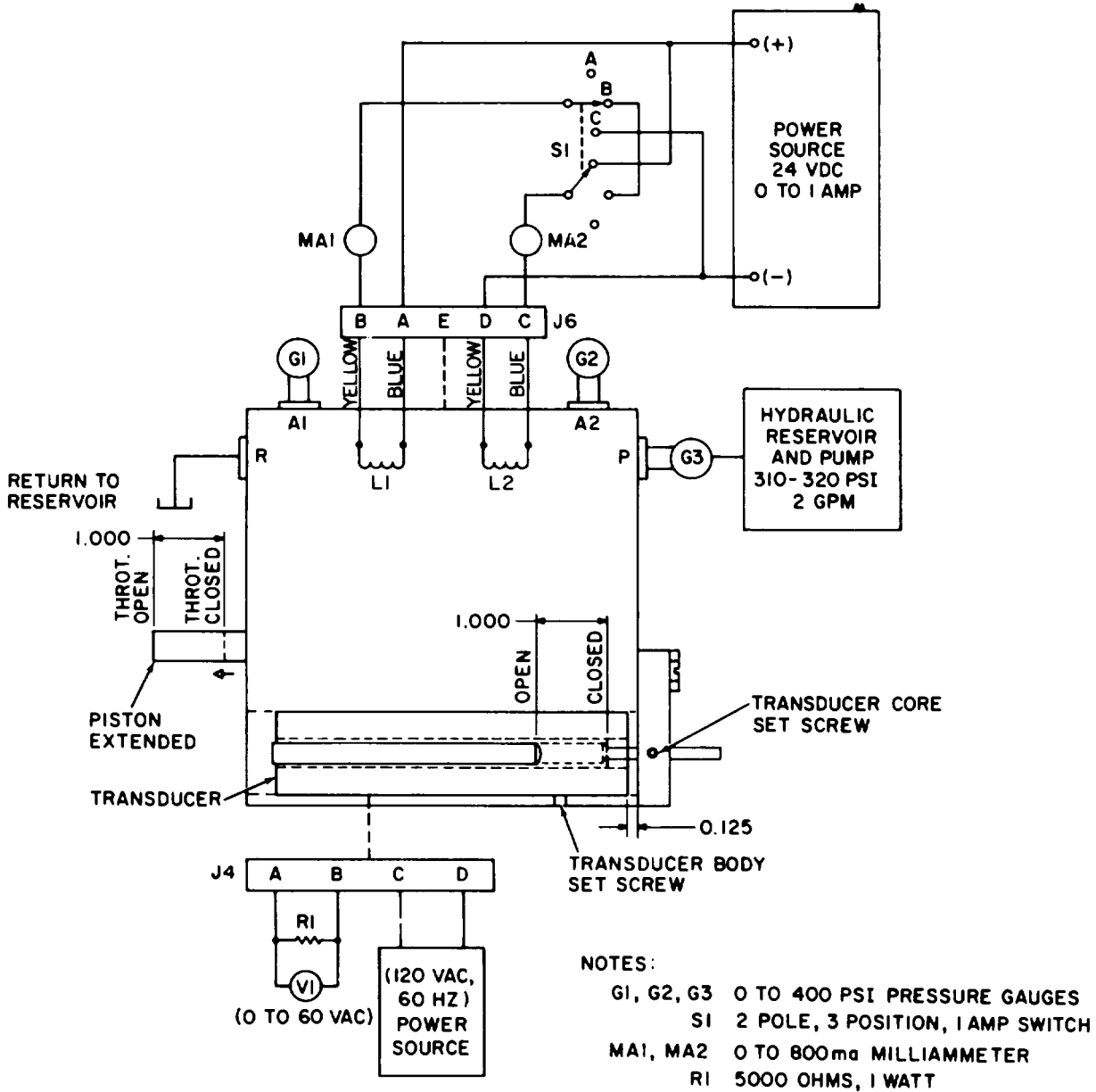


Figure 8-27. Governor actuator unit, test and adjustment

body of actuator unit is positioned like that shown in figure 8-27.

c. When inserting transducer assembly (40, figure 8-26) in transducer body (41), refer to figure 8-27 for location of transducer body and position of core in relation

to transducer body (41). This dimension is critical.

d. After core is positioned in transducer body, tighten set screw (29) in link (32) to secure core control arm.

8-115. TEST AND ADJUSTMENT.

a. Test equipment required.

1. Hydraulic pump (310 to 320 psi at 2 GPM).
2. Power source (120V 60 Hz).
3. D.C. power source (0 to 1 AMP 24 V. D.C. ).
4. Switch, 2 pole, 3 position, 1 amp rating.
5. Meter (2) (0 to 800 ma milliammeter).
6. Meter (1) (0 to 60 volts A.C.),.
7. Resistor (fixed -5000 ohms, 1 watt).
8. Gauge (3) (pressure 0 to 400 psi).

b. Actuator Valve and Piston Test.

Connect the governor actuator unit to test equipment as illustrated in figure 8-27 and proceed as follows:

1. With 24 vdc supply off, turn on the hydraulic pump drive and adjust the pressure to port P until G3 indicates  $320 \pm 10$  psi. Adjust pressure by setting the relief valve in the pump.

NOTE

The actuator output shaft shall be in the fully extended position (throttle open). Gauge G1 shall indicate  $150 \pm 10$  psi. Gauge G2 shall indicate  $200 \pm 10$  psi.

2, If gauges G1 and G2 do not indicate the required pressures, adjustment of valve screws (6, figure 8-26) on the armature and coil assembly (9) will have to be made. Proceed as follows.

(a) Remove cover (3) and place the governor actuator in a catch pan. The catch pan should drain back to the reservoir.

(b) Loosen lock nuts (5, figure 8-26) on each valve adjustment screw (6).

(c) To adjust pressure at gauge G1, insert an allen wrench in screw (6) on coil L1 adjustment screw (6) and rotate clockwise (or in) to reduce pressure on gauge G1. Rotating screw (6) counterclockwise will increase pressure on G1.

(d) Adjust pressure at gauge G1 by rotating screw (6) on coil L2 in the same manner as pressure adjustment on coil L1 was preformed.

NOTE

Adjustment of one side (L1) will in some degree effect the opposite side (L2); therefore, several adjustments of both sides will be required to obtain the setting specified in step c.

(e) Tighten lock nuts (5).

(f) Turn power supply on and position switch S1 to B and adjust 24 vdc power source until MA1 and MA2 indicate  $350 \pm 20$  ma. The actuator output shaft shall remain in the extended position. Gauge G1 shall indicate  $150 \pm 10$  psi. Gauge G2 shall indicate  $200 \pm 10$  psi.

(g) Position switch S1 to A. Adjust 24 vdc power supply until MA2 indicates 700  $\pm$ 40 ma. Piston shall fully retract. Gauge G1 shall indicate 310 to 400 psi. Gauge G2 shall indicate 0 to 20 psi.

(h) Position switch S1 to C. Adjust 24 vdc power supply until MA1 indicates 700  $\pm$ 40 ma. Piston shall fully extend. Gauge G1 shall indicate 0 to 40 psi. Gauge G2 shall indicate 310 to 400 psi.

c. Actuator Output Shaft Position Transducer Test and Adjustment. Connect voltmeter V1 and power sources to receptacle J4 on actuator as illustrated in figure 8-27 and proceed as follows:

**NOTE**

Hydraulic system components are not used during this test.

**CAUTION**

The output shaft position transducer is factory aligned and does not normally require readjustment.

1. Turn on the power supply.

2. Move the actuator output shaft to fully extended position. Transducer assembly (40) locked in place at dimensions indicated in figure 8-27. V1 shall indicate 0.5 to 2.5 volts. This shall be minimum voltage regardless of what other position the output shaft is placed.

3. If voltage range on V1 is not with the required 0.5 to 2.5 volts, loosen transducer core set screw (29, figure 8-26) on link (32) and move the core relative to the body until the minimum voltage of 0.5 to

2.5 is obtained on meter VI. Adjust to 1 volt as a starting point. Tighten the set screw (29) in place.

d. Move the piston (39) gradually towards the fully closed throttle position. The transducer secondary voltage shall increase in a linear manner to a maximum of 48 to 55 volts. Loosen set screw (29) and adjust to 50 volts as a starting point. Repeat core adjustment until the transducer secondary voltage increases linearly from the lowest possible value to a maximum value over the entire 1.0 inch travel of the piston (39). The ideal voltage range would be from 0.5 volt minimum to 55 volts maximum. This range may not be possible to obtain so the widest voltage spread will be acceptable as long as the minimum and maximum voltages are within the specified limits.

e. Tighten transducer core set screw (29).

8-116. **INSTALLATION.**

Refer to figure 8-25 and install precise governor actuator in reverse order of index numbers assigned. Pay particular attention to the following.

a. Before connecting actuator clevis to linkage, rotate fuel injection pump lever to maximum throttle position and scribe an indicating mark for referent e. Then rotate fuel injection pump lever to minimum throttle position and scribe an indicating mark for reference.

**NOTE**

Fill FUEL POSITION on pump lever is when top of lever is pushed towards front of engine.

b. Install actuator on mounting plate and secure with four mounting bolts.

c. Connect hydraulic and electrical connections.

d. Align actuator clevis hole with hole in linkage.

e. Loosen bolts securing pin bracket and slide bracket forward. Pass pin through clevis and pin bracket. Then tighten bolts and secure clevis to pin with cotter pin.

f. Check that actuator output shaft can move fuel inspection pump lever from full throttle to closed throttle position according to the scribe marks.

g. If full operating range cannot be reached, refer to linkage adjustment procedure in the Operator and Organizational Maintenance Manual.

## Section XVI. WATER PUMP GROUP

### 8-117. GENERAL

The water pump is mounted on the front side of the timing gear cover. The centrifugal-type pump is driven by the cam-shaft gear. The pump consists of an impeller and drive gear mounted on a common rotating shaft. Seals mounted on the shaft prevent water from leaking into the gear section and oil from leaking into the impeller section. As the engine is running, the drive gear in the water pump turns the shaft and impeller. The impeller creates a forceful flow of water through the engine cooling system.

### 8-118. REMOVAL

Refer to Operator and Organizational maintenance Manual, and remove water pump.

### 8-119. DISASSEMBLY

Refer to figure 8-28, and disassemble water pump in the order of index numbers assigned. Pay particular attention to the following:

- a. Remove impeller (30) by removing cotter pin (27), nut (28) and lock washer (29). Install three 5/16-18 inch bolts in tapped holes provided on the impeller. Thread bolts evenly as they bottom out on housing. As tension is increased, impeller will slide from tapered shaft.
- b. When pressing shaft (35) and bearing (34) out of housing, place a nut on end of shaft (35) to protect threads,
- c. Press shaft (35) and bearing (34) out of housing (42). Press from impeller end. Do not remove bearing (34) and gear (23) front shaft (35) unless bearing (34), gear

(23) or shaft (35) is being replaced. Press seal and ceramic ring assembly (33) out of impeller end of housing.

### 8-120. CLEANING

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- a. Clean all metal parts with an approved cleaning solvent and dry thoroughly.
- b. Clean calcium deposits from housing using a stiff wire brush.
- c. Remove all traces of old gasket material from gear cover.

### 8-121. INSPECTION

- a. Check bearings for freedom of rotation. Replace a bearing if its rotation is rough.
- b. Inspect bearings for pits, scratches, cracks or chipped races. Replace defective bearing.
- c. Inspect shaft for nicks, burrs, pits cracks. Replace defective shaft.
- d. Inspect threaded parts for thread damage.
- e. Inspect impeller for nicks, burrs, erosion, or cracks, Replace eroded or cracked impeller.
- f. Inspect cover and housing for cracks. Replace defective parts.

g. Inspect gear teeth for nicks, burrs, cracks and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear.

h. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.

i. Discard seals and gaskets.

#### 8-122. REPAIR.

a. Remove minor nicks and burrs using a suitable file or hone.

b. Repair minor thread damage using a suitable thread chaser.

#### 8-123. REASSEMBLY.

Refer to figure 8-28, and reassemble water pump in the reverse order of index numbers assigned. Pay particular attention to the following:

a. If bearing (34) is being replaced, gear (23) and bearing (22) must also be removed from shaft (35) by preheating shaft assembly in oil to a temperature of 300° F. Reassemble in reverse order before installing shaft (35) in housing (42). Make sure bearing housing (26) is installed on shaft after pressing bearing (34) on shaft (35).

b. Allow shaft assembly to cool. Install water pump seal (36) in housing (42) using an installation tool. Hand pack bearings (22 and 34) with an approved grease. Install shaft assembly into housing.

c. Place seal ring (33) and ceramic ring (32) onto shaft and seat into housing (38) and press seal and spring assembly (31) until carbon washer contacts ceramic ring.

d. Slide impeller (30) onto shaft (35). Install washer (29) and nut (28). Tighten nut slowly forcing the impeller over the tapered shaft surface until washer (29) bottom out on shaft shoulder.

e. Torque impeller nut (28) from 25 to 35 foot pounds.

f. Check impeller tip clearance between backside of impeller and housing. Clearance should be between 0.010 and 0.030 inch. If clearance is not within limits disassemble and reassemble pump to achieve proper clearance.

#### 8-124. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual, and install water pump group.

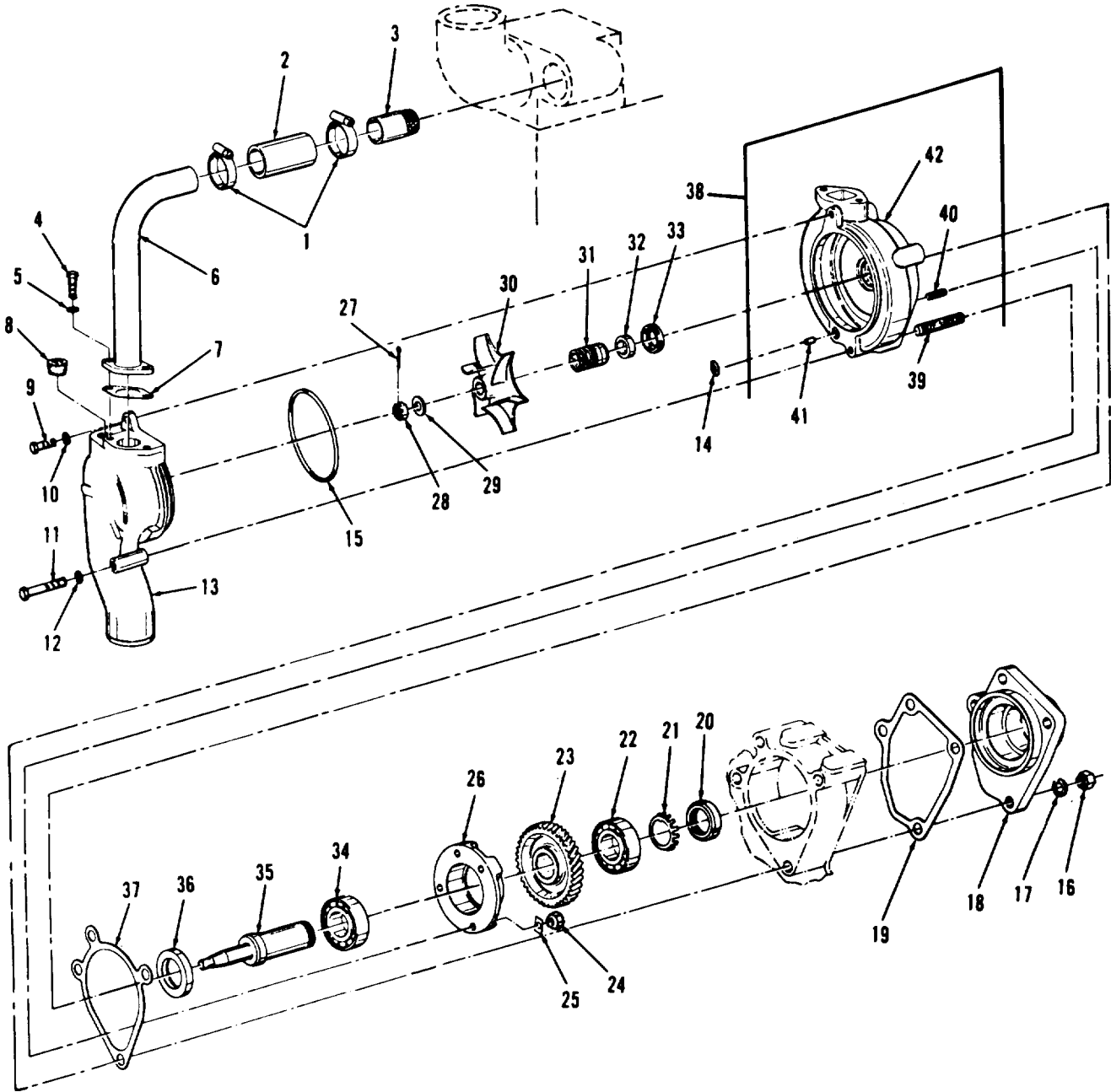


Figure 8-28. Water pump group, exploded view



Legend to figure 8-28:

- |                    |                     |                              |
|--------------------|---------------------|------------------------------|
| 1. clamp (2)       | 16. Nut (4)         | 30. Impeller                 |
| 2. Hose            | 17. Lock washer (4) | 31. Seal and spring assembly |
| 3. Nipple          | 18. Cover           | 32. Ceramic ring             |
| 4. Bolt (2)        | 19. Gasket          | 33. Seal ring                |
| 5. Lock washer (2) | 20. Nut             | 34. Bearing                  |
| 6. Tube assembly   | 21. Lock            | 35. Shaft                    |
| 7. Gasket          | 22. Bearing         | 36. Seal                     |
| 8. Plug            | 23. Gear            | 37. Gasket                   |
| 9. Bolt            | 24. Nut (4)         | 38. Housing assembly         |
| 10. Washer         | 25. Lock (4)        | 39. Stud (4)                 |
| 11. Bolt           | 26. Cage            | 40. Stud (4)                 |
| 12. Washer         | 27. Cotter pin      | 41. Ferrule                  |
| 13. Cover          | 28. Nut             | 42. Housing                  |
| 14. Seal           | 29. Washer          |                              |
| 15. Seal           |                     |                              |

Section XVII. CRANKSHAFT PULLEY, DAMPER AND TIMING GEAR COVER GROUP

8-125. GENERAL

The crankshaft pulley is installed on the front end of the engine crankshaft and, by means of V-type drive belts, drives the cooling fan pulley. The timing gear cover is sealed to protect the timing gear train, which consists of five gears located at the front of the engine.

f. Remove water pump group (para 8-118).

g. Refer to Operator and Organizational Maintenance Manual and remove alternator.

h. Remove five bolts, washers and lockwashers securing oil pan to timing gear cover.

8-126. REMOVAL

a. Remove engine assembly (para 2-8).

b. Remove fan mounting group (para 8-31).

c. Remove hydraulic tank (precise sets only) (para 8-86).

d. Remove hydraulic pump (precise sets only) (para 8-94).

e. Remove hydraulic pump drive group (para 8-101).

i. Removal of the crankshaft pulley, damper and timing gear cover group is accomplished during disassembly (para 8-127).

8-127. DISASSEMBLY

Refer to figure 8-29, and disassemble crankshaft pulley, damper and timing gear cover group in the order of index numbers assigned. Pay particular attention to the following:

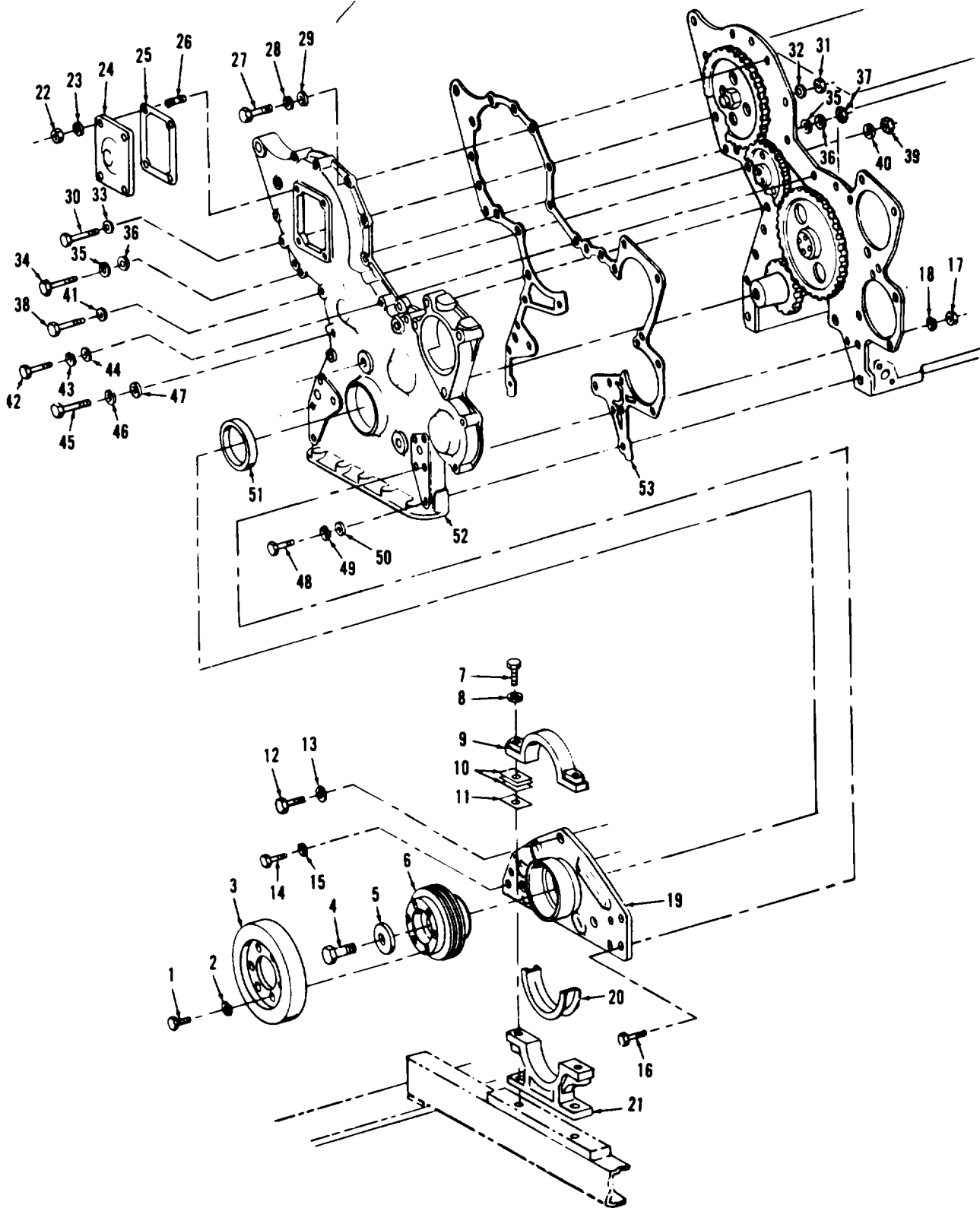


Figure 8-29. Crankshaft pulley, damper, and timing gear cover group, exploded view

Legend to figure 8-29:

- |                       |                     |
|-----------------------|---------------------|
| 1. Bolt (6)           | 28. Lock            |
| 2. Washer (6)         | 29. Washer          |
| 3. Damper             | 30. Bolt            |
| 4. Bolt               | 31. Nut             |
| 5. Washer             | 32. Lock washer     |
| 6. Pulley             | 33. Washer          |
| 7. Bolt (2)           | 34. Bolt            |
| 8. Lock washer (2)    | 35. Lock washer (2) |
| 9. Cap                | 36. Washer (2)      |
| 10. Shim (12)         | 37. Nut             |
| 11. Shim (2)          | 38. Bolt            |
| 12. Bolt (3)          | 39. Nut             |
| 13. Lock washer (3)   | 40. Lock washer     |
| 14. Bolt (5)          | 41. Washer          |
| 15. Lock washer (5)   | 42. Bolt (2)        |
| 16. Bolt              | 43. Lock washer (2) |
| 17. Nut               | 44. Washer (2)      |
| 18. Lock washer       | 45. Bolt            |
| 19. Trunnion assembly | 46. Lock washer     |
| 20. Bushing           | 47. Washer          |
| 21. Trunnion support  | 48. Bolt (2)        |
| 22. Nut (4)           | 49. Lock washer (2) |
| 23. Lock washer (4)   | 50. Lock washer (2) |
| 24. Cover             | 51. Seal            |
| 25. Gasket            | 52. Cover           |
| 26. Stud              | 53. Gasket          |
| 27. Bolt              |                     |

a. Remove bolts (1) from face of vibration damper (3) and separate damper from pulley (3).

b. After removing bolt (4), use a suitable puller and remove crankshaft pulley (6).

c. Separate top half of trunnion (9) and retain shims (10 and 11) if present, for reuse.

d. Since the accessory drive gear, camshaft gear, crankshaft gear and oil pump gears are covered under separate sections that deal with these gears as part of other assemblies, their removal, cleaning and inspection are covered in the following sections.

Accessory drive gear, Section XX,  
 Par 8-150

Oil pump gears, Section XXIII, Par 8-172

Camshaft gear, Section XXVII, Par 8-204

Crankshaft gear, Section XXIX, Par 8-220

e. If it is necessary to remove one of the timing gears, bar engine over manually to bring all timing marks in line as shown in figure 8-30, before removing a gear.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

8-128. CLEANING

Clean all parts in approved solvent and dry using compressed air or a lint free

cloth. Remove rust from pulley groove using a stiff wire brush.

#### 8-129. INSPECTION

- a. Inspect threaded parts for thread damage,
- b. Inspect crankshaft pulley for cracks and worn grooves. Replace defective pulley.
- c. Inspect timing gear cover for cracks, burred or nicked gasket surfaces. Replace cracked timing gear cover.
- d. Check trunnion and trunnion support for flat spots and rough or grooved surfaces.

e. Discard seal and gasket.

#### 8-130. REPAIR.

- a. Remove minor nicks and burrs using a suitable file or hone.
- b. Repair minor thread damage using a suitable thread chaser.
- c. Remove rough edges on pulley grooves with a small hand file.

#### 8-131. REASSEMBLY

Refer to figure 8-29, and reassemble crankshaft pulley, damper and

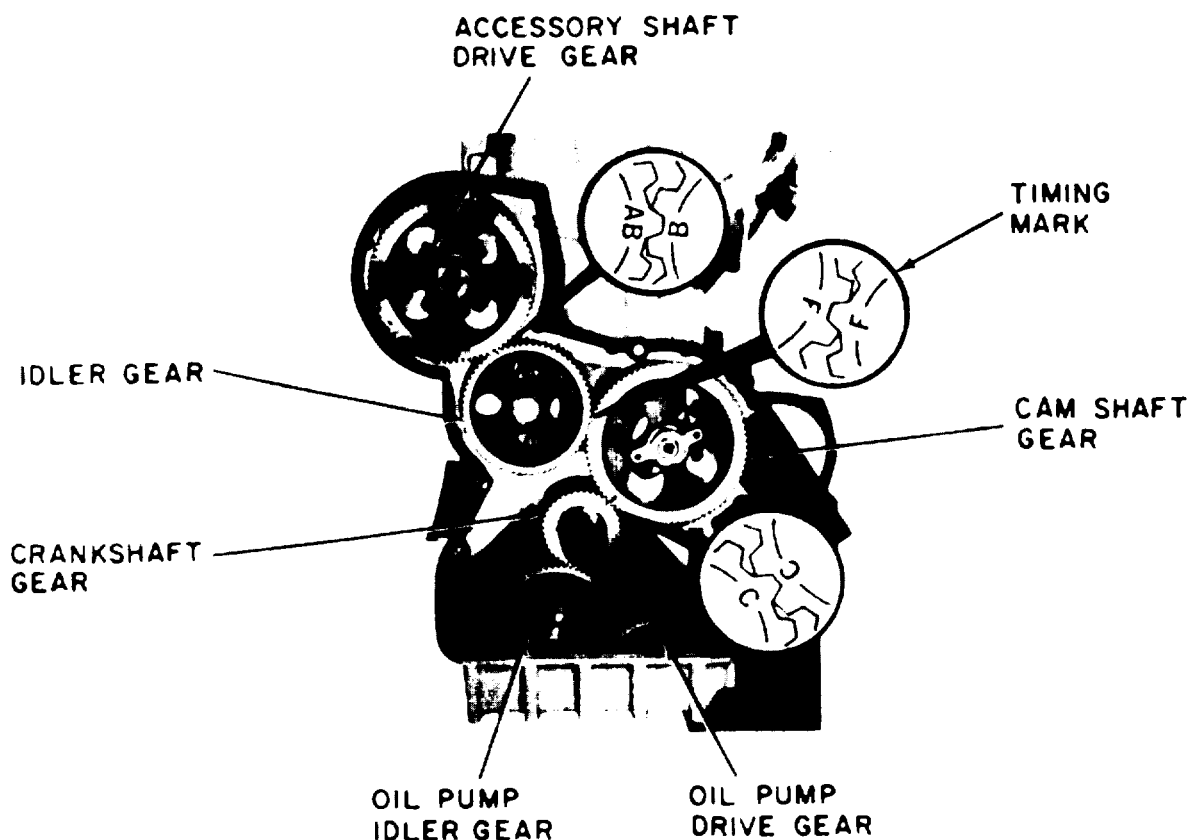


Figure 8-30. Alignment of timing marks

timing gear cover group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Apply a thin coat of approved sealant to timing gear cover studs (26) before installing cover (52).

b. When installing new gasket (53), trim gasket flush with bottom face of cylinder block and top front flange of oil pan.

c. Torque all timing gear cover bolts from 27 to 37 foot pounds.

d. Lubricate seal (51) lightly with engine oil. Put MIL-S-22473 sealant on the outer metal shell of the seal. Install seal into cover with flexible lip toward the engine.

e. Fill slot in trunnion (9) with an approved grease. Install trunnion (9) and trunnion support (21) using shims (10 and 11) previously removed.

f. Place a feeler gauge between trunnion (9) and bearing collar (19), add enough shims to one side to maintain a clearance of 0.002 inch to 0.003 inch tight.

g. Torque bolt (4) from 210 to 250 foot pounds, tap bolt head with a hammer, and retighten to specified torque.

#### 8-132. INSTALLATION

a. Installation of the crankshaft pulley, damper and timing gear cover group is accomplished during reassembly (para 8-131).

b. Install oil pan to timing gear cover and secure with five bolts, washers and lock washers.

c. Refer to Operator and Organizational Maintenance Manual and install alternator.

d. Install water pump group (para 8-124).

e. Install hydraulic pump drive group (para 8-107).

f. Install hydraulic pump (precise sets only) (para 8-99).

g. Install hydraulic tank (precise sets only) (para 8-92).

h. Install fan mounting group (para 8-37).

i. Install engine assembly (para 2-8).

### Section XVIII. UTILITY GOVERNOR GROUP

#### 8-133. GENERAL

The utility governor group is made up of two major assemblies mounted on the right side of the engine, the hydraulic governor assembly and the governor drive assembly. The governor consists of a governor drive shaft, speed adjusting shaft, low speed and high speed stop screws, related linkages, and shutdown solenoid valve. The speed adjusting shaft is used to set the

governor at the desired running speed. Low speed and high speed stop screws are provided to limit the speed range of the governor. The utility governor is mechanical-hydraulic type which senses engine speed by means of flyweights balancing against a speeder spring. This governor is designed to correct the fuel rate as a result of an off-speed condition only. On units equipped with the precise governor, the utility governor is adjusted to maintain an engine

speed above the desired speed. Therefore, when the precise governor is controlling the engine, the utility governor will move to the position to deliver maximum fuel, while the precise governor controls the fuel rate so as to maintain the desired speed.

#### 8-134. REMOVAL

a. Refer to Operator and Organizational Maintenance Manual and remove manual speed control.

b. Remove governor actuator unit (precise sets only) (para 8-109).

c. UTILITY GOVERNOR, LINKAGE AND OVERSPEED SHUTDOWN DEVICE. Refer to figure 8-31 and remove utility governor, linkage, oil lines and overspeed shutdown device in the order of index numbers assigned. Refer to figure 8-31A when disassembly of overspeed shutdown device is required.

#### NOTE

Prior to removal of the utility governor, make a note of the overall distance between the ball joint centers (4, 5, and 6) so that this rod assembly can be reinstalled at the same distance between ballpoint centers.

d. GOVERNOR DRIVE HOUSING. Refer to figure 8-32 and remove governor drive housing in the order of index numbers assigned. Pay particular attention to the following:

1. Remove governor drive coupling (1) before removing housing bolt.

2. When bolts (2, 4, and 6) are removed, governor housing (10) may be separated from rear plate assembly (12) by pulling housing (10) to the rear approximately 1/2 inch. Allow housing (10) to drop approximately 1/2 inch to disengage rack

control arm from injector rack. Remove housing, but do not force it.

3. Remove nut (8) and remove rear plate assembly (12) from rear of fuel injection pump.

#### 8-135. DISASSEMBLY

a. UTILITY GOVERNOR. Refer to figure 8-33 and disassemble utility governor assembly in the order of index numbers assigned. Pay particular attention to the following:

1. Clamp the governor lightly in a vise; vise jaws must grasp the base below the base case joint on the sides under the terminal shaft.

2. Insert a 5/16 inch diameter rod in the opening left after removing shaft (13), and drive the other shaft (13) out.

3. Make a note of the distance the high speed stop screw (19) protrudes from the case (69) so that it can be set approximately the same when reassembling.

4. Use a 1/8 inch diameter punch or rod to drive the pin (22) down from the top of lever (28) into the case (69).

5. Pull shaft (25) out of the case (69).

6. Lift out the assembly consisting of the lever (28), pilot valve plunger (49), bearing assembly (50), and connecting parts.

7. Remove plug (29), and gasket (30).

8. Remove springs (31 and 32).

NOTE

If the valve (33) and sleeve assembly (34) cannot be removed easily with a small pair of long-nosed pliers (or tweezers) and a hook scriber, leave them in the case (69) until step 14,

9. Remove the valve (33), and sleeve assembly (34).

10. Take the governor out of the vise and invert it, catching pin (39), piston (40), and rollpin (22) (driven out of the speed adjusting lever earlier),

11. Use snap ring pliers to take out the snap ring (53) under the ballarms. Lift out the ballhead assembly (57),

12. Remove snap ring (43) around the bushing assembly (54) drive shaft spline, and drive out bushing assembly (54) from base (62).

13. Remove screws (42) from the base (62) and remove the base (62). If the base (62) does not easily detach from the case (69), clamp base (62) (governor nameplate side of the case up) lightly in a vise; using a plastic or soft hammer, tap the underside of case (69) to loosen it from base (62).

CAUTION

Hold a hand under the base (62) and case (69) joint to catch the pump gears (58 and 59) which may drop out as the base (62) and case (69) are separated.

14. Remove pump gears (58 and 59) and gasket (61).

15. If the valve (33) and sleeve assembly (34) could not be removed in step 9, insert a 3/16 inch diameter rod in the tapped hole opposite the relief valve opening and push the valve (33) out. Then insert a suitable extracting tool in the relief valve opening to pull out the sleeve assembly (34).

16. Clamp stud (66) in a vise. Twist and pull case (69) to remove stud.

CAUTION

Be careful not to score the ground bottom surface of case (69).

17. If necessary, drive out bushings (67 and 68) using a 3/8 diameter rod and a suitable piloted driving block. In each instance drive the bushing (67 and 68) out of the case (69) (rather than in towards the center).

18. Clamp the fork (45) in a vise with a pin hole up; use a thin screwdriver or a small punch to drive the spring (46) Off of the fork (45).

19. Twist the spring (46) to detach it from the spring seat.

b. GOVERNOR DRIVE HOUSING. Refer to figure 8-34 and disassemble governor drive housing in the order of index numbers assigned. Pay particular attention to the following:

1. If maximum fuel stop assembly (1, 2, 3, 4, and 5) is not to be repaired it should not be disassembled,

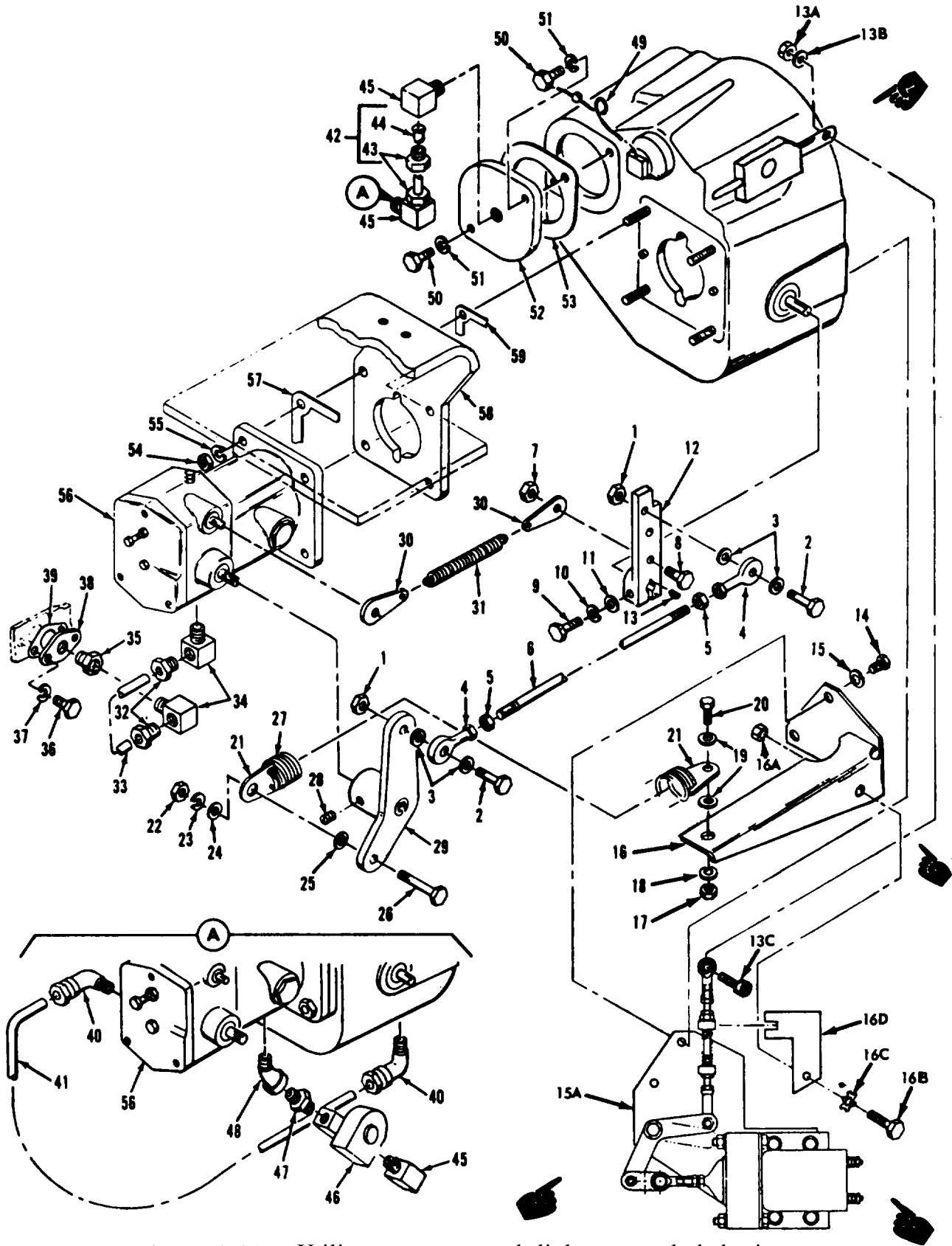


Figure 8-31. Utility governor and linkage, exploded view



Legend to figure 8-31:

- |                              |                            |
|------------------------------|----------------------------|
| 1. Nut (2)                   | 27. Spring                 |
| 2 Bolt (2)                   | 28. Screw set              |
| 3. Lock washer (2)           | 29. Lever                  |
| 4. Rod end (2)               | 30. Spring end (2)         |
| 5. Nut, lock (2)             | 31. Spring                 |
| 6. Rod                       | 32. Tube fitting (2)       |
| 7. Nut                       | 33. Tube                   |
| 8. Bolt                      | 34. Elbow (2)              |
| 9. Bolt (2)                  | 35. Coupling               |
| 10. Lock washer              | 36. Bolt (2)               |
| 11. Washer                   | 37. Lock washer (2)        |
| 12. Lever                    | 38. Flange                 |
| 13. Key                      | 39. Gasket                 |
| 13A. Nut                     | 40. Elbow (2)              |
| 13B. Washer                  | 41. Tube                   |
| 13C. Screw                   | 42. Tube Assembly          |
| 14. Bolt (2)                 | 43. Inverted flare nut (2) |
| 15. Lock washer (2)          | 44. Tube                   |
| 1A Overspeed shutdown device | 45. Elbow (2)              |
| 16. Bracket                  | 46. Solenoid valve         |
| 16A. Nut                     | 47• Union                  |
| 16B.Screw, cap               | 48. Elbow 45"              |
| 16C. Washer                  | 49. Safety wire            |
| 16D. Bracket                 | 50. Bolt (2)               |
| 17. Nut                      | 51. Lock washer (2)        |
| 18. Lock washer (2)          | 52. Flange                 |
| 19. Washer (2)               | 53. Gasket                 |
| 20. Bolt                     | 54• Nut (4)                |
| 21• Spring end (2)           | 55* Lock washer (4)        |
| 22. Nut                      | 56. Utility gov. assy      |
| 23. Lock washer              | 57. Gasket                 |
| 24. Washer                   | 58. Mounting plate         |
| 25. Washer                   | 59. Gasket                 |
| 26. Bolt                     |                            |

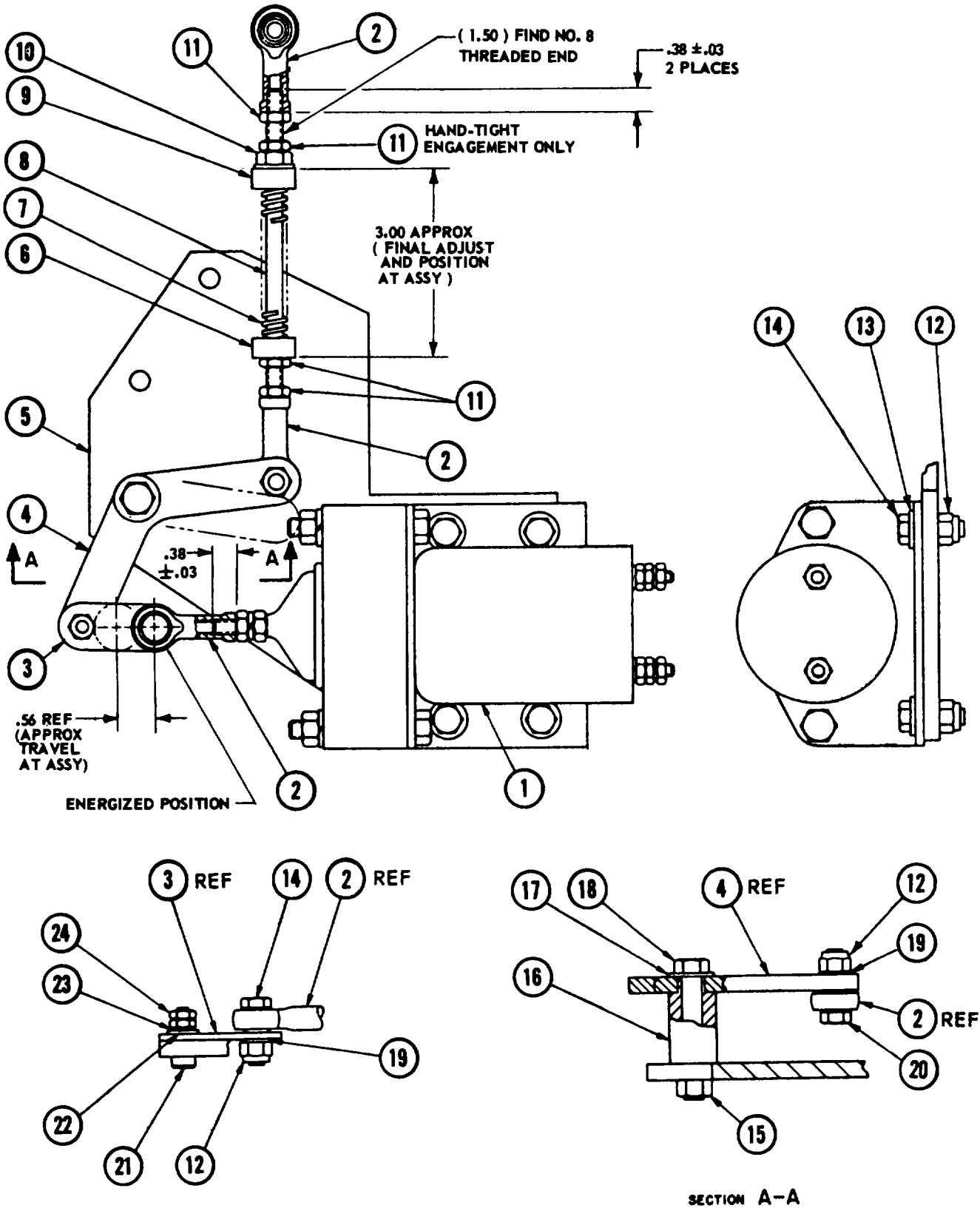


Figure 8-31A. Overspeed Shutdown Device

Legend to figure 8-31A:

1. Solenoid
2. Rod end (3)
3. Link
4. Lever
5. Baseplate
6. Bushing
7. Spring
8. Rod
9. Bushing
10. Nut, flanged
11. Nut (4)
12. Nut (6)
13. Washer (4)
14. Screw, cap (4)
15. Nut
16. Spacer
17. Washer
18. Screw, cap
19. Washer
20. Screw, cap
21. Screw
22. Washer
23. Washer
24. Nut (2)

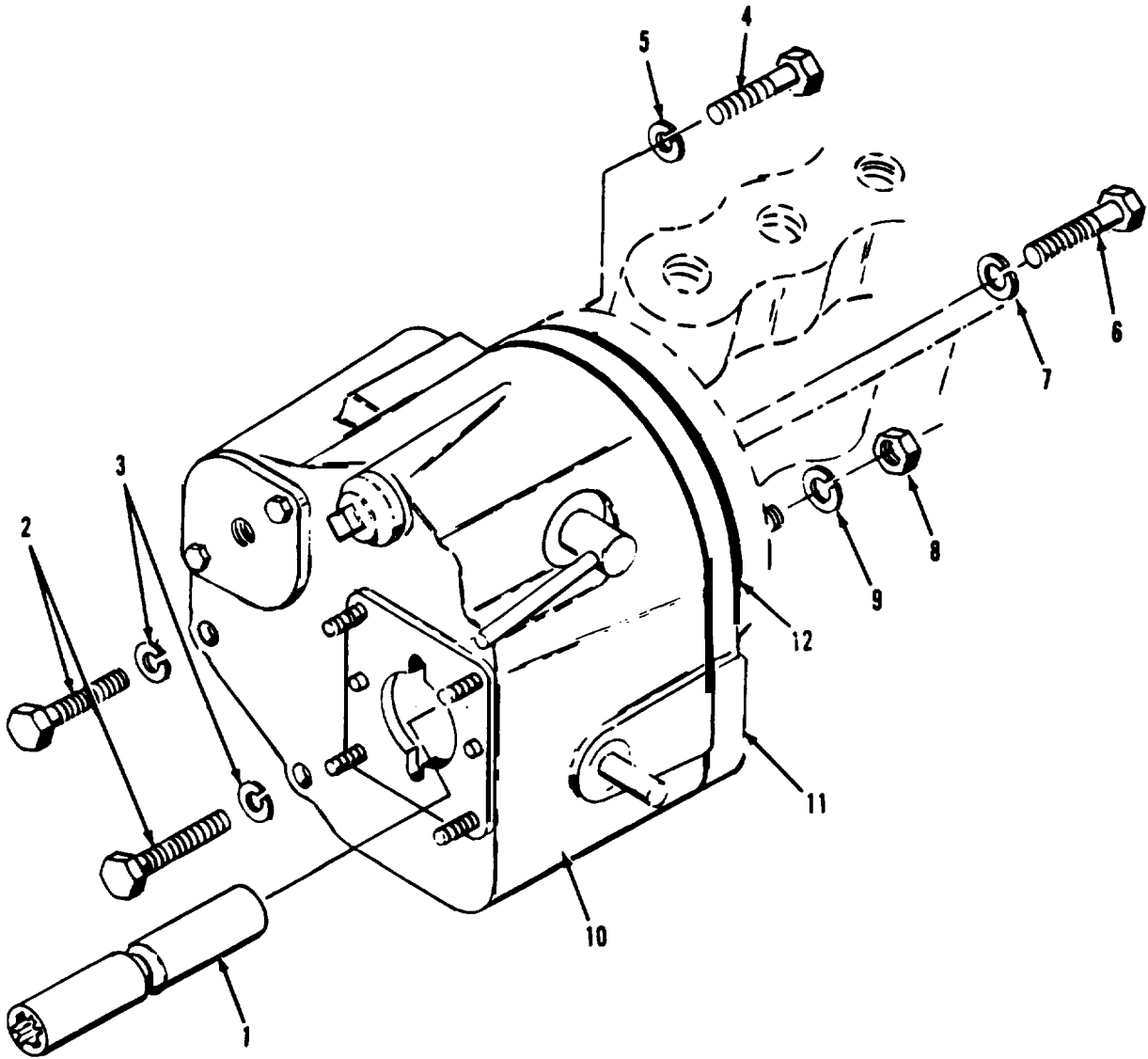


Figure 8-32. Governor drive housing, removal and installation

Legend to figure 8-32:

- |                    |                            |
|--------------------|----------------------------|
| 1. Coupling        | 7. Lock washer             |
| 2. Bolt(2)         | 8. Nut                     |
| 3. Lock washer (2) | 9. Lock washer             |
| 4. Bolt            | 10. Governor drive housing |
| 5. Lock washer     | 11. Gasket                 |
| 6. Bolt            | 12. Plate assembly         |

2. Seals (50) must be removed from the outside of the housing. Do not attempt to push towards center of housing.

### 8-136. CLEANING.

#### a. UTILITY GOVERNOR.

##### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

1. Clean all parts in unapproved cleaning solvent and dry with a lint free cloth.

##### CAUTION

Use extreme care when polishing the pilot valve (49, figure 8-33) control land. Leave corners sharp; broken or rounded corners on this land will ruin the valve.

2. Polish parts using No. 320 to 500 fine grit emery cloth.

b. GOVERNOR DRIVE HOUSING. Clean all parts in an approved cleaning solvent and dry with a lint free cloth.

### 8-137. INSPECTION.

#### a. UTILITY GOVERNOR

1. Refer to table I-1, and using a suitable micrometer, check the following parts for wear:

(a) Power piston (40, figure 8-33) O.D.

- (b) Pilot valve (49) lands.  
(c) Bushing (55) O.D.  
(d) Shaft (56) spline end,  
(e) Speed adjusting shaft (13) O.D.  
(f) Terminal shaft (25) O.D.  
(g) Idler gear stud (66).  
(h) Drive gear (59) O.D.  
(i) Relief valve (33) O.D.

(j) Replace parts that have exceeded maximum-allowable wear limits.

2. Inspect ground bottom surface of case (69) for grooves, scratches or wear.

3. Inspect the ground flat surface of the base (62) for warp, nicks, or deep scratches.

4. Inspect the pump gears (58 and 59) as follows:

(a) Place the pump gears in the gear pockets and check for free rotation,

(b) If the gears turn roughly, inspect for nicks or wear of the gear teeth, and for interference at internal corners of the gear pockets in the base (62).

5. Check clearance between piston (40) and case (69), piston should move freely without binding or catching.

##### **NOTE**

Excessive clearance between piston (40) and case (69), however, will result in excessive oil leakage within the governor.

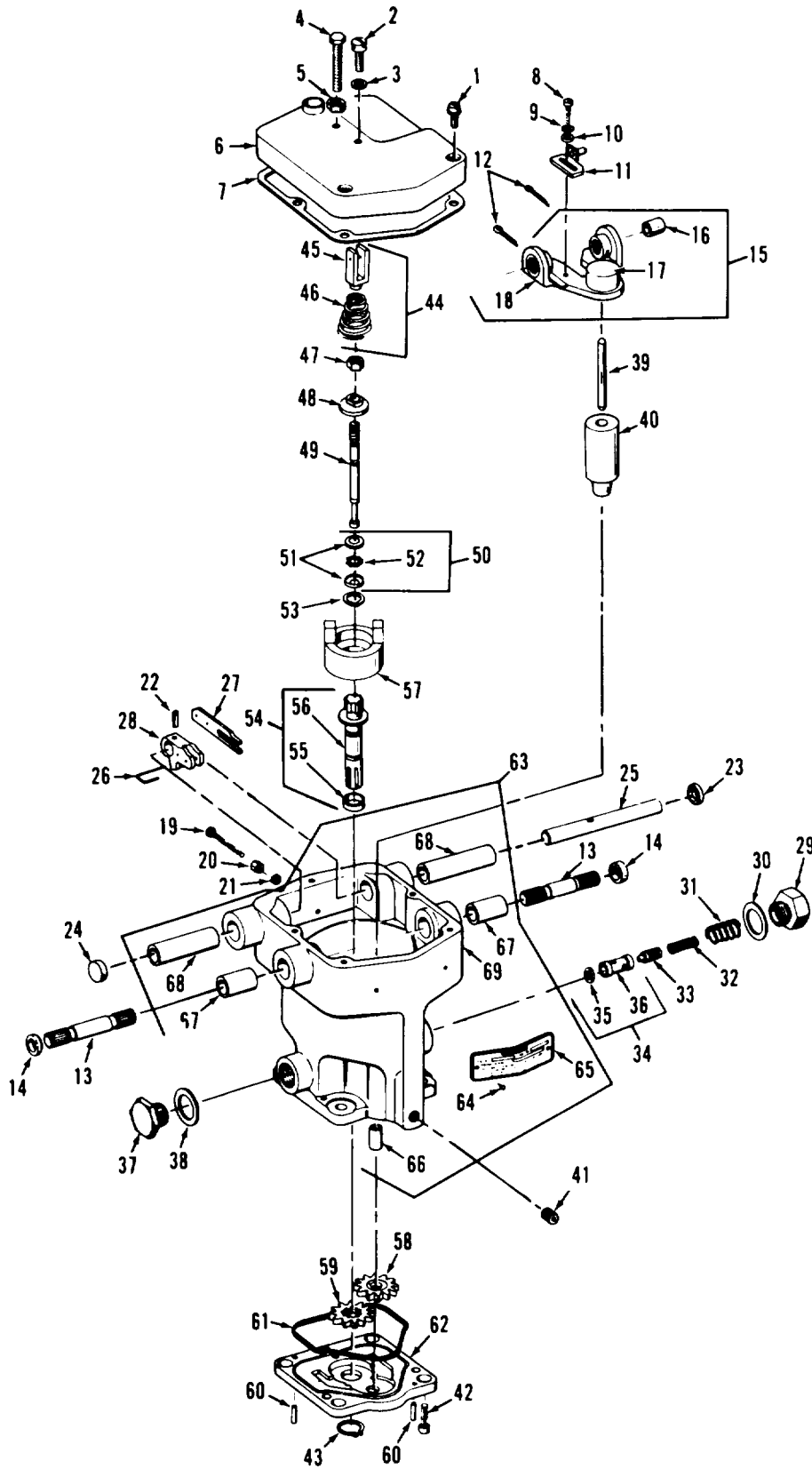


Figure 8-33. Utility governor assembly, exploded view

Legend to figure 8-33:

- |                     |                        |
|---------------------|------------------------|
| 1. Screw (3)        | 36. Sleeve             |
| 2. Screw            | 37. Plug               |
| 3. Washer           | 38. Washer             |
| 4. Screw            | 39. Pin                |
| 5. Nut              | 40. Power piston       |
| 6. Cover            | 41. Plug               |
| 7. Gasket           | 42. Screw (3)          |
| 8. Screw            | 43. Snap ring          |
| 9. Lockwasher       | 44. Spring assembly    |
| 10. Washer          | 45. Fork               |
| 11. Bracket         | 46. Spring             |
| 12. Cotter pin (2)  | 47. Nut                |
| 13. Shaft (2)       | 48. Spring retainer    |
| 14. Seal (2)        | 49. Pilot valve        |
| 15. Lever assembly  | 50. Bearing assembly   |
| 16. Bushing (2)     | 51. Race               |
| 17. cup             | 52. Balls              |
| 18. Lever           | 53. Snap ring          |
| 19. Screw           | 54. Bushing assembly   |
| 20. Nut             | 55. Bushing            |
| 21. Washer          | 56. Shaft              |
| 22. Roll pin        | 57. Ball head assembly |
| 23. Seal            | 58. Gear               |
| 24. Plug            | 59. Gear               |
| 25. Shaft           | 60. Pin (2)            |
| 26. Spring wire     | 61. Gasket             |
| 27. Lever           | 62. Base               |
| 28. Lever           | 63. Case assembly      |
| 29. Plug            | 64. Screw (2)          |
| 30. Gasket          | 65. Nameplate          |
| 31. Spring          | 66. Stud               |
| 32. Spring          | 67. Bushing (2)        |
| 33. Valve           | 68. Bushing (2)        |
| 34. Sleeve assembly | 69. Case               |
| 35. Washer          |                        |

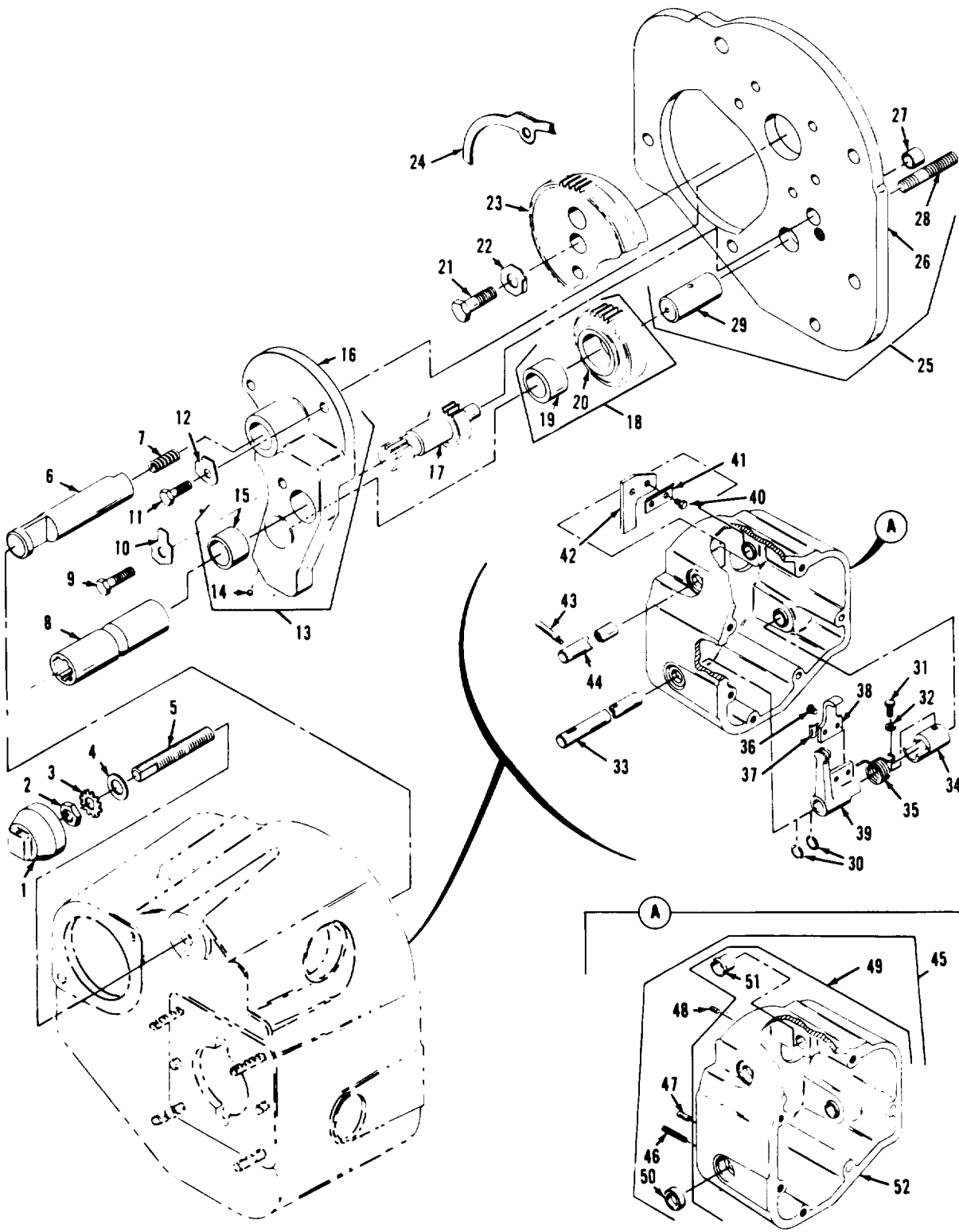


Figure 8-34. Governor drive housing, exploded view



Legend to figure 8-34:

- |                          |                         |
|--------------------------|-------------------------|
| 1. Cap                   | 27. Bushing             |
| 2. Locknut               | 28. Stud                |
| 3. Lock washer           | 29. Shaft               |
| 4. Washer                | 30. Snap ring (2)       |
| 5. Threaded rod          | 31. Bolt                |
| 6. Rack extension        | 32. Lock washer         |
| 7. Spring                | 33. Shaft               |
| 8. Drive coupling (ref)  | 34. Coupling            |
| 9. Bolt                  | 35. Spring              |
| 10. Lockplate            | 36. Bolt (2)            |
| 11. Bolt                 | 37. Lockplate (2)       |
| 12. Lockplate            | 38. Lever               |
| 13. Plate assembly       | 39. Lever               |
| 14. Ball                 | 40. Bolt (2)            |
| 15. Bushing              | 41. Lockplate (2)       |
| 16. Plate                | 42. Plate               |
| 17. Gear                 | 43. Pin                 |
| 18. Gear assembly        | 44. Handle              |
| 19. Bushing              | 45. Housing assembly    |
| 20. Gear                 | 46. Stud (4)            |
| 21. Bolt                 | 47. Dowel (2)           |
| 22. Lockplate            | 48. Pin                 |
| 23. Gear                 | 49. Housing subassembly |
| 24. Gasket               | 50. Seal (2)            |
| 25. Cover plate assembly | 51. Bushing (4)         |
| 26. Cover plate          | 52. Housing             |

6. Inspect rod ends (4, figure 8-31 and 6, figure 8-31A) for freedom of movement of the ball within the housing socket. Replace rod ends that bind.

7. Inspect governor return spring (27, figure 8-31) for cracked coils and the extremities (21) for worn/elongated holes. Replace defective spring assembly.

8. Inspect overspeed shutdown device for worn or defective parts and linkage for freedom of movement. Replace worn or defective parts.

9. Discard gaskets (7 and 61, figure 8-33).

10. DC Solenoid - Refer to Figure 8-31.

a. Check DC solenoid for loose connection.

b. Check for foreign material causing poor electrical connection.

c. Inspect DC solenoid valve for worn or defective parts and valve for freedom of movement. Replace worn or defective part.

d. Check for proper voltage 24 VDC at solenoid terminals.

b. GOVERNOR DRIVE HOUSING.

1. Inspect bushings (15, 19, and 27, figure 8-34) for scoring, excessive wear, and other damage. Replace worn bushings.

2. Inspect drive gears (20 and 23) for excessively worn gear teeth.

3. Inspect shaft (29) for wear. Check to see that all four oil holes are open and clean.

4. Inspect shaft bushings (51) for excessive wear and for grooving. Replace defective bushings.

5. Discard gaskets (24) and seals (50).

8-138. REPAIR

a. UTILITY GOVERNOR.

1. Most of the repair work consists of cleaning and polishing of parts. Use No. 320 to 500 fine grit emery cloth for polishing. All pistons should move freely without binding or catching; excessive clearance between mating parts, however, will result in excessive leakage of pressure oil within the governor.

2. Be extremely careful when polishing pilot valve (49, figure 8-33) control land. Leave the corners sharp; broken or rounded corners on this land will ruin the pilot valve.

3. If ground bottom surface of the case (69) is grooved or worn from rotation of the pump gears (58 and 59), or scratched from mishandling, it may be surface ground. Up to 1/32 inch may be removed. Lap the surface smooth on a flat plate if a surface grinder is not available.

CAUTION

Do not remove more stock than necessary to clean up.

4. If the ground, flat surface of the base (62) is warped, nicked, or deeply scratched, it may be lapped smooth on a flat plate. If the depth of the gear pockets is reduced, the gears will bind; in this event, the faces of the gears (58 and 59) must be lapped to provide clearance,

b. GOVERNOR DRIVE HOUSING.

1. Repair gear (20 and 23, figure 8-34) teeth that have small nicks with a fine hone.

2. Clean plugged oil holes in shaft (29) using a small piece of wire. Do not attempt to redrill holes.

8-139. REASSEMBLY

a. UTILITY GOVERNOR, Refer to figure 8-33 and reassemble utility governor assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

1. Drive dowel pins (60) out of base (62).

2. If necessary to install new bushings (67 and 68), insert a suitable support plate of exactly the correct width between the inner walls of the case (69). Press bushings (67 and 68) in with arbor press to dimensions shown in figure 8-35. Press in idler gear stud (66) to depth shown in figure 8-35.

3. After installing bushings (67 and 68, figure 8-33), line size or line ream with standard 3/8 inch diameter line reamer.

4. Place pump gears (58 and 59) in gear pockets of base (62).

CAUTION

Do not use adhesive on surface of base (62).

5. Coat surface of base (62) with engine oil (precise generator sets only).

6. Place gasket (61) in groove of base (62).

7. Place case (69) on base (62), invert, and put the bushing assembly (54) in

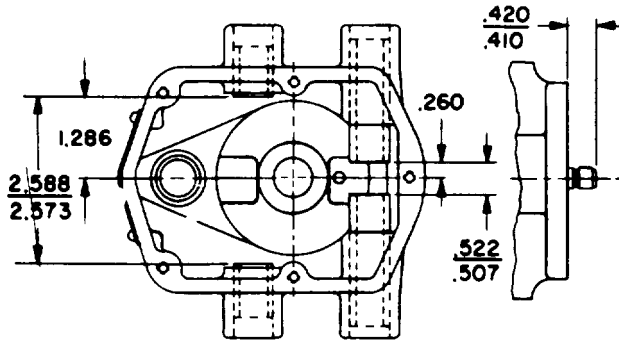


Figure 8-35. Dimensions for installing utility governor assembly bushings

through the bottom of the base (62) to permit rotating the pump gears (58 and 59).

8. Insert base screws (42) and tighten while turning bushing assembly (54) to insure free rotation of gears (58 and 59).

9. Insert dowel pins (60) and drive them down approximately 1/16 inch below base (62) surface. Remove bushing assembly (54).

10. Place the ballhead assembly (57) and bushing assembly (54) into its correct position in the case (69), and using suitable snap ring pliers install the snap ring (43).

11. Turn bushing assembly with fingers. If it binds, loosen screws (42) slightly and free up by striking at corners of base (62). Tighten screws (42) and re-check.

12. Assemble seat (48) to pilot valve (49), secure with nut (47), and wind the spring (46) and fork (45) firmly into the spring seat. Each end of spring (46) must be securely attached to its mating part.

13. Be sure relief valve plunger (33) moves freely in sleeve assembly (34)

(plunger installed with small diameter towards outside of governor). Sleeve must fit freely into case (69) bore.

14. Install high speed stop screw (19) to the distance noted during disassembly paragraph 8-135, step a. 3.

b. GOVERNOR DRIVE HOUSING. Refer to figure 8-34 and reassemble governor drive housing in the reverse order of index numbers assigned. Pay particular attention to the following:

1. Assemble items (30 through 51) in housing (52).
2. Press bushing (27) into plate (26) with open end of bushing flush with housing side of plate.
3. Press shaft (29) into plate (26) flush with fuel injection pump side of plate.
4. Assemble items (11 through 23) to plate (26). Secure all lock plates. Gears (20 and 23) are not timed.

#### 8-140. INSTALLATION

a. GOVERNOR DRIVE HOUSING. Refer to figure 8-32 and install governor drive housing in reverse order of index numbers assigned. Pay particular attention to the following:

1. Install plate assembly (12) to rear of fuel injection pump. Plate assembly is located with two dowels secured in pump housing. When installing plate assembly, drive gear (23, figure 8-34) will slide over the extended camshaft on fuel injector pump. Rotate gear (23) until dowel pin on pump camshaft engages hole in rear face of gear (23).

2. Install new gasket (11, figure 8-32) and install nut (8) and lockwasher (9).

3. Install rack extension (6, figure 8-34) and compression spring (7) through plate assembly (13) until rack extension contacts fuel inject on pump control rack. Press in to collapse spring and rotate until collar on rack extension (6) locks over the fuel injection pump rack land. Slide entire rack assembly back and forth to ensure that parts are not binding. The double notch at the housing end of the rack extension (6) should be in a vertical position.

4. Refer to figure 8-36 (view B). Remove two screws from front of fuel injection pump. Insert finger and push control rack back. Note that entire rack and each extension move together. View A of figure 8-36 illustrates how the rack extension will engage the control lever.

This connection is extremely critical and since it is made by feel only, extreme care must be used.

5. Rotate shutdown lever handle (44, figure 8-34) to downward position. Pull control rack extension to the rear. With complete drive housing in left hand and with fingers of right hand on control shaft (33), position drive housing onto face of rear cover plate (25) approximately 3/4 inch below top of rear plate. Slowly raise drive housing while rotating control shaft (33) back and forth until engagement is felt between the lever and rack extension (figure 8-36, view A). Raise drive housing completely, and secure with bolts (2, figure 8-32) and lock washers (3).

6. With finger inserted in opening or front of injection pump (figure 8-36, view B), and touching control rack, rotate control shaft lever (33, figure 8-34) back and forth. Control rack should follow in

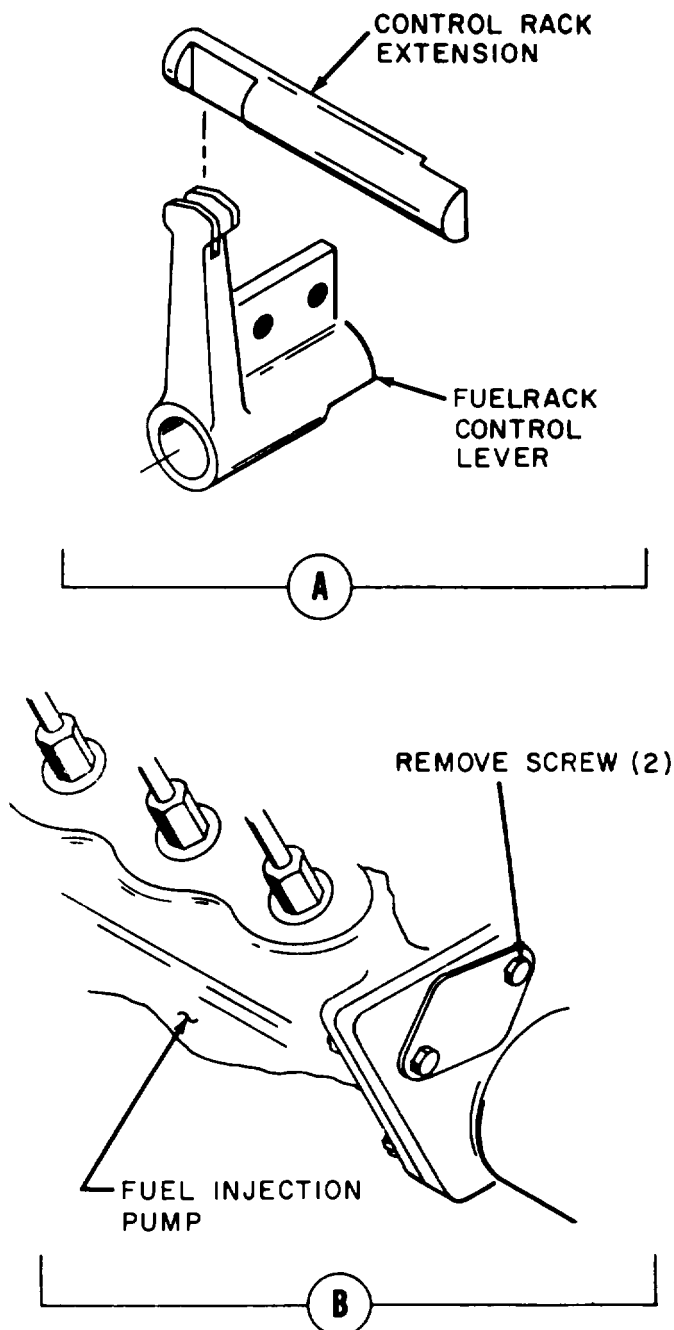


Figure 8-36. Engagement of control rack to control lever

both directions. If control rack only moves forward but not backward, remove drive housing, and attempt to re-engage control lever with rack extension.

## NOTE

Under no condition should the engine be run unless the control shaft can move the fuel injection pump rack in both directions at the point.

Under no condition should the control lever (39, figure 8-34) or the rack extension be filed to make an easier fit. If the parts do not mate, it is only because the parts are damaged and should therefore be replaced, or the parts have been assembled incorrectly,

7. If fuel rack stop assembly (1, 2, 3, 4, and 5) has been removed, assemble to rear of housing but do not install cap (1). Fuel stop will have to be set. This is covered under governor drive housing adjustment.

b. GOVERNOR DRIVE HOUSING ADJUSTMENT. Maximum fuel stop setting must be checked whenever governor drive housing is removed. Proceed as follows:

1. Using an approved rack setting gauge, refer to figure 8-36, view B, and remove two screws, flange, and gasket from flange at rear of accessory drive housing.

2. Rotate knob of rack setting tool counter clockwise until the number 3 appears under the micrometer dial. Install tool in opening, using the same screws that secure the flange. Do not use gasket or lockwasher. Tighten screws with fingers just enough to engage threads.

3. Rotate shaft (33, figure 8-34) in a clockwise direction, pushing the pump rack toward the front of the unit. When end of rack contacts open end of rack setting

tool, wiggle the tool slightly so that rack slides inside of collar on the rack setting tool.

4. Tighten two screws holding rack setting tool until they are tight. Use a wrench to tighten these two screws only enough to firmly anchor the tool against the flange face.

5. Turn micrometer dial clockwise until the leading edge of the rotating dial lines up with NO. 1. on the non-rotating shaft and #0 on the rotating dial. Refer to figure 8-37 (view A).

6. Rotate shaft (33, figure 8-34) clockwise, pushing fuel injection pump rack forward until it contacts rack setting tool; and hold in this position with right hand,

7. With the rack setting tool, set in position as described in step 5. , slowly rotate rack stop screw (5) clockwise with the fingers or a small flat bladed screw driver until contact is felt. While holding rack stop screw, remove right hand from shaft (33, figure 8-34) and tighten lock nut (2) without moving rack stop screw (5).

8. To check adjustment, turn the rack setting tool micrometer dial a few turns counterclockwise. Rotate shaft (33) back and forth a few times and end up rotating shaft (33) clockwise and hold in full fuel position. Rotate micrometer dial on rack setting tool clockwise until it contacts fuel injection pump rack. Dial should be reading +1 on the shaft and "0" on the rotating dial. Refer to figure 8-37 (view A) for allowable tolerances.

9. If reading is not within indicated tolerances (figure 8-37, view A), repeat procedure starting with step 5.

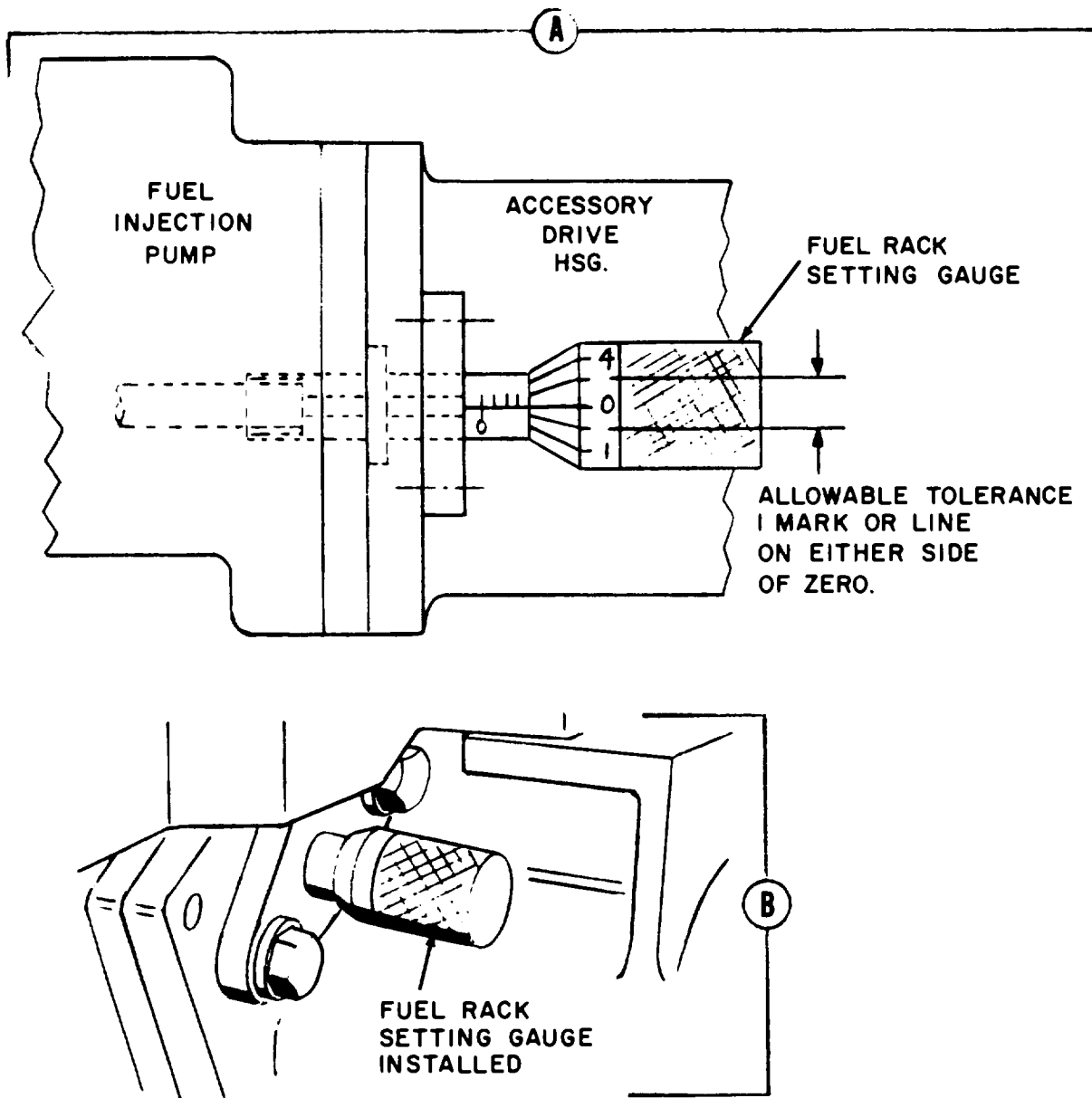


Figure 8-37. Installing fuel rack setting gauge

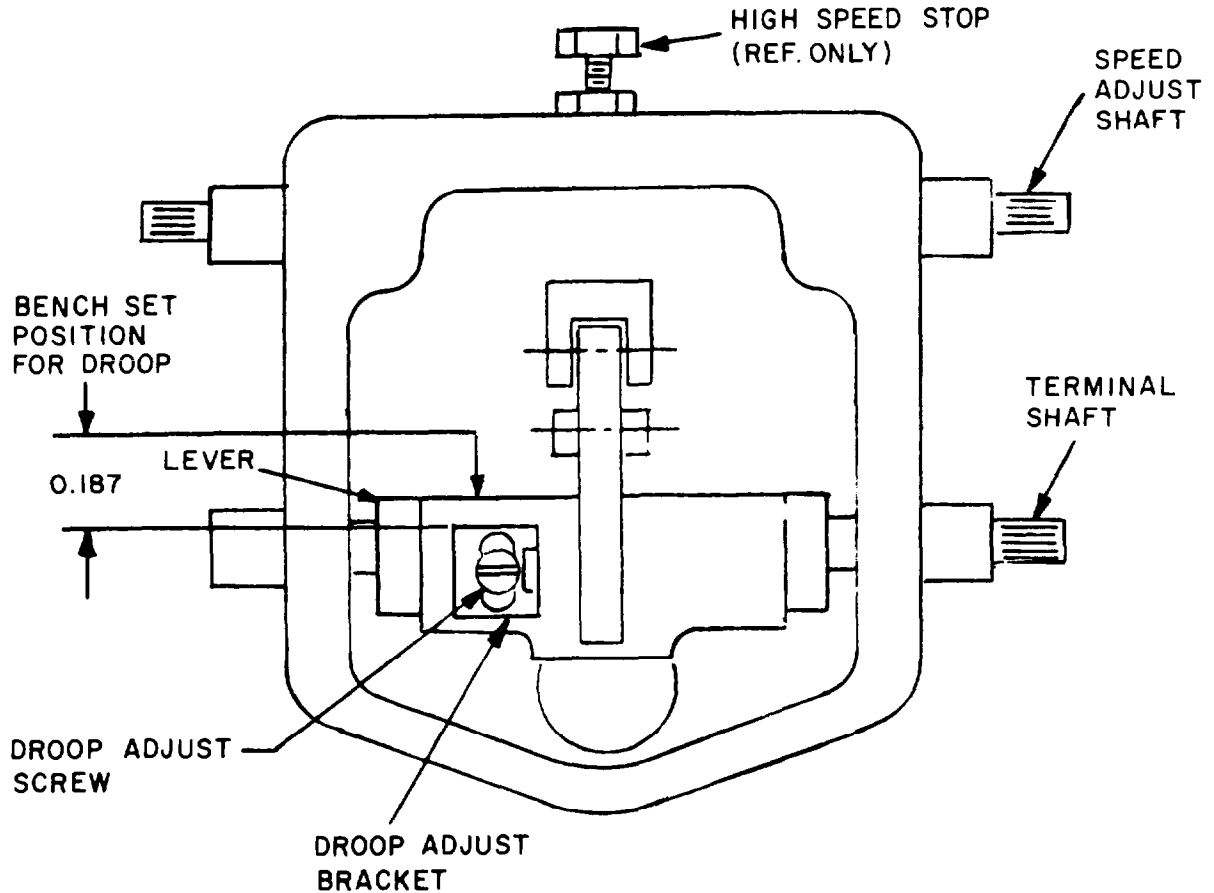
10. Check to see that locknut (2, figure 8-34) is secure, apply cap (1), and tighten. Secure with safety wire.

c. UTILITY GOVERNOR ADJUSTMENT - OFF UNIT. Set utility governor droop setting prior to installation on the engine. Refer to figure 8-38 and set droop adjust bracket (11, figure 8-33) 0.187 inch

from edge of lever (18) when viewed in the position shown.

NOTE

This setting is nominal. Additional adjustment may have to be made. Refer to paragraph 8-237 for final adjustments during engine operation.



TOP VIEW OF GOVERNOR WITH COVER REMOVED

Figure 8-38. Utility governor droop setting

d. UTILITY GOVERNOR, LINKAGE AND OVER-SPEED SHUTDOWN DEVICE. Refer to figures 8-31 and 8-31A and install utility governor, linkage, oil lines and overspeed shutdown device in the reverse order of index numbers assigned. Pay particular attention to the following:

1. Insert governor drive coupling (1, figure 8-32) into governor drive housing and engage spline.

2. Install new gaskets (57 and 59, figure 8-31) and mounting plate (58).

3. Install utility governor (56) on the four mounting studs of the governor drive housing. Governor drive coupling (1, figure 8-32) will engage spline on utility governor drive shaft. Do not force. If coupling and spline do not engage, pull

utility governor back just far enough to rotate utility governor drive shaft with the fingers, into a new position.

4. Install oil lines in such a manner that undue stress is not applied to the tube assemblies when positioning the fittings.

5. Install governor linkage in accordance with figure 8-31. Adjust rod assembly (4, 5, and 6) in accordance with Operator and Organizational Maintenance Manual. Whenever precise governor linkage is to be installed, refer to Operator and Organizational Maintenance Manual.

6. Adjust overspeed shutdown device linkage as follows:

(a) Disconnect governor rod assembly (6, figure 8-31) from the governor control fuel rack lever (12).

(b) Adjust flanged nut (10,

figure 8-31A) against the spring limiter bracket (16D, figure 8-31) to allow approximately .03 inch free travel of governor control fuel rack lever (12, figure 8-31). This free travel measurement is made at the top of the lever.

(c) Tighten nut (11, figure 8-31A) against flanged nut (10).

(d) Adjust lower bushing (6, figure 8-31A) to provide a measurement of 3.0 (+.125, -.062) inches between the outside faces of bushings (6 and 9, figure 8-31A).

e. Install governor actuator unit (precise sets only) paragraph 8-116).

f. Refer to Operator and Organizational Maintenance Manual for the following:

1. Install manual speed control.
2. Make final adjustment.

## Section XIX. FUEL INJECTION GROUP

### 8-141. GENERAL.

The fuel injection group is mounted to the rear of the accessory drive housing. The fuel injection group consists of the fuel injection pump housing, camshaft, fuel injection pumps, fuel injection valves, and associated tubing. Fuel, after passing through the filters, flows into the injection pump housing manifold which distributes the fuel to the injection pumps. The injection pump for each cylinder measures and delivers the fuel to its associated fuel injection valve for insertion into the pre-combustion chamber. The amount of fuel pumped per stroke is varied by turning the pump plunger in the barrel. This turning is accomplished by governor action through the fuel regulator rack and gear arrangement. Injection pump plungers and lifters are lifted by lobes on the fuel injection camshaft.

### 8-142. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove secondary fuel filter and relief valve group, hydraulic oil filter (precise generator sets only), and overspeed switch,

b. Remove utility governor group (paragraph 8-134).

c. Removal of the fuel injection group is accomplished during disassembly (paragraph 8-143).

### CAUTION

Do not rotate engine crankshaft after fuel injection pump has been disconnected from accessory drive.



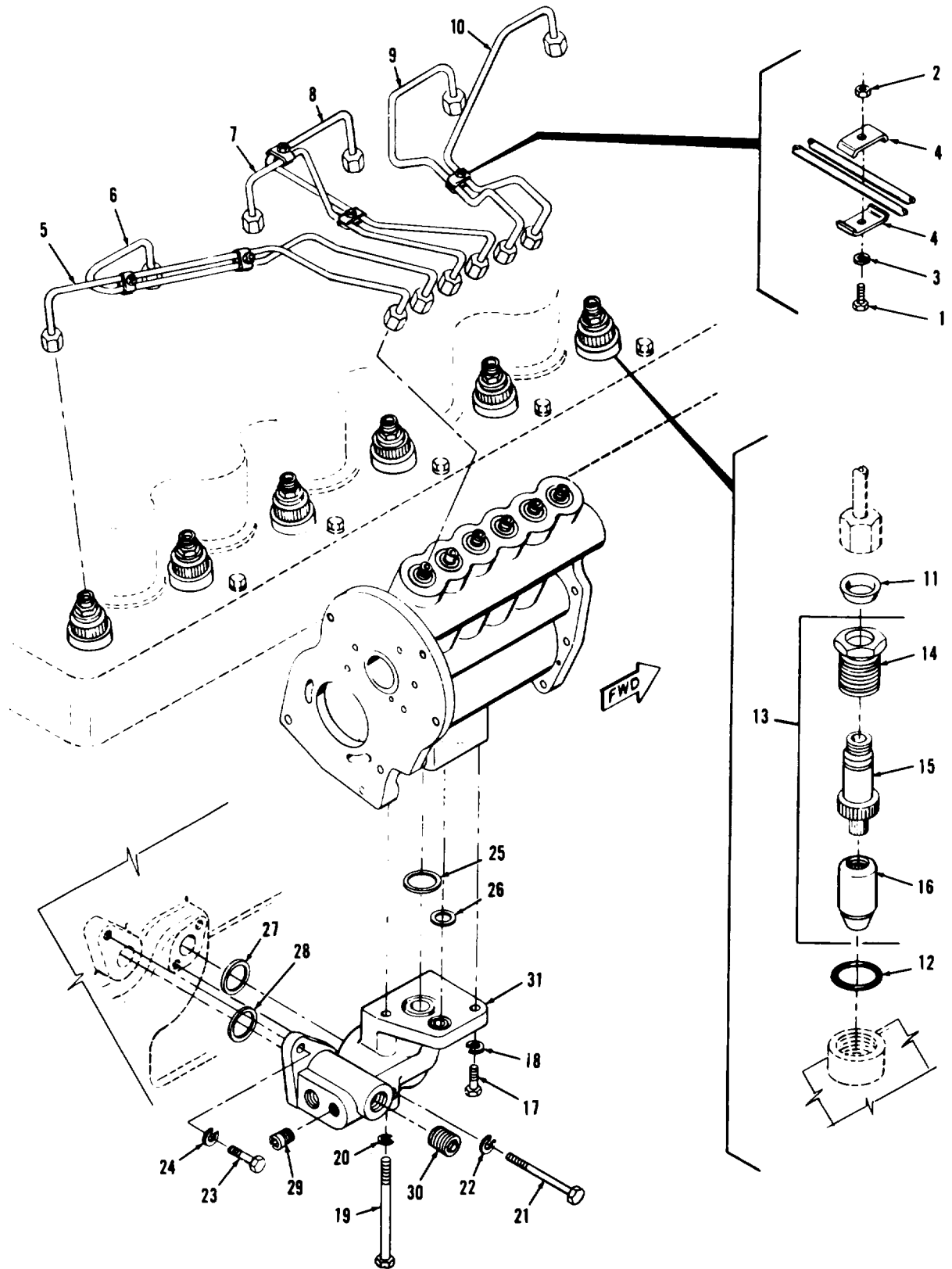


Figure 8-39. Fuel injection group, exploded view  
(sheet 1 of 2)

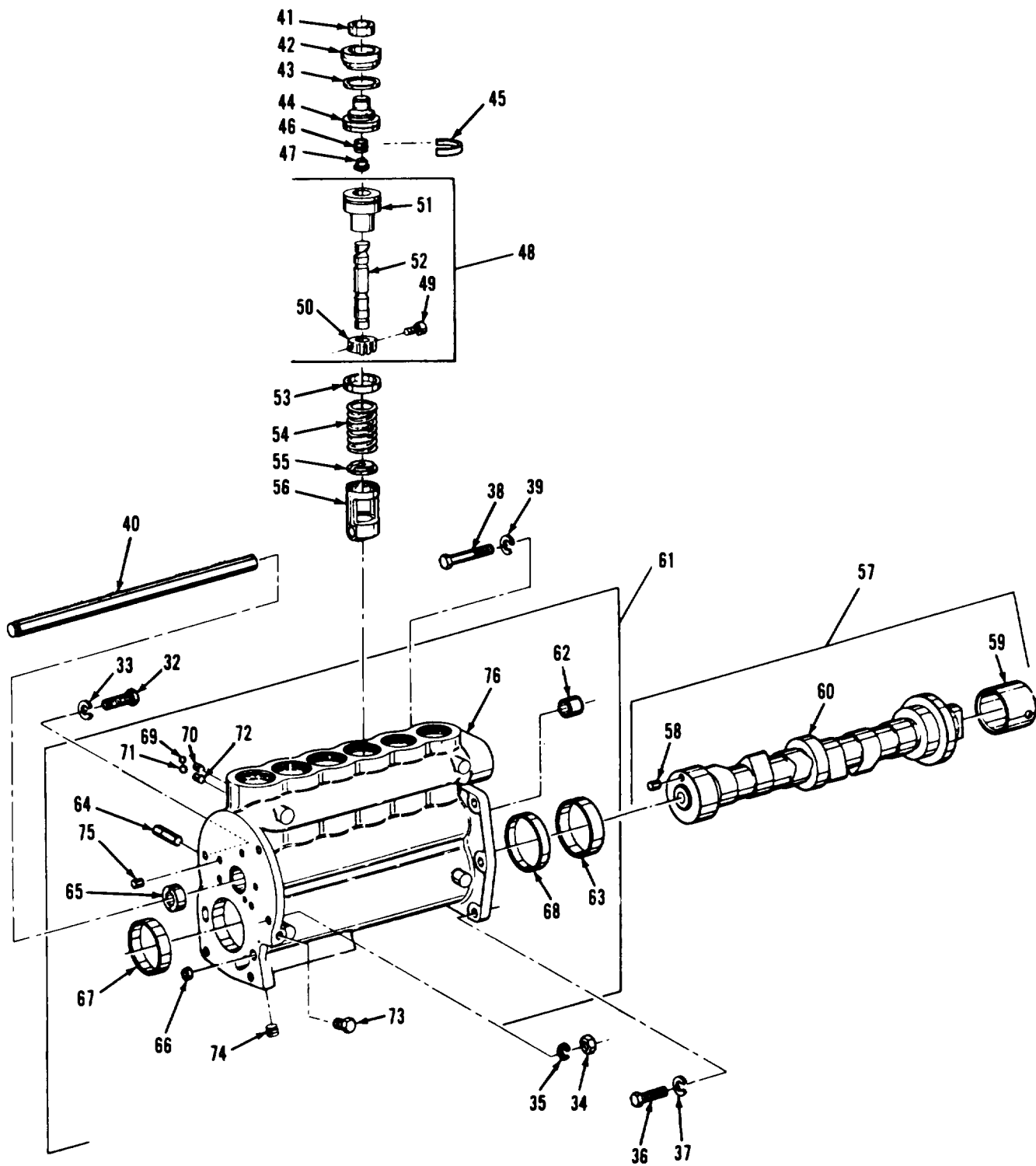


Figure 8-39. Fuel injection group, exploded view  
(sheet 2 of 2)

Legend to figure 8-39:

- |                        |  |                         |
|------------------------|--|-------------------------|
| 1. Bolt (5)            | 27. Seal                               | 52. Plunger             |
| 2. Nut (5)             | 28. Seal                               | 53. Spacer (6)          |
| 3. Lock washer (5)     | 29. Plug                               | 54. Spring (6)          |
| 4. Clamp (10)          | 30. Plug                               | 55. Washer (6)          |
| 5. Fuel line assembly  | 31. Bracket                            | 56. Lifter assembly (6) |
| 6. Fuel line assembly  | 32. Bolt                               | 57. Camshaft assembly   |
| 7. Fuel line assembly  | 33. Lockwasher                         | 58. Dowel               |
| 8. Fuel line assembly  | 34. Nut                                | 59. Sleeve              |
| 9. Fuel line assembly  | 35. Lock washer                        | 60. Camshaft            |
| 10. Fuel line assembly | 36. Bolt (4)                           | 61. Housing assembly    |
| 11. Seal assembly (6)  | 37. Lock washer (4)                    | 62. Bearing             |
| 12. Seal (6)           | 38. Bolt (2)                           | 63. Bearing             |
| 13. Valve assembly (6) | 39. Lock washer (2)                    | 64. Pin (3)             |
| 14. Nut                | 40. Fuel regulator rack                | 65. Bearing             |
| 15. Body               | 41. Felt washer (6)                    | 66. Plug                |
| 16. Nozzle assembly    | 42. Bushing (6)                        | 67. Bearing             |
| 17. Bolt               | 43. Seal (6)                           | 68. Bearing             |
| 18. Lock washer        | 44. Bonnet (6)                         | 69. Ball (6)            |
| 19. Bolt               | 45. Retainer ring (6)                  | 70. Dowel (6)           |
| 20. Lock washer        | 46. Spring (6)                         | 71. Ball (6)            |
| 21. Bolt               | 47. Check valve (6)                    | 72. Dowel (6)           |
| 22. Lock washer        | 48. Plunger and barrel<br>assembly (6) | 73. Plug                |
| 23. Bolt (2)           | 49. Screw                              | 74. Plug                |
| 24. Lock washer (2)    | 50. Gear                               | 75. Dowel (2)           |
| 25. Seal               | 51. Barrel                             | 76. Housing             |
| 26. Seal               |  |                         |

8-143. DISASSEMBLY.

Refer to figure 8-39 and disassemble fuel injection group in the order of index numbers assigned. Pay particular attention to the following:

a clean, lint free cloth. Keep parts for each injection pump separate since each pump has matched parts that are not interchangeable.

**NOTE**

Tag all lines from each cylinder for ease of assembly.

b. Using a suitable extracting tool, remove fuel pumps items (41 through 55, figure 8-39).

a. Prior to disassembly of the valve assemblies (13) and the fuel injection pumps, perform tests outlined in paragraph 8-149, step a.

c. Fuel regulator rack (40) must be removed before removing lifters (56).

**CAUTION**

All service work should be done at a cleaning facility. Hands should be clean and disassembly done on

d. Using a suitable driver, remove bearings (67 and 68).

e. Using a suitable removal tool, remove camshaft bearing (63).

f. When removing fuel regulator rack bearings (62 and 65, figure 8-39), first make two scribe marks on housing above groove on bearing (figure 8-40). This procedure allows for the alignment of groove on bearing with drilled lubrication passage during reassembly.

g. Wire together each spacer (55, figure 8-39) and fuel pump lifter (56). Tag each pair and identify the pump bore from which they were removed.

**WARNING**

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

8-144. **CLEANING.**

Clean metal components with an approved cleaning solvent to remove fuel oil, dirt, and accumulated deposits, and dry thoroughly.

8-145. **INSPECTION.**

a. Refer to table 1-1, and using a suitable micrometer and feeler gauge, check for excessive wear as follows:

1. Rack bearing bore.
2. Fuel rack diameter.
3. Fuel rack to bearing clearance.
4. Camshaft bearing bore.
5. Camshaft bearing journal diameter.
6. Camshaft to bearing clearance.

7. Pump plunger length. Inspect plungers (52, figure 8-39) for excessive wear on end which makes contact with lifting washers (55). Length of new plunger is 2.5931 to 2.5937 inches. The minimum allowable length that a worn plunger may continue to be used is 2.5881 inches.

**NOTE**

Whenever a plunger is replaced, it is necessary to replace the entire pump assembly.

8. If allowable limits are not met on above parts, replace part.

b. Inspect pump housing (76) for cracks, breaks, and clogged oil passages.

c. Inspect the drive tang on camshaft (60) and drive sleeve (59) for signs of wear.

d. Inspect camshaft (60) for damaged lobes.

e. Inspect plunger and barrel assembly (48), lifter assembly (56), and washer (55) for excessive wear or damage.

f. Inspect fuel rack (40) for nicks and burrs and for chipped or cracked gear teeth. If gear segments are cracked or chipped, replace fuel rack.

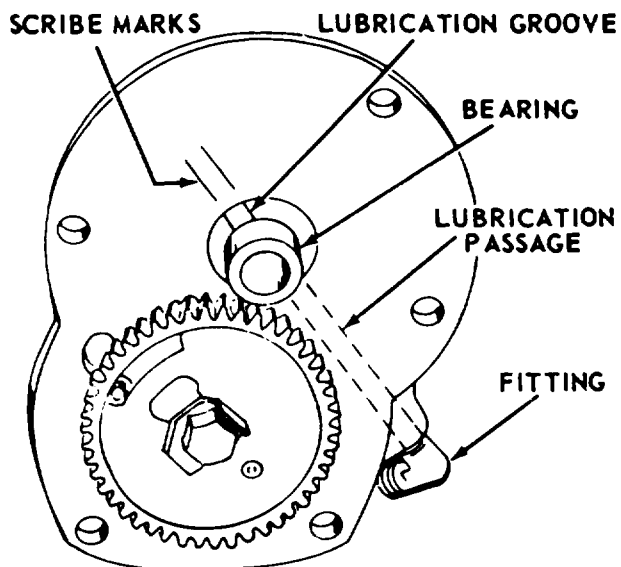


Figure 8-40. Removing fuel regulator rack bearings

g. Inspect threaded holes for damaged threads.

h. Discard seals.

#### 8-146. REPAIR.

a. Repair minor nicks and burrs on fuel rack (40, figure 8-39) using a suitable file or hone.

#### WARNING

Fuel Oil if flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Ream out clogged passages in housing (76) with a thin flexible wire. After cleaning passages, flush with fuel oil.

c. Repair minor thread damage using a suitable thread chaser.

#### 8-147. REASSEMBLY.

Refer to figure 8-39 and reassemble fuel injection group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. All assembly should be done with clean hands and on a clean, lint-free cloth.

b. Using a suitable installing tool, install camshaft bearing (63) so that hole in bearing aligns with oil passage in housing (76) and is flush with housing face.

c. Install fuel regulator rack bearings (62 and 65) so that groove in bearings aligns with scribe marks on housing (76). Bearing (65) must be installed  $0.195 \pm 0.005$  inch deep from the housing face.

d. Use a suitable fuel rack setting gauge when installing fuel regulator rack, figure 8-41. Position fuel regulator rack so that gauge indicates 0.00 inch.

e. Use the same extractor that was used to remove each pump to install each fuel injection pump. Sighting down the

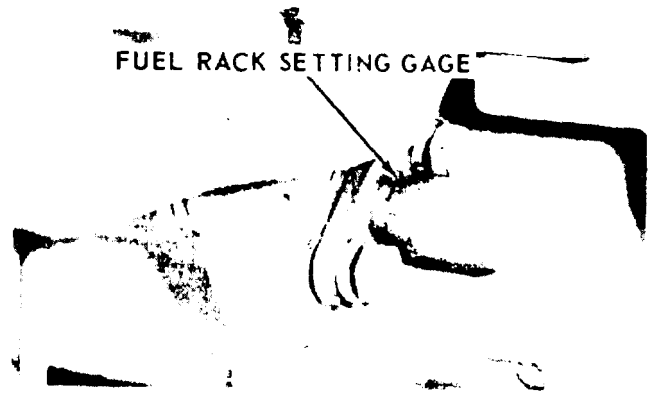


Figure 8-41. Installing regulator fuel rack

pump, align the notches in the bonnet (44, figure 8-39), and barrel (51) with the alignment mark 180 degrees from the pump gear segment center tooth (figure 8-42). Position pump so that the notches align with the two locating dowel pins (70 and 72, figure 8-39) in the housing bore. Align the pump gear segment center tooth with fuel regulator rack center notch (figure 8-43). Install pump. Keep a downward force on the pump, and install bushing (42, figure 8-39) until flush with the top of the housing. If the bushing cannot be installed, this far by hand, remove bushing, realign component parts, and install again.

#### CAUTION

When tightening bushing (42), a lesser torque value will allow pump to leak; a greater torque value can damage housing.

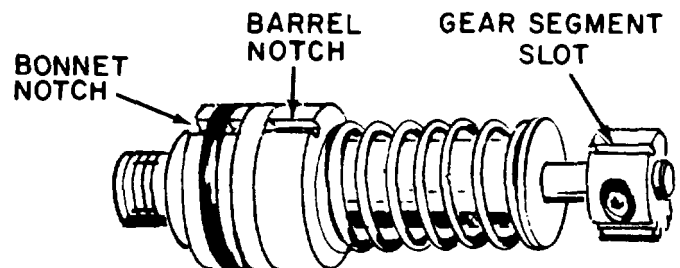


Figure 8-42. Fuel injection pump alignment

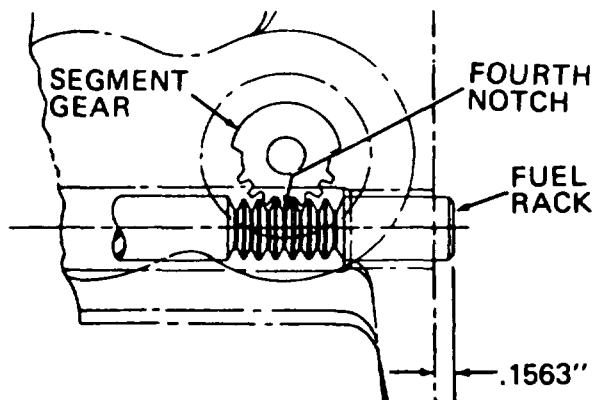


Figure 8-43. Correct position of gear segment and rack

f. Tighten each pump bushing (42, figure 8-39) to a torque value of 140 to 160 foot-pounds.

#### CAUTION

A misaligned fuel injection pump can cause an engine to overspeed with resultant damage to engine, turbocharger, and compressor.

g. Measure the rack travel to make sure that the plunger gear segment is properly meshed with the fuel rack. The gear segment and rack are so constructed that the maximum travel of the rack in either direction can be obtained only when the fourth tooth of the gear segment is meshed with the fourth notch on the fuel rack (figure 8-43). If the gear segment is misplaced in either direction, the rack travel will be reduced in both directions. It is, therefore, necessary to measure the rack travel in only one direction to make certain that the gear segment is properly meshed with the fuel rack. This is measured by using the rack setting gauge (figure 8-41). The rack is moved to its extreme fuel on position. A minimum reading of +0.312 on the gauge indicates

that the gear segment is properly positioned with the rack.

#### CAUTION

An injection pump improperly installed in the "fuel on" side position of its gear segment can cause an engine to overspeed with resulting serious damage to the engine and driven equipment.

h. Torque nozzle retaining nut (14, figure 8-39) from 100 to 110 foot-pounds.

i. Torque fuel line nuts from 25 to 35 foot-pounds.

#### 8-148. INSTALLATION.

a. Installation of the fuel injection group is accomplished during reassembly (paragraph 8-147).

b. Install utility governor group (paragraph 8-140).

c. Refer to Operator and Organizational Maintenance Manual and install overspeed switch, hydraulic oil filter (precise generator sets only), and secondary fuel filter and relief valve group.

#### 8-149. TESTING.

a. TEST FUEL INJECTION VALVES FOR SPRAY CHARACTERISTICS, VALVE OPENING PRESSURE AND LEAKING RATE. Using a suitable diesel injector pump test stand and diesel injector tool test set, perform the following:

1. Before testing the valve assembly (13, figure 8-39), inspect screen filter. If the screen is broken or clogged, discard the valve assembly (13). If the screen appears normal, test the valve assembly (13).

2. Apply 1875 PSI to the valve assembly (13, figure 8-39), a satisfactory valve should emit a complete atomized spray with a sharp cut-off of fuel and no air dribble. If the valve assembly (13) emits a solid stream of fuel with little or no atomization, replace the nozzle assembly (16).

3. Valve assembly (13) unseating pressure should be between 400 to 800 PSI. If valve assembly fails to reach a minimum of 400 PSI, replace valve assembly (13). Reduce gauge pressure to 300 PSI. Observe the gauge and note whether leakage causes an additional drop in pressure. If the pressure falls more than 100 PSI in 30 seconds, replace the nozzle assembly (16).

**b. FUEL INJECTION PUMP TIMING  
 DIMENSION CHECK AND ADJUSTMENT -  
 ON ENGINE (See figure 8-44).**

1. Remove two bolts and lockwashers and timing pointer cover from flywheel housing.

2. Remove fuel injection pump for Cylinder No. 1 as outlined in paragraph 8-143.

3. Rotate crankshaft counterclockwise (as viewed from flywheel end) at least 60 degrees. Continue rotating crankshaft counterclockwise until TC1-6 CYL mark on flywheel is aligned with timing pointer as shown in figure 8-45 and both the inlet

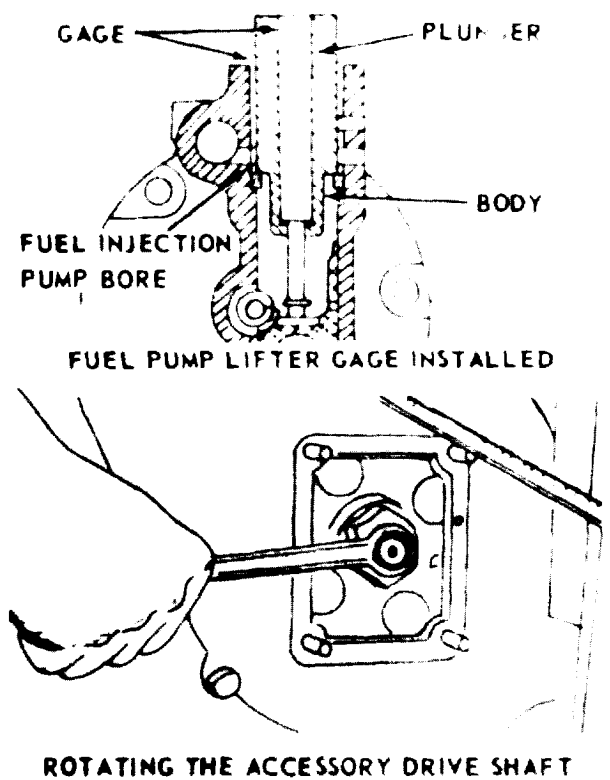
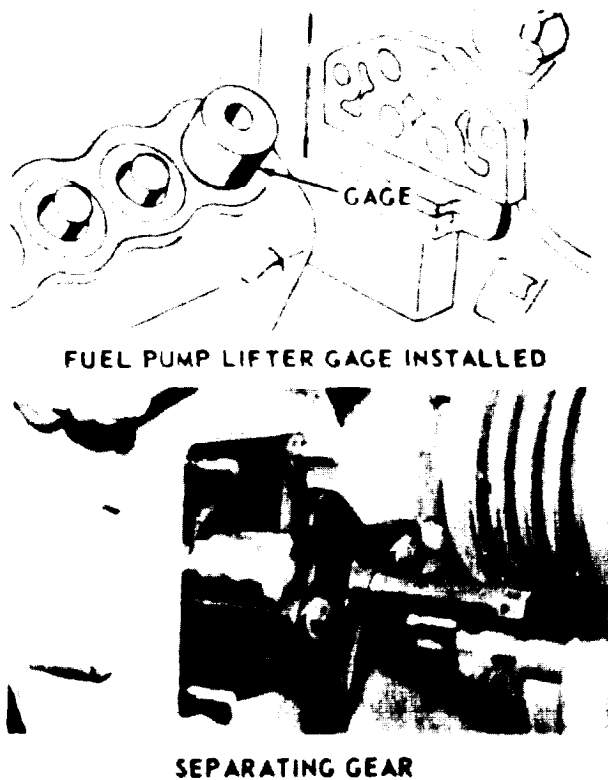


Figure 8-44. Fuel injection timing on the engine

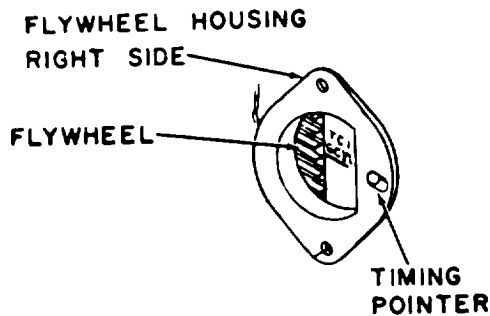


Figure 8-45. Aligning timing pointer on flywheel

and exhaust valves of Cylinder No. 1 are closed.

4. Install a suitable gauge in pump bore. Measure timing dimension using a depth micrometer. Timing dimension should be 4.2159 to 4.2199 inches. If timing dimension is correct, proceed to step 9. If timing dimension is not correct, proceed to step 5., and make an adjustment.

5. Remove small cover (24, figure 8-29) from front of timing gear cover (50) and loosen accessory drive gear retaining nut (figure 8-44) (do not remove nut).

6. Using a suitable gear pulling tool, separate gear from accessory drive shaft (figure 8-44). Remove pulling tools.

7. Turn accessory drive shaft extension counterclockwise and adjust timing dimension. Timing dimension should be 4.2159 to 4.2199 inches. If timing dimension is within specified depth range, proceed to step 8. If timing dimension is not within specified depth range, replace worn spacer (55, figure 8-39) with an approved spacer of additional thickness.

8. Install accessory drive gear. Tighten retaining nut from 90 to 110 foot-pounds. Recheck timing dimension. Replace cover.

9. Install fuel injection pump for Cylinder No. 1 as outlined in paragraph 8-148.

10. Install timing pointer cover and two bolts and lockwashers on flywheel housing.

**NOTE**

Timing the fuel injection pump on engine will take into consideration a slipped accessory drive shaft coupling or worn timing gears.

**c. FUEL INJECTION PUMP TIMING DIMENSION CHECK AND ADJUSTMENT - (OFF ENGINE (See figure 8-46).**

**NOTE**

Timing the fuel injection pump off engine will adjust for wear on the fuel injection pump only.

1. Install a suitable pointer assembly on fuel injection pump housing.

2. Install a suitable timing plate on drive end of fuel injection camshaft (60, figure 8-39).

3. Remove fuel injection pump for cylinder being checked (paragraph 8-143). Install a suitable gauge in pump bore.

4. Refer to table 8-1 and select the timing plate degree setting for lifter being checked. Rotate timing plate counterclockwise until proper degree setting aligns with pointer assembly (figure 8-46). Tighten screw to lock in position.

5. Measure timing dimension using a depth micrometer. Timing dimension should be 4.2670 to 4.2680 inches. If timing dimension is correct, proceed to



Table 8-1. Timing Plate Degree Settings

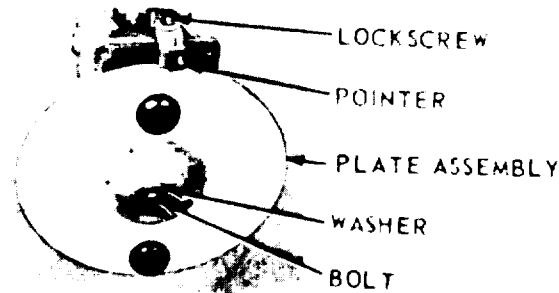
LIFTER NUMBER (NUMBERED CONSECUTIVELY FRONT TO REAR)	TIMING PLATE DEGREES
1	179° 30'
2	59° 30'
3	299° 30'
4	119° 30'
5	239° 30'
6	359° 30'

step 7. If timing dimension is not correct, proceed to step 6.

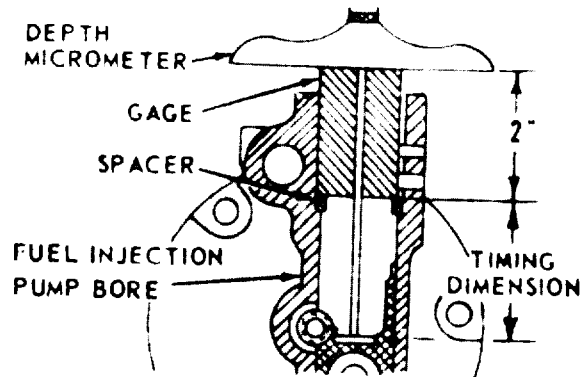
6. If timing dimension is not correct, replace spacer (53, figure 8-3 9). Select a spacer thickness which will correct the timing dimension. Spacers (53) are available in varying thicknesses from 0.170 to 0.198 inch. Re-check timing dimension.

7. Install fuel injection pump as outlined in paragraph 8-148.

8. If timing dimension is to be checked for each cylinder, repeat step b. following firing order of engine.



TIMING DIMENSION SETTING (OFF ENGINE)



CHECKING TIMING DIMENSION SETTING

Figure 8-46. Fuel injection timing - off the engine

## Section XX. ACCESSORY DRIVE GROUP

### 8-150. GENERAL.

The accessory drive group is mounted to the timing gear housing plate. The accessory drive group consists of housing assembly, gear assembly, drive shaft, bearing, sleeve, idler gear and shaft. The accessory drive shaft drives the utility governor, fuel injection pump, fuel supply pump, and speedswitch. The accessory drive gear is driven indirectly by the crankshaft gear through an idler gear which reduces the accessory drive to one half engine speed.

### 8-151. REMOVAL.

#### NOTE

Removal of the accessory drive group does not require removal of the timing gear cover unless the drive gear on the accessory drive shaft or the idler gear has to be replaced. If removal of the accessory drive group less accessory drive gear and idler gear is required, perform step a. If removal of the accessory drive gear and idler gear is required, perform step b.

a. If only the removal of the accessory drive group less the drive gear and idler gear is required, proceed as follows:

1. Remove utility governor group (paragraph 8-134).

2. Remove fuel injection pump group (paragraph 8-142).

3. Refer to Operator and Organizational Maintenance Manual and remove

fuel filter and relief valve, speedswitch, and hydraulic filter (precise sets only).

4. Remove fuel pump (paragraph 8-62).

b. If drive housing, drive shaft, drive gear, and idler gear are to be removed, proceed as follows:

1. Remove engine assembly (paragraph 2-8).

2. Refer to Operator and Organizational Maintenance Manual and remove alternator.

3. Remove fan group (paragraph 8-3 1).

4. Remove water pump group (paragraph 8-118).

5. Remove hydraulic tank (precise sets only) (paragraph 8-86).

6. Remove hydraulic pump (precise sets only) (paragraph 8-94).

7. Remove hydraulic pump drive group (paragraph 8-101).

8. Remove crankshaft pulley, damper, and timing gear cover group (paragraph 8-126).

9. Refer to Operator and Organizational Maintenance Manual and remove secondary fuel filter and relief valve, speedswitch and hydraulic filter (precise sets only).

10. Remove fuel pump group (paragraph 8-62).

11. Remove utility governor group (paragraph 8-134).

12. Remove fuel injection group (paragraph 8-142).

c. Removal of the accessory drive group is accomplished during disassembly.

#### 8-152. DISASSEMBLY.

Refer to figure 8-47 and disassemble accessory drive group in the order of index numbers assigned. Pay particular attention to the following:

a. If only the accessory drive housing and drive shaft is to be removed and not the accessory drive gear and idler gear, proceed as follows:

1. Refer to figure 8-29 and remove cover (24) and gasket (25) by removing nuts (22) and lockwasher (23).

#### CAUTION

Do not allow parts to drop inside of transmission.

2. Remove nut (1, figure 8-47) and washer (2) securing gear (3) to shaft (9). Using a suitable puller, loosen drive gear (3, figure 8-47) from shaft (9). Remove bolts (5) and locks (6).

#### CAUTION

Do not allow puller to hook bearing on outer race.

3. Remove bearing (8) using a suitable puller.

4. Accessory drive shaft (9) may be removed from housing, using a suitable drift pin on hex head end of shaft inside gear cover. Shaft (9) and bearing (8) can be removed through rear of housing.

#### NOTE

Idler gear assembly can not be removed for repair without removing front gear cover. If repair or replacement is required, refer to paragraph 8-126 and remove timing gear cover.

5. Before removing idler gear (26, figure 8-47), bar engine over manually to bring timing gear marks in line as shown in figure 8-30.

#### 8-153. CLEANING.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

a. Wash all parts in approved solvent and dry with low pressure compressed air or a lint-free cloth. Do not spin dry bearing.

#### 8-154. INSPECTION.

a. Refer to table 1-1 and inspect parts for dimensional tolerances.

b. Check bearing (8, figure 8-47) for freedom of rotation. Replace a bearing if its rotation is rough.

c. Inspect bearing (8) for pits, scratches, cracks, or chipped race.

d. Inspect bearing (25) and shaft (30) for grooves and discoloration.

e. Inspect housing for cracks. Replace cracked housing.

f. Inspect gear teeth for nicks, burrs, cracks, and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear.



Legend to figure 8-47:

1. Nut	12. Bolt (2)	22. Lock
2. Washer	13. Lock washer (2)	23. Plate
3. Gear	14. Cover	24. Gear assembly
4. Sleeve	15. Gasket	25. Bearing
5. Bolt (4)	16. Housing assembly	26. Gear
6. Lock (2)	17. Dowel (3)	27. Nut
7. Retainer	18. Dowel	28. Bolt (2)
8. Bearing	19. Housing	29. Lock
9. Shaft	20. Gasket	30. Shaft
10. Gasket	21. Bolt	31. Stud
11. Plug (2)		

g. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.

h. Inspect threaded parts for thread damage.

i. Measure O. D. of rear bearing surface at tang end of shaft. Measure I.D. of bearing surface at fuel pump end of housing. Maximum allowable clearance between shaft bearing surface and housing should not exceed 0.006 inch.

j. Inspect tang at fuel pump end of shaft for nicks, burrs, and damage. Replace damaged shaft.

k. Discard gaskets.

#### 8-155. REPAIR.

a. Remove minor nicks and burrs, using a suitable file or hone.

b. Repair minor thread damage using a suitable thread chaser.

#### 8-156. REASSEMBLY.

Refer to figure 8-47 and reassemble accessory drive group in the reverse order of index numbers assigned. Pay particular attention to the following:

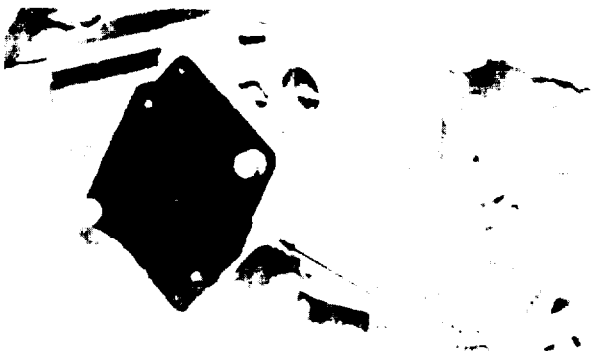
a. Install idler gear washer (23) with concave side toward idler gear.

b. Remove timing pointer cover from flywheel housing.

c. Rotate crankshaft counterclockwise (as viewed from flywheel end) at least 60 degrees. Continue rotating crankshaft counterclockwise until TC1-6-CYL mark on flywheel is aligned with timing pointer as shown in figure 8-45 and both the inlet and exhaust valves of Cylinder No. 1 are closed.

d. Install timing plate on rear face of accessory drive housing as shown in figure 8-48. If timing plate can be installed, timing is correct; proceed to step g. If timing plate cannot be installed, proceed to step f. and adjust timing.

e. Turn accessory drive shaft, using extension nut, as shown in figure 8-48 until timing plate fits properly on accessory drive housing. When plate fits flush against housing (19, figure 8-47), drive shaft is properly timed.



**TIMING FIXTURE PLATE INSTALLED**



**ROTATING THE ACCESSORY DRIVE SHAFT**

Figure 8-48. Accessory drive shaft timing

f. Remove timing plate. Install accessory drive gear as shown in figure 8-30. Install conical washer with O.D. in contact with gear, Align timing marks as shown in figure 8-30. Tighten retaining nut (1, figure 8-47) from 90 to 110 foot-pounds.

g. Refer to figure 8-29 and install cover (24) and gasket (25) and secure with nuts (22) and lockwashers (23).

### 8-157. INSTALLATION.

a. Installation of accessory drive group is accomplished during reassembly (paragraph 8-156).

b. If only the accessory drive housing and drive shaft were removed, proceed as follows:

1. Install fuel injection group (paragraph 8-148).
2. Install utility governor group (paragraph 8-140).
3. Install fuel pump group (paragraph 8-68).
4. Refer to Operator and Organizational Maintenance Manual and install secondary fuel filter tank, speed switch, and hydraulic filter (precise sets only).

c. If drive housing, drive shaft, drive gear, and idler gear were removed, proceed as follows:

1. Install fuel injection group (paragraph 8-148).
2. Install utility governor group (paragraph 8-140).
3. Install fuel pump group (paragraph 8-68).
4. Refer to Operator and Organizational Maintenance Manual and install secondary fuel filter and relief valve, speedswitch and hydraulic filter (precise sets only).
5. Install crankshaft pulley, damper, and timing gear cover group (paragraph 8-132).
6. Install hydraulic pump drive group (paragraph 8-107).
7. Install hydraulic pump (precise sets only) (paragraph 8-99).

8. Install hydraulic tank (precise sets only) (paragraph 8-92).

9. Install water pump group (paragraph 8-124).

10. Install fan group (paragraph 8-37).

11. Refer to Operator and Organizational Maintenance Manual and install alternator.

12. Install engine assembly (paragraph 2-8).

## Section XXI. EXHAUST MANIFOLD GROUP

### 8-158. GENERAL.

The exhaust manifold group is mounted to the cylinder head. The exhaust manifold group consists of a heat shield, manifold assembly, and gaskets. The exhaust gases from the cylinders enter the exhaust manifold and are then directed to the turbocharger.

### 8-159. REMOVAL AND DISASSEMBLY.

Refer to figure 8-49 and remove and disassemble exhaust manifold group in the order of index numbers assigned. Pay particular attention to the following:

Refer to Operator and Organizational Maintenance Manual and remove turbocharger.

### 8-160. CLEANING.

a. Remove any traces of old exhaust manifold gaskets,

### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Use an approved cleaning solvent and a stiff brush and remove all excess rust and carbon deposits from manifold and manifold hardware. Dry thoroughly. Place hardware in a container of light

weight oil and allow to soak until needed for reassembly.

c. Clean turbocharger mounting studs with a stiff brush to remove rust.

### 8-161. INSPECTION.

a. Inspect manifold for casting cracks around mounting flange bolt holes. Replace defective casting.

b. Inspect threaded parts for thread damage.

c. Inspect manifold mating surfaces for nicks and burrs.

d. Replace all gaskets.

e. Replace all locks and lockwashers.

### 8-162. REPAIR.

a. Remove minor nicks and burrs from manifold mating surfaces, using a suitable file or hone.

b. Repair minor thread damage using a suitable thread chaser.

### 8-163. REASSEMBLY AND INSTALLATION.

Refer to figure 8-49 and reassemble and install exhaust manifold group in

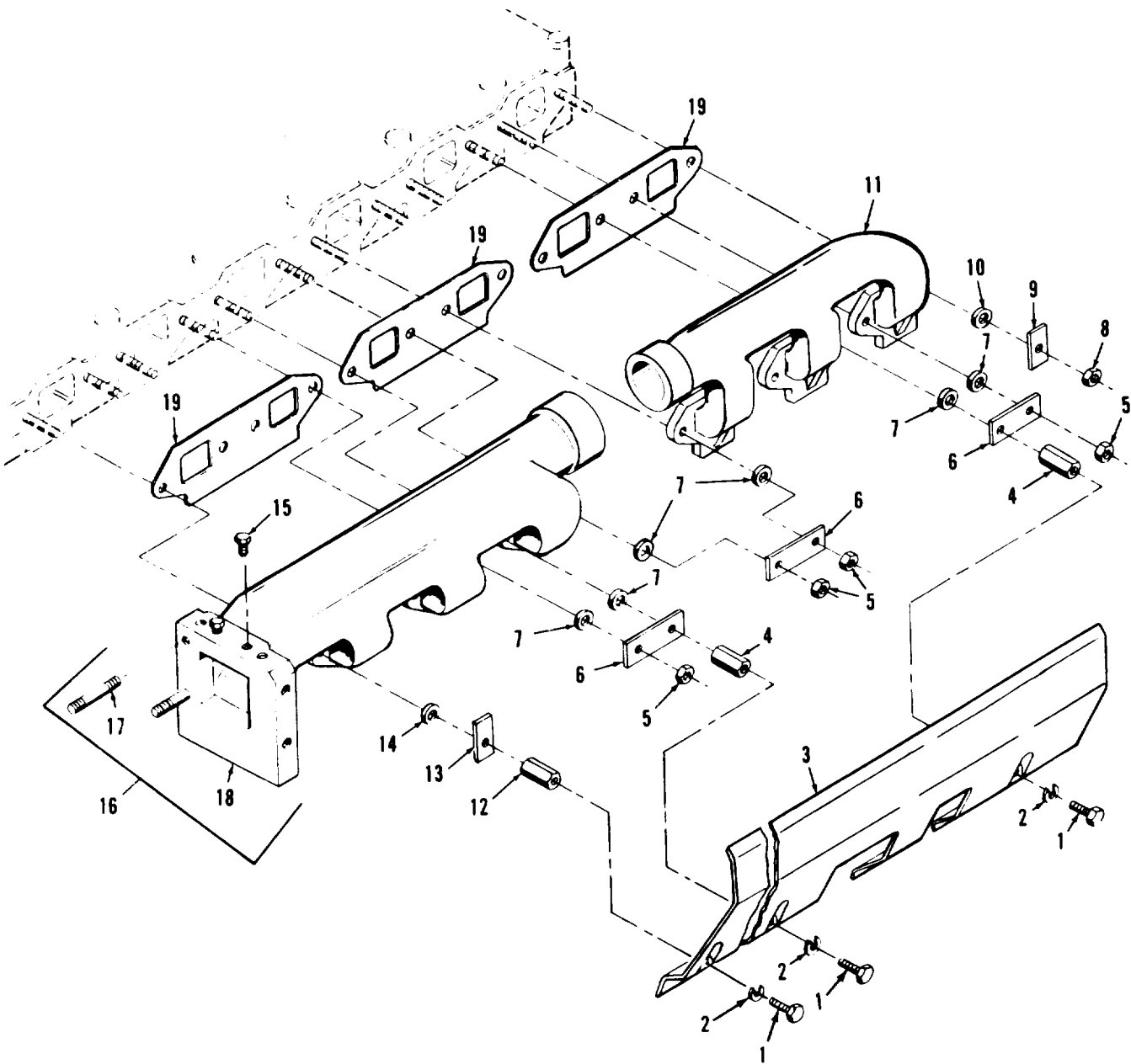


Figure 8-49. Exhaust manifold group, exploded view

Legend to figure 8-49:

- |                    |              |                       |
|--------------------|--------------|-----------------------|
| 1. Bolt (2)        | 8. Nut       | 14. Washer            |
| 2. Lock washer (3) | 9. Lock      | 15. Plug              |
| 3. Shield          | 10. Washer   | 16. Manifold assembly |
| 4. Nut (2)         | 11. Manifold | 17. Stud (2)          |
| 5. Nut (8)         | 12. Nut      | 18. Manifold          |
| 6. Lock (5)        | 13. Lock     | 19. Gasket (3)        |
| 7. Washer          |              |                       |



the reverse order of index numbers assigned. Pay particular attention to the following:

a. Coat stud threads with an approved antiseize compound.

b. Torque manifold bolts from 29 to 35 foot-pounds.

c. Refer to Operator and Organizational Maintenance Manual and install turbocharger.

## Section XXII. OIL PAN GROUP AND RELATED PARTS

### 8-164. GENERAL.

The oil pan group is bolted to the bottom of the crankcase. The oil pan group consists of scavenge pump suction tube, fluid level indicator and drain plug. The oil sump contains an oil heater tube with external water connections. The oil pan is the reservoir which supplies the oil pump with lubricating oil.

### 8-165. REMOVAL.

#### NOTE

Fuel tank must be moved to the rear approximately two feet if the oil pump is not to be removed.

- a. Drain oil from oil pan.
- b. Remove fuel fired heater if unit is so equipped.
- c. Disconnect oil pan drain line at valve
- d. Disconnect water connections at the rear of oil pan if unit is equipped with a heater kit.
- e. Refer to figure 8-50, and remove oil pan group as follows:
  1. Remove bolts (6, 9, and 12), lockwashers (7, 10, and 13), and washers (8, 11, and 14). Remove pan (20) and gasket (15).
  2. Remove bolts (21 and 23), lockwashers (22 and 24), and plates (25 and 26).
  3. Remove bolts (27), lockwashers (28), plate assembly (34), and gasket (29).

### 8-166. DISASSEMBLY.

Refer to figure 8-50 and disassemble oilpan group in the order of index numbers assigned.

### 8-167. CLEANING.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- a. Clean components with an approved cleaning solvent, and dry thoroughly.
  - b. Flush interior of oil pan with an approved cleaning solvent, and dry thoroughly. Use a stiff brush to remove encrusted oil sediment in bottom of pan.
  - c. Flush tube (2, figure 8-50) with an approved cleaning solvent, and dry thoroughly.
  - d. Flush tube (19) with an approved cleaning solvent to remove encrusted calcium deposits, and dry thoroughly.
- ### 8-168. INSPECTION.
- a. Inspect gasket seal surface at top of oil pan for burrs, nicks, or other damage.
  - b. Inspect scavenge tube (33, figure 8-50) to ensure that tube is open throughout its length.

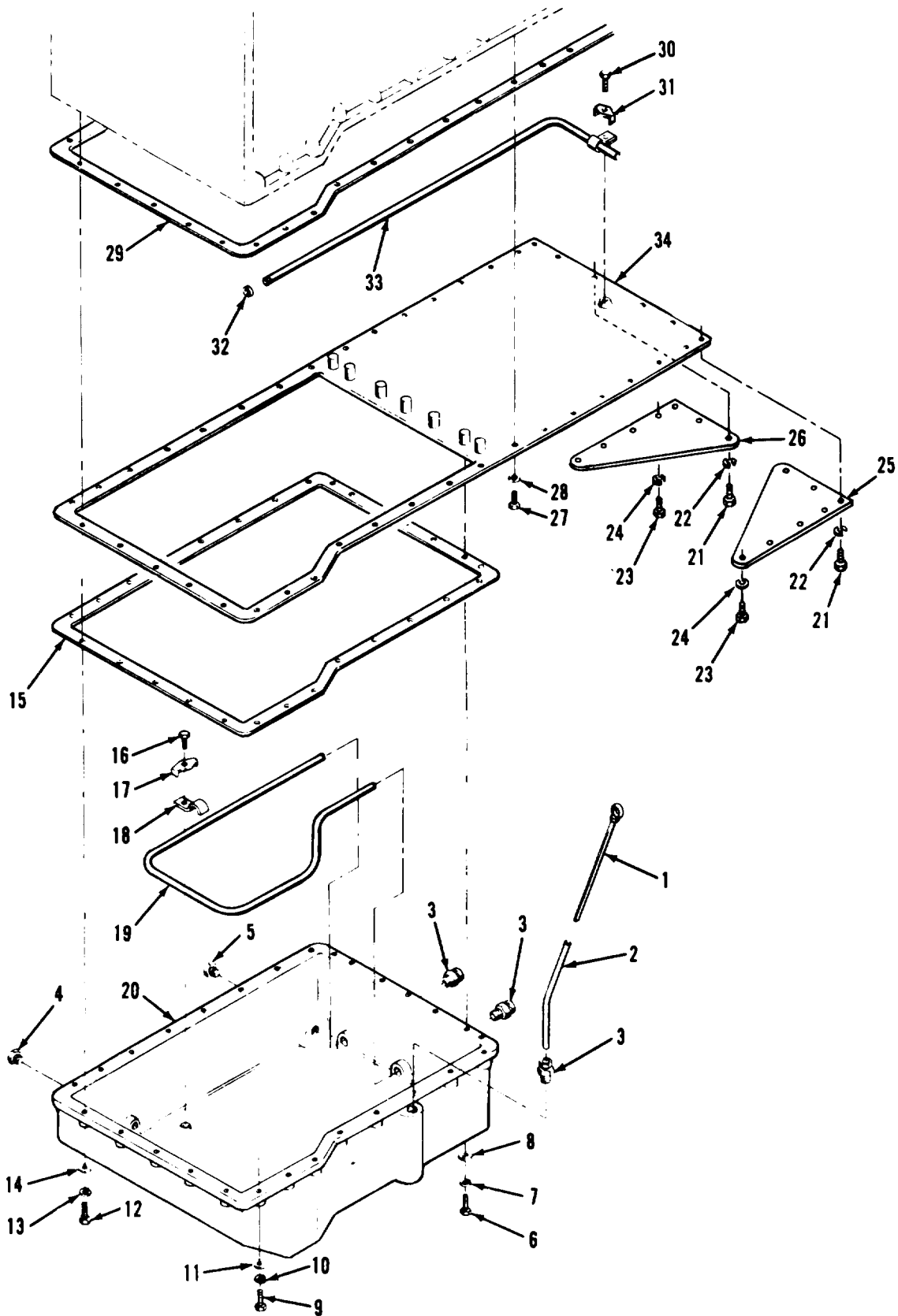


Figure 8-50. Oil pan group and related parts, exploded view

Legend to figure 8-50:

- |                     |                     |                     |
|---------------------|---------------------|---------------------|
| 1. Gauge assembly.  | 13. Lock washer (5) | 24. Lock washer (8) |
| 2. Tube             | 14. Washer (5)      | 25. Plate           |
| 3. Fitting (3)      | 15. Gasket          | 26. Plate           |
| 4. Plug             | 16. Bolt (2)        | 27. Bolt (4)        |
| 5. Plug             | 17. Lock (2)        | 28. Lock washer (4) |
| 6. Bolt (20)        | 18. Clip (2)        | 29. Gasket          |
| 7. Lock washer (20) | 19. Tube            | 30. Bolt            |
| 8. Washer (20)      | 20. Pan             | 31. Lock            |
| 9. Bolt (3)         | 21. Bolt (6)        | 32. Seal            |
| 10. Lock washer (3) | 22. Lock washer (6) | 33. Tube assembly   |
| 11. Washer (3)      | 23. Bolt (8)        | 34. Plate assembly  |
| 12. Bolt (5)        |                     |                     |

c. Inspect tube (19) for damage.  
Replace damaged tube.

d. Inspect fittings (3) for damage.  
Replace damaged fittings.

e. Inspect components for dents, cracks,  
distortion, and damaged threads.

f. Discard gaskets (15 and 29) and seal  
(32).

#### 8-169. REPAIR.

a. Remove minor nicks and burrs using  
a suitable file or hone.

b. Repair dents and distortion using  
proper tools.

c. Repair minor thread damage using  
a suitable thread chaser.

#### 8-170. REASSEMBLY.

Refer to figure 8-50 and reassem-  
ble oil pan group in the reverse order of  
index numbers assigned.

#### 8-171. INSTALLATION.

a. Refer to figure 8-50 and install oil  
pan group as follows:

1. Install new gasket (29), plate  
assembly (34), lock washers (28), and bolts  
(27).

2. Install plates (25 and 26), lock  
washers (22 and 24), and bolts (21 and  
23).

3. Install new gasket (15) and pan  
(20). Install washers (8, 11, and 14),  
lock washers (7, 10, and 13), and bolts  
(6, 9, and 12).

b. Connect water lines at the rear of  
oil pan.

c. Connect oil pan drain line.

d. Remount fuel fired heater if so  
equipped.

## Section XXIII. OIL PUMP GROUP

### 8-172. GENERAL.

The oil pump is mounted on the bottom face of the cylinder block at the front of the engine. The pump is a two-section, positive displacement, gear-type pump. One section scavenges oil from the rear of the engine and dumps it into the oil pan sump. The other section supplies lubrication, under pressure, to the basic engine through passages in the cylinder block, and to external components through oil lines. The pump is driven by the crankshaft through the oil pump idler gear.

### 8-173. REMOVAL.

- a. Remove fuel fired heater and mounting brackets on right side if so equipped.
- b. Drain oil from oil pan.
- c. Disconnect oil pan drain line at valve.
- d. Disconnect water connections at the rear of oil pan.
- e. Refer to figure 8-50 and remove bolts (6, 9, and 12), lock washers (7, 10, and 13), and washers (8, 11, and 14). Remove oil pan (20) and gasket (15). Discard gasket.
- f. Refer to figure 8-51 and remove oil pump in the order of index numbers assigned.

### 8-174. DISASSEMBLY.

Refer to figure 8-52 and disassemble oil pump group in the order of index numbers assigned. Pay particular attention to the following:

- a. Using a suitable puller, remove gears (30, Figure 8-52) from shaft assemblies (33 and 31).
- b. Using a suitable puller, remove gear (28) from shaft (33) and gear (37)

from shaft (41).

- c. Using a suitable arbor press, remove bearings (22) from body (24) and bearings (36 and 44) from body (45).
- d. Using a suitable arbor press, remove shift (11) from body (45).
- e. Do not remove ball (42) from body (45). If ball (42) is damaged, replace body (45).

### WARNING

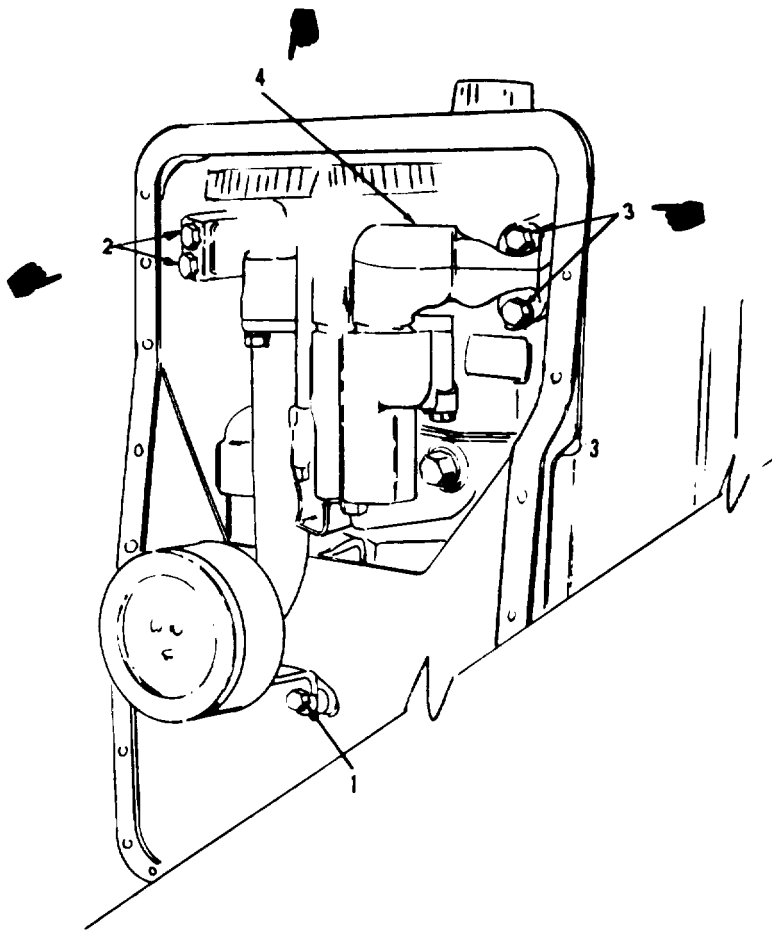
Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

### 8-175. CLEANING.

Clean components with an approved cleaning solvent, and dry thoroughly.

### 8-176. INSPECTION.

- a. Inspect gear teeth for nicks, burrs, cracks, and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of gear.
- b. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.
- c. Refer to table 1-1 and, using a suitable micrometer and feeler gauge, check for excessive wear as follows:
  1. Drive gear shaft (33) diameter.
  2. Gear to cover clearance.



Legend to figure 8-51:

- 1. Bolt (1)
- 2. Bolts (2)
- 3. Bolts (2)
- 4. Oil pump assembly

Figure 8-51. Oil pump group, removal and installation

3. Idler gear shaft (34, figure 8-52) diameter.

4. Drive idler gear shaft (41) diameter.

5. Relief valve pressure spring (13) outside diameter.

6. If allowable limits are not met, replace part.

d. Using a suitable spring compressor, apply a load of 36.6 to 43.0 pounds and compress spring (13) to a length of 3.25 inches. If spring does not compress to a length of 3.25 inches under a load of 36.6

to 43.0 pounds, replace spring. Replace spring if free length is not 3.57 inches after test. . Do not attempt to stretch spring.

e. Inspect components for dents, cracks, distortion, and damaged threads.

f. Discard gaskets.

#### 8-177. REPAIR.

a. Repair minor nicks and burrs using a suitable file or hone.

b. Repair dents and distortion using proper tools.

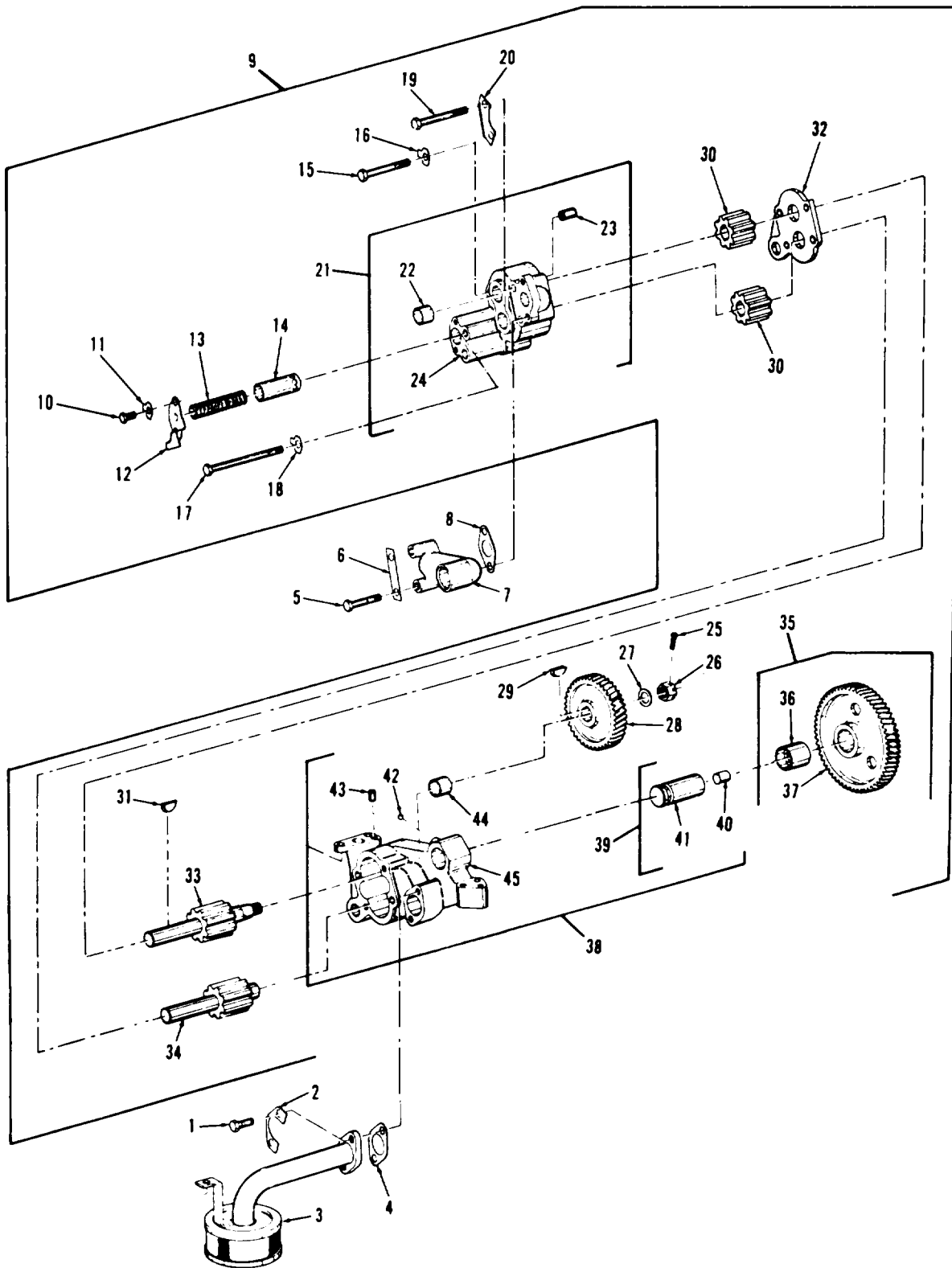


Figure 8-52. Oil pump group, exploded view

Legend to figure 8-52:

- |                  |                   |                    |
|------------------|-------------------|--------------------|
| 1. Bolt (2)      | 16. Lock          | 31. Key            |
| 2. Lock          | 17. Bolt          | 32. Spacer         |
| 3. Bell assembly | 18. Lock          | 33. Shaft assembly |
| 4. Gasket        | 19. Bolt (2)      | 34. Shaft assembly |
| 5. Bolt (2)      | 20. Lock          | 35. Gear assembly  |
| 6. Lock          | 21. Body assembly | 36. Bearing        |
| 7. Elbow         | 22. Bearing (2)   | 37. Gear           |
| 8. Gasket        | 23. Dowel (2)     | 38. Body assembly  |
| 9. Pump assembly | 24. Body          | 39. Shaft assembly |
| 10. Bolt (2)     | 25. Cotter pin    | 40. Dowel          |
| 11. Lock (2)     | 26. Nut           | 41. Shaft          |
| 12. Cover        | 27. Washer        | 42. Ball           |
| 13. Spring       | 28. Gear          | 43. Dowel          |
| 14. Plunger      | 29. Key           | 44. Bearing (2)    |
| 15. Bolt (2)     | 30. Gear (2)      | 45. Body           |

c. Repair minor thread damage using a suitable thread chaser.

8-178. REASSEMBLY.

Refer to figure 8-52 and reassemble oil pump group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Using a suitable arbor press, install bearing (36) flush with face opposite timing mark.

b. Using a suitable arbor press, install bearings (44, figure 8-52). The edges of bearings (44) must be recessed 0.20 inch beneath face of body (45) toward gear (28).

c. The edges of the bearings (22) must be recessed 0.060 inch beneath face of body (24) toward gears (30).

d. Using a suitable puller, install gear (28) on shaft assembly (33). Tighten gear retaining nut (26) to 60 foot-pounds torque, plus amount to align cotter pin (25).

e. Make sure that all shafts turn freely with no binding or drag on gears after reassembly. If gears bind, loosen bolts (15, 17, and 19) slightly, and relocate the pump bodies by tapping them lightly until shafts turn freely. Retighten bolts (15, 17, and 19).

8-179. INSTALLATION.

a. Refer to figure 8-51 and install oil pump group.

b. Refer to figure 8-50 and install new gasket (15) and oil pan (20). Install washers (8, 11, and 14), lockwashers (7, 10, and 13), and bolts (6, 9, and 12).

c. Connect water lines at the rear of oil pan.

d. Connect oil pan drain line.

e. Install fuel fired heater and mounting brackets if so equipped.

f. Refer to engine run-in (paragraph 8-237) for testing of oil pump.

Section XXIV. VALVE COVER AND VALVE MECHANISM GROUP

8-180. GENERAL.

The valve cover and valve mechanism group is mounted on top of the cylinder head. The valve cover is equipped with a breather assembly, which is provided for crankcase ventilation. The valve mechanism group consists of intake and exhaust rocker arm assemblies, push rods, and lifters. Two arm assemblies are provided for each cylinder, one operating the intake valve and the other operating the exhaust valve. The arm assemblies are operated by the camshaft through lifters (and push rods).

8-181. REMOVAL.

Removal of valve cover and valve mechanism group is accomplished during disassembly (paragraph 8-182).

8-182. DISASSEMBLY.

Refer to figure 8-53 and disassemble the valve cover and valve mechanism group in the order of index numbers assigned. Pay particular attention to the following:

Legend to figure 8-53:

- |                      |                        |                             |
|----------------------|------------------------|-----------------------------|
| 1. Clamp (2)         | 14. Gasket             | 27. Bracket assembly (6)    |
| 2. Hose              | 15. Bolt (6)           | 28. Dowel                   |
| 3. Bolt              | 16. Washer (6)         | 29. Front bracket           |
| 4. Washer            | 17. Nut (12)           | 30. Intake arm assembly (6) |
| 5. Breather assembly | 18. Screw (12)         | 31. Bearing                 |
| 6. Seal              | 19. Push rod (12)      | 32. Washer (11)             |
| 7. Bolt (4)          | 20. Lifter (12)        | 33. Spring (5)              |
| 8. Lock washer (4)   | 21. Retaining ring (2) | 34. Bracket (4)             |
| 9. Cover             | 22. Washer             | 35. Shaft assembly          |
| 10. Gasket           | 23. Spring (2)         | 36. Dowel                   |
| 11. Bolt (15)        | 24. Washer (2)         | 37. Rear bracket            |
| 12. Lock washer (15) | 25. Arm assembly (6)   | 38. Plug (2)                |
| 13. Cover assembly   | 26. Bearing            | 39. Shaft                   |

- a. Using a suitable driver, remove bearings (26 and 31) from arm assembly bores (25 and 30).

NOTE

All lifters (20), except those in the number one cylinder can be removed without removing the cylinder head.

- b. Use a suitable piece of wire approximately 15 inches long, bent into a 1/2 inch hook at one end, to remove lifters (20). If lifters in the number one cylinder must be removed, refer to paragraph 8-189 and remove cylinder head.

8-183. CLEANING.

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- a. Soak breather assembly in an approved cleaning solvent to remove oil fume deposits, and dry thoroughly.
- b. Clean components with an approved cleaning solvent, and dry thoroughly.



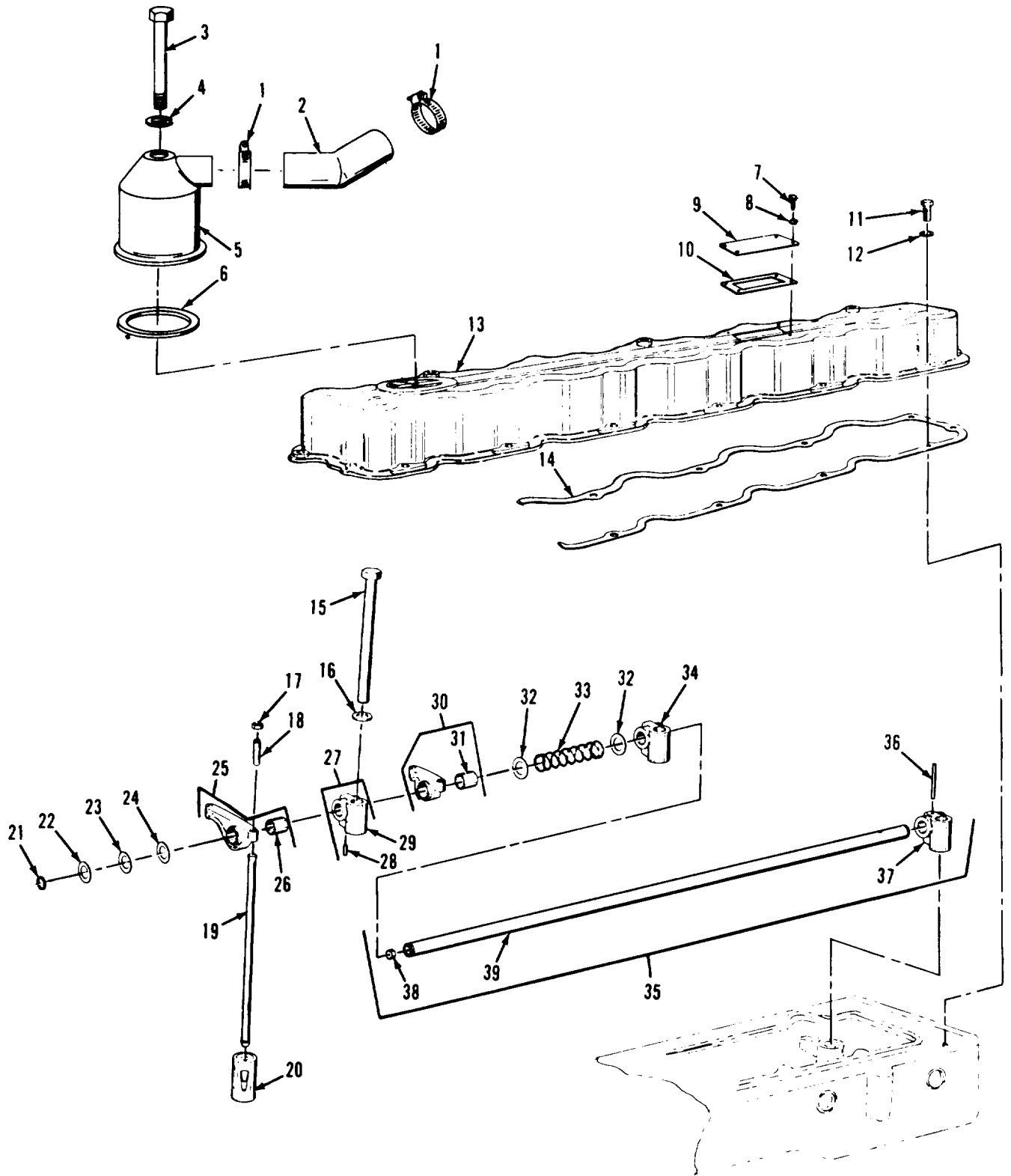


Figure 8-53. Valve cover and valve mechanism group, exploded view

#### 8-184. INSPECTION.

a. Refer to table 1-1 and, using a suitable micrometer, check for excessive wear as follows:

1. Rocker arm bearing (26 and 31, figure 8-53) bore.
2. Shaft (39) diameter.
3. Clearance between bearings and shaft.
4. If allowable limits are not met, replace part.

b. Inspect ball end of adjusting screw (18) and valve contact surface of rocker arm assembly (25) for nicks, discoloration, and uneven wear.

c. Inspect rocker arm assembly (30) and shaft (35) to ensure that oil passages are open.

d. Check clearance between lifter (20) and bore in block. Maximum allowable clearance is 0.012 inch. If clearance is exceeded, replace lifter.

e. Inspect push rod (19) for straightness. Rotate push rod on its ball center. Maximum allowable runout is 0.020 inch T.I.R. If limit is exceeded, replace push rod. Do not attempt to straighten push rod.

f. Inspect spring for cracks or distortion. If defective, replace spring.

g. Inspect rocker arm contact surfaces for excessive wear. If defective, replace rocker arm.

h. Inspect components for cracks, breaks, and other damage.

i. Discard seal and gaskets.

#### 8-185. REPAIR.

##### CAUTION

Do not remove any more material than is required to remove discoloration and small nicks.

##### NOTE

The contact surfaces on adjustment screw (18) and lifter end of push rod (19) may be noted to have a flat surface on the ball end. This flat surface is allowed by the manufacturer during production and is not to be considered a worn part. The adjusting screw ball end is allowed a 0.19 inch diameter flat, and the lifter end of the push rod is allowed a 0.125 inch diameter flat.

a. Clean up contact surfaces on adjusting screw (18, figure 8-53) and rocker arm assembly (25), using a hone.

##### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean out oil passages in rocker arm assembly and shaft using a thin wire. Flush with an approved cleaning solvent.

#### 8-186. REASSEMBLY.

Refer to figure 8-53 and reassemble the valve cover and valve mechanism group in the reverse order of index numbers assigned. Pay particular attention to the following:

##### CAUTION

When installing bearing (26 and 31) into arm assembly bores (25 and 30), ensure that hole in bearing aligns with hole in bore arm.

a. Using a suitable driver, install bearings (26 and 31, figure 8-53) into arm bores (25 and 30).

accomplished during reassembly (paragraph 8-186).

#### 8-187. INSTALLATION.

Installation of valve cover and valve mechanism group is

Refer to Operator and Organizational Maintenance Manual and adjust valve lash.

### Section XXV. CYLINDER HEAD GROUP

#### 8-188. GENERAL.

The cylinder head group is mounted to the cylinder block. The cylinder head group consists of chamber assemblies, valve springs, valve guides, and lifting eyes. Cored passages in the cylinder head directs the flow of coolant around the valve ports and precombustion chambers. Oil passages allow lubricant to be distributed to the valve mechanism.

b. Remove exhaust manifold group (paragraph 8-159).

c. Disconnect fuel injection pump lines and injectors (paragraph 8-142) and install plugs or caps to prevent dirt entering fuel injection pump.

d. Remove fan mounting group (paragraph 8-31).

e. Remove valve cover and valve mechanism group (paragraph 8-181).

#### 8-189. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove the following:

1. Lifting frame.
2. Air cleaner assembly.
3. Drain cooling system, loosen hose clamp, and remove top radiator hose and water pump by-pass hose.
4. Ether start atomizer.
5. Water temperature sensing bulb.
6. High water temperature shutdown sensing bulb.
7. Lube oil filter assembly.
8. Remove turbocharger group.

f. Refer to figure 8-54 and remove cylinder head by removing bolts (6 and 8) and lockwashers (7 and 9). Attach a suitable lifting device to lifting eyes (3) and remove cylinder head.

#### 8-190. DISASSEMBLY.

Refer to figure 8-54 and disassemble cylinder head group in the order of index numbers assigned. Pay particular attention to the following:

a. Using a suitable wrench, remove precombustion chamber assemblies (21) from cylinder head (38).

b. Using a suitable spring compressor, remove springs (28) from exhaust and intake valves (30 and 32).

c. Tag each intake and exhaust valve and the cylinder number it was taken from.

d. Using suitable bushing driver, remove bushings (29, figure 8-54) from cylinder head (38).

#### NOTE

Do not remove inserts (31 and 33) unless replacement is required.

e. Using a suitable extracting tool, remove inserts (31 and 33) from cylinder head (38).

#### 8-191. CLEANING.

##### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

##### CAUTION

Do not use a wire brush or a grinding wheel when cleaning components.

a. Place valves, valve bushings, and retainers in an approved cleaning solvent and allow to soak for at least one hour. Using a stiff brush, remove all carbon lacquer, and residue from parts, and dry thoroughly.

b. Remove scale from cylinder head using an approved cleaning solvent and a stiff brush, and dry thoroughly.

c. Clean metal components with an approved cleaning solvent, and dry thoroughly.

#### 8-192. INSPECTION.

a. Inspect cylinder heads for cracks, damaged threads, distortion, or any other defect.

b. Inspect precombustion chambers for damaged threads, distortion, or cracks. Check tightness of plug (20) on the side of precombustion chamber.

c. Inspect valve springs for damaged coils, cracks, and distortion. Check spring

force. Compress each spring to a length of 1.766 inches. Force required for compression should be 54.8 to 60.6 pounds. Refer to table 1-1 for spring free length and valve spring O.D. If limits are not met, replace springs.

d. Inspect valve guides (29, figure 8-54) for cracks, distortion, and excessive wear. Check inside diameter of valve guides (29), using suitable pilot gauges. Refer to table 1-1 for acceptable diameter and maximum allowable wear limits. If limits are exceeded, replace valve guides.

e. Inspect valve seat inserts for excessive wear, pitting, cracking or improper seat angle. The proper angle for seat and valve is 30 degrees. Refer to table 1-1, and using a suitable micrometer, check diameters of inlet valve seat inserts and exhaust valve seat inserts. If allowable limits are exceeded, replace insert.

f. Inspect valves (30 and 32) for cracks, pitting, distortion, or excessive wear. Use a suitable micrometer and check valve stem diameter. Refer to table 1-1 for maximum allowable wear limits. If limits are not met, replace valve.

g. Coat each valve face with a thin film of Prussian blue, then rotate each valve in associated valve seat. Remove valves and examine contact pattern on each valve and valve seat. A line of contact near top and around entire circumference of valve seat indicates line contact with valve. This amount of line contact would indicate that the valves and valve seats are acceptable. If, however, line contact is not noted to extend completely around the seat, or gaps in line contact appear around the seat, it would indicate that the valves have to be reground.

h. Inspect valve seats (31 and 33). If valve seat does not conform to the

manufacturer's minimum and maximum dimension, it can not be reground and must be replaced. Refer to figure 8-55.

i. Inspect valves (30 and 32) using a suitable micrometer, and check valve head diameter, valve face angle, closed valve projection, valve head diameter, and valve lip thickness. Refer to figure 8-55. If limits are exceeded, replace valve.

j. Inspect rotocoil assembly (27) for freedom of rotation. Place rotocoil assembly in suitable test fixture with a 1 inch hole. Insert the rotocoil in the hole and load the top of the rotocoil to 58 pounds. The deflected height of the rotocoil under this load should be  $0.295 \pm 0.010$  inch when measured from the fixture surface to the top of the rotocoil. If this deflection required is not met, replace rotocoil assembly.

k. Discard all gaskets.

#### 8-193. REPAIR.

a. When results of inspections in step g. , paragraph 8-192 indicate that valves were not properly seated, grind the valve seat or seats using an approved valve seat grinder, and grind the valve or valves, using a suitable valve face grinding machine.

b. After valve seats and/or valve faces have been ground until they are smooth and concentric with valve guides, clean all parts with an approved cleaning solvent, and dry thoroughly.

c. If exhaust and intake valve faces (30 and 32, figure 8-54) and valve seat inserts (31 and 33) have been ground for proper seating, the dimensional specifications outlined in figure 8-55 must be met. If dimensions are unacceptable, exhaust and intake valves (30 and 32) and valve

seat inserts (31 and 33) must be replaced. Use a suitable valve seat extractor to replace valve seat inserts.

d. To install new valve seat inserts that have been worn beyond acceptable grinding tolerances, observe the following: (This does not include valve seat inserts that are loose.)

1. Clean cylinder head with an approved cleaning solvent, and dry thoroughly.

2. Refer to table 1-1 to ensure that head counterbores meet allowable limits before installing inserts.

3. Immerse the cylinder head in water heated to 180°F to 200°F for at least 30 minutes.

4. Rest the cylinder head upside down on a bench, and lay a new insert in counterbore, valve seat up. This must be done quickly while the cylinder head is hot and the insert is cold (room temperature).

5. Using an approved valve seat insert installation tool, drive insert down tight into counterbore.

6. Grind the new valve seat insert to the minimum allowable limit of the valve seat insert tolerances shown in table 1-1.

e. To replace a loose valve seat insert, the insert counterbore must be enlarged to accept the next standard oversize insert. After enlarging counterbore, refer to preceding step d. for insert installation procedure.

#### 8-194. REASSEMBLY.

Refer to figure 8-54 and reassemble cylinder head group in the reverse

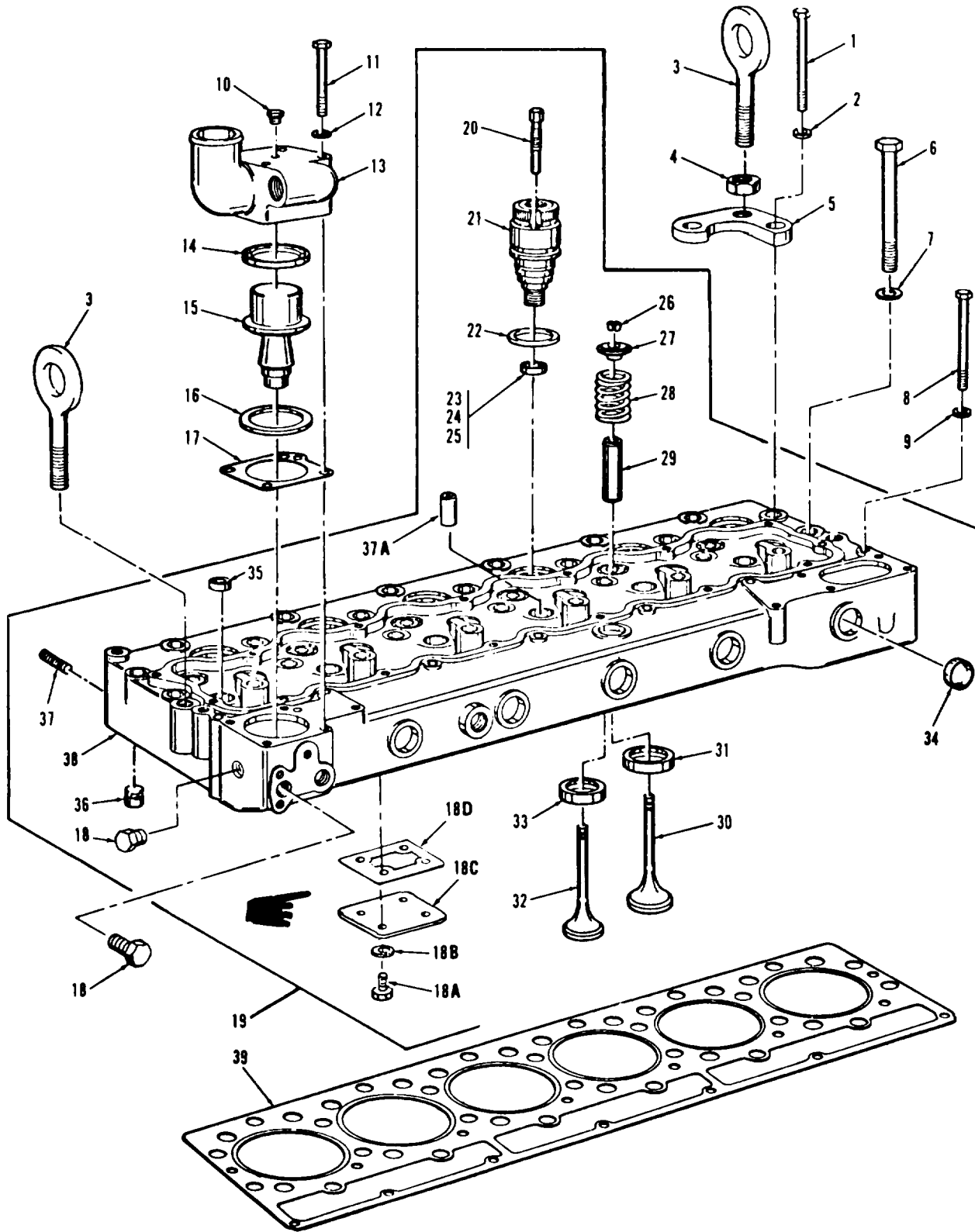


Figure 8-54. Cylinder head group, exploded view

Legend to figure 8-54:

- |                      |                           |                            |
|----------------------|---------------------------|----------------------------|
| 1. Bolt (2)          | 15. Temperature regulator | 25. Gasket (6)             |
| 2. Washer (2)        | 16. Washer                | 26. Lock (24)              |
| 3. Lifting eye (2)   | 17. Gasket                | 27. Rotocoil assembly (12) |
| 4. Nut               | 18. Plug (4)              | 28. Spring (12)            |
| 5. Plate             | 18A. Screw (4)            | 29. Valve guide (12)       |
| 6. Bolt (18)         | 18B. Lock washer (4)      | 30. Valve (6)              |
| 7. Washer (18)       | 18C. Cover                | 31. Insert (6)             |
| 8. Bolt (7)          | 18D. Gasket               | 32. Valve (6)              |
| 9. Washer (7)        | 19. Head assembly         | 33. Insert (6)             |
| 10. Plug             | 20. Plug (6)              | 34. Plug (7)               |
| 11. Bolt (4)         | 21. Chamber assembly (6)  | 35. Plug (6)               |
| 12. Lock washer (4)  | 22. Seal (6)              | 36. Director (18)          |
| 13. Housing assembly | 23. Gasket (6)            | 37. Stud (12)              |
| 14. Seal             | 24. Gasket (6)            | 37A. Bushing (12)          |
|                      |                           | 38. Head                   |
|                      |                           | 39. Gasket                 |

order of index numbers assigned, Pay particular attention to the following:

- a. Lubricate exhaust and intake valve (30 and 32), stems and valve guides (29) prior to installation. Exhaust and intake valve (30 and 32) heads are marked on top for identification; e.g. , EX for exhaust and IN for inlet,
- b. If removed, install inserts (31 and 33) into cylinder head (38) using a suitable installing tool.
- c. Make preliminary valve clearance adjustment. Adjust clearance for each exhaust valve to 0.028 inch and each inlet valve to 0.015 inch. Refer to Operator and Organizational Maintenance Manual for final valve adjustment.
- d. Using a suitable valve guide driver, install valve guides (29) into cylinder head (39). Valve guide projection above cylinder must not exceed 0.875 inch.
- e. Using a suitable spring compressor, install springs (28) with painted end up. Tap rotocoil assembly (27) lightly as spring compressor is being removed to help seat locks (26) properly.

f. Align opening in director (36) with “V” mark stamped on head.

g. Install new gaskets (25, 24, 23, 18D and 14.

h. Coat seal (22) and mating surface in bore with liquid soap. Using a suitable wrench, install chamber assemblies (21) into cylinder head (38).

i. Torque plug (20) from 96 to 144 inch-pounds.

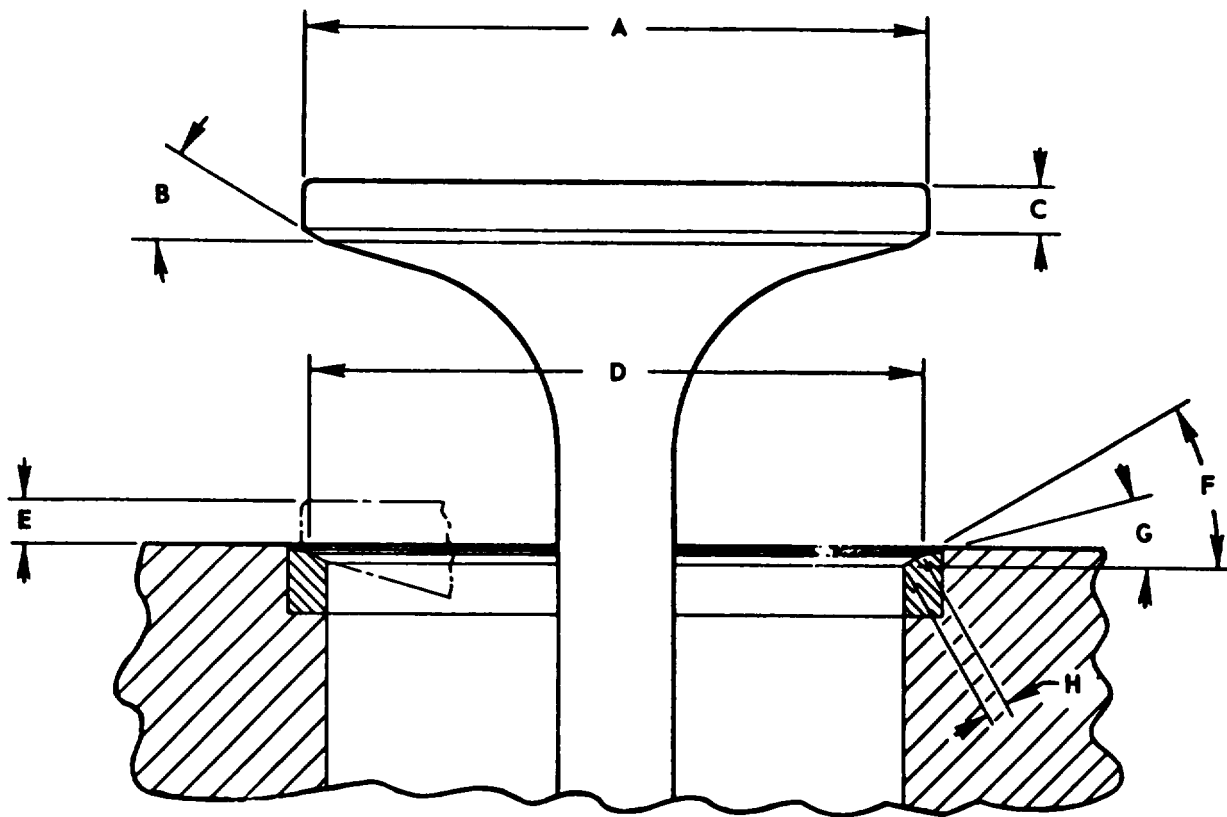
j. Torque chamber assemblies (21) from 140 to 160 foot-pounds.

NOTE

Gasket (39) is to be clean and dry prior to installation.

k. Position a new cylinder head gasket (39) on the cylinder block. Rock head gentle until it seats flat on head gasket.

l. Install cylinder head (38) and torque cylinder head bolts (6 and 8) as shown in figure 8-56.



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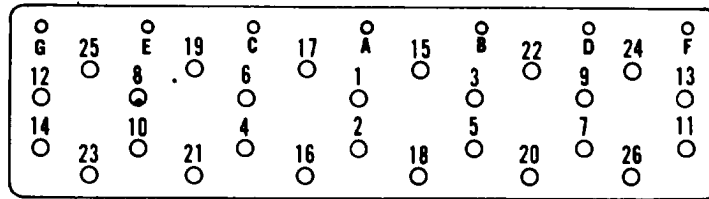
**VALVE AND VALVE SEAT SPECIFICATIONS**

**A - VALVE HEAD DIAMETER. B - VALVE FACE ANGLE. C - MINIMUM VALVE LIP THICKNESS. D - OUTSIDE DIAMETER OF VALVE SEAT FACE. E - CLOSED VALVE PROJECTION. F - VALVE SEAT FACE ANGLE. G - ANGLE TO GRIND INSERT SEAT FACE TO REDUCE MAXIMUM SEAT DIAMETER. H - MAXIMUM PERMISSIBLE VALVE SEAT WIDTH.**

	<b>INLET</b>	<b>EXHAUST</b>
<b>A</b>	<b>2.025/2.015 INCHES</b>	<b>1.901/1.891 INCHES</b>
<b>B</b>	<b>29-1/4 DEGREES</b>	<b>29-1/4 DEGREES</b>
<b>C</b>	<b>0.057 INCHES</b>	<b>0.070 INCHES</b>
<b>D</b>	<b>1.984/1.934 INCHES</b>	<b>1.860/1.810 INCHES</b>
<b>E</b>	<b>0.134 INCHES</b>	<b>0.157 INCHES</b>
<b>F</b>	<b>30 DEGREES</b>	<b>30 DEGREES</b>
<b>G</b>	<b>15 DEGREES</b>	<b>15 DEGREES</b>
<b>H</b>	<b>0.076 INCHES</b>	<b>0.076 INCHES</b>

Figure 8-55. Valve and valve seat specifications





CYLINDER HEAD

Step 1 - Tighten all bolts in numerical order to	115 ft. lbs.
Step 2 - Retighten all bolts in numerical order to	170 to 180 ft. lbs.
Step 3 - Finally, retighten all bolts in numerical order (hand torque only) to	170 to 180 ft. lbs.
Step 4 - Tighten all bolts in alphabetical order to	22 ft. lbs.
Step 5 - Retighten all bolts in alphabetical order to	27 to 37 ft. lbs.
Step 6 - Finally, retighten all bolts in alphabetical order (hand torque only) to	27 to 37 ft. lbs.

NOTE: Coat cylinder head bolts threads with Moly-Coat Military Specification MIL-M-7866

Figure 8-56. Tightening sequence for cylinder head

### 8-195. INSTALLATION.

a. Attach a suitable lifting device to lifting eyes (3, figure 8-54) on cylinder head. Install cylinder head and secure with bolts (6 and 8) and lock washers (7 and 8). Refer to figure 8-56 for torquing sequence.

b. Install valve cover and valve mechanism group (paragraph 8-187).

c. Install fan mounting group (paragraph 8-37).

d. Install fuel injection pump lines and injectors (paragraph 8-148).

e. Install exhaust manifold group (paragraph 8-163).

f. Refer to Operator and Organizational Maintenance Manual and install the following:

1. Turbocharger group.
2. Lube oil filter assembly.
3. High water temperature shut-down sensing bulb.
4. Water temperature sensing bulb.
5. Ether start atomizer.
6. Connect water pump by-pass hose and top radiator hose.
7. Air cleaner assembly.
8. Lifting frame.
9. Service cooling system.

Section XXVI. FLYWHEEL AND FLYWHEEL HOUSING GROUP

8-196. GENERAL.

The flywheel and flywheel housing group is mounted on the rear of the cylinder block. The flywheel and flywheel housing group consists of a cast housing flywheel, ring gear, and engine support brackets. The ring gear is shrink-fitted to the rim of the flywheel. The purpose of the flywheel is to provide a mass at the end of the crankshaft to smooth out power impulses and reduce variation in rotative speed; and to provide a mounting surface for the generator coupling disc. The ring gear provides a place for starting motor engagement when cranking the engine. The flywheel housing also provides a machined surface to mount the generator adapter flange. Special brackets are bolted to the housing pads to provide support for the engine when the generator is removed for repair. The flywheel housing also provides a counterbore for locating the rear main oil seal.

8-197. REMOVAL.

- a. Remove engine assembly (paragraph 2-8).
- b. Refer to Operator and Organizational Maintenance Manual and remove air cleaner assembly, starter motor, and turbocharger.
- c. Removal of flywheel and flywheel housing group is accomplished during disassembly (paragraph 8-198).

8-198. DISASSEMBLY.

Refer to figure 8-57 and disassemble flywheel and flywheel housing in the order of index numbers assigned. Pay particular attention to the following:

- a. Scribe a mark on flywheel and crankshaft to show a relative position between these two parts.

WARNING

Attach lifting device prior to removal of bolts (8) to prevent flywheel from falling off the crankshaft end.

- b. To lift flywheel assembly (10), thread eyebolt into tapped hole provided on flywheel face.
- c. Attach lifting device, minimum capacity 250 lb (113.4 kg), and remove bolts (8), lockring (9), and flywheel (10).
- d. Using a suitable mallet, stroke front face of flywheel housing (21) alternately on each side of engine to loosen and work flywheel housing (21) off dowel pins.

NOTE

Do not remove ring gear (11) from flywheel assembly (10) unless damage to ring gear (11) or housing (12) is evident.

- e. Discard crankshaft seal (22).

8-199. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.
- a. Clean parts with an approved cleaning solvent and dry thoroughly.
  - b. Remove rust from ring gear, using a stiff brush. Wash ring gear with solvent and dry thoroughly.

c. Flush out turbo drain port in housing with solvent and dry with low pressure compressed air.

#### 8-200. INSPECTION.

- a. Inspect flywheel housing for cracks. Replace cracked flywheel housing.
- b. Check machined gasket surface at ring of flywheel housing for nicks and burrs.
- c. Inspect threaded holes for damaged threads.
- d. Inspect ring gear teeth for nicks, burrs, cracks, and broken teeth. Nicks and burrs that extend below the hardened surface of the gear teeth are cause for rejection of the gear. Replace ring gear if cracked or if teeth are broken.
- e. Inspect ring gear for wear that may have destroyed the original tooth shape. If this condition is found, replace gear.
- f. Inspect coupling disc counter bore on flywheel for burred edges or an indication that coupling disc on generator does not seat properly.
- g. Discard seal and gaskets.

#### 8-201. REPAIR.

- a. Remove minor nicks and burrs from flywheel housing and ring gear teeth, using a suitable file or hone.
- b. Repair minor thread damage using a suitable thread chaser.
- c. Replace a defective ring gear as follows:
  1. Cut or press off defective ring gear.

#### CAUTION

Under no circumstances should the ring gear (11, figure 8-57) be heated over 600°F as excessive heating may destroy the original heat treatment. Do not heat ring gear in one area.

2. Heat new ring gear to a maximum of 600°F. Use a torch and apply heat evenly around diameter of ring gear.

3. Install ring gear with chamfered portion of ring gear teeth facing toward starter pinion or to backside of flywheel. Gear must be flush with flywheel shoulder.

#### CAUTION

Be careful to remove only the burred material on the edge of the coupling disc counterbore.

- d. Remove sharp edges and burrs from coupling disc counterbore in flywheel using a suitable file,

#### 8-202. REASSEMBLY.

Refer to figure 8-57 and reassemble flywheel and flywheel housing group in the reverse order of index numbers assigned. Pay particular attention to the following:

- a. Bottom edges of housing gasket (22) that contacts oil pan plate must be cut square and flush with oil pan plate before flywheel housing is secured to crankcase.

- b. Install two suitable pilot studs in cylinder block to act as guide pins while flywheel housing is hoisted into position and located on dowel pins.

- c. Install crankshaft seal (13) as follows :

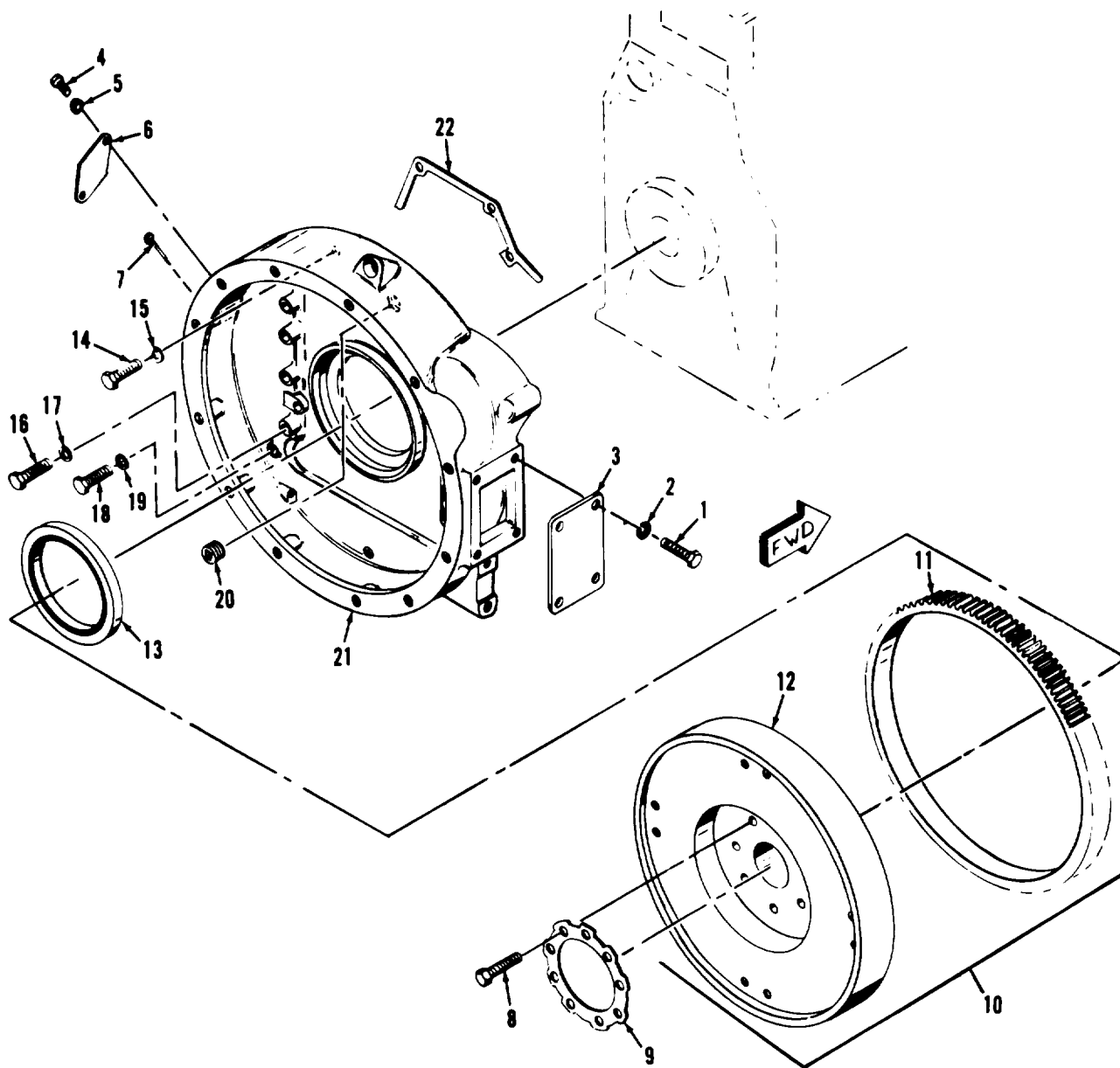


Figure 8-57. Flywheel and flywheel housing group,  
exploded view

Legend to figure 8-57:

- |                    |                       |                      |
|--------------------|-----------------------|----------------------|
| 1. Bolt (4)        | 9. Lockring           | 16. Bolt (9)         |
| 2. Lock washer (4) | 10. Flywheel assembly | 17. Lock washer (9)  |
| 3. Plate           | 11. Ring gear         | 18. Bolt (2)         |
| 4. Bolt (2)        | 12. Flywheel          | 19. Lock washer (2)  |
| 5. Lock washer (2) | 13. Seal              | 20. Plug             |
| 6. Cover           | 14. Bolt (2)          | 21. Flywheel housing |
| 7. Pointer         | 15. Lock washer (2)   | 22. Gasket           |
| 8. Bolt (9)        |                       |                      |

1. Fabricate pilot and sleeve as shown in figure 2-1 (view F and G).

2. Lubricate sealing lip of seal (13, figure 8-57) lightly with crankcase oil. Put MIL-S-22473 sealant on the outer metal shell of the seal. Bolt pilot to the crankshaft flange and position seal on pilot with lip facing cylinder block as shown in figure 8-58 (view B).

3. Place sleeve on stud and install 3/4 inch washer 3/4-10 inch NC nut.

4. Tighten nut to press seal (13, figure 8-57) into flywheel housing (21). Remove installation tools.

d. Torque flywheel housing bolts to 100 foot-pounds.

e. Before locating flywheel assembly (10, figure 8-57) on crankshaft, make sure that alignment scribe lines are lined up.

f. Torque flywheel bolts to 150 foot-pounds. If lock rings tabs do not match with flats on bolt heads, tighten bolts slightly to match.

**CAUTION**

Do not loosen bolts to line up lock ring tabs with bolt head flats.

g. Refer to figure 8-50 and install lockwashers (22) and bolts (21) to secure bottom of flywheel housing.

h. Check flywheel and flywheel housing for parallelism and concentricity, using suitable dial indicators as follows:

1. Remove fuel injectors, this will relieve engine compression when rotating crankshaft.

2. When making checks, position dial indicators straight and square as shown in figure 8-59 and 8-60 and make sure indicators have adequate travel in each direction.

3. Using a suitable board, apply pressure to front end of crankshaft to make sure end play is in one direction only.

4. Perform concentricity check as shown in figure 8-59. Adjust dial indicator to read zero at twelve o'clock position. Apply continuous pressure to front end of crankshaft and using tool, rotate crankshaft one full revolution, taking readings at 45 degree intervals (8 readings each on

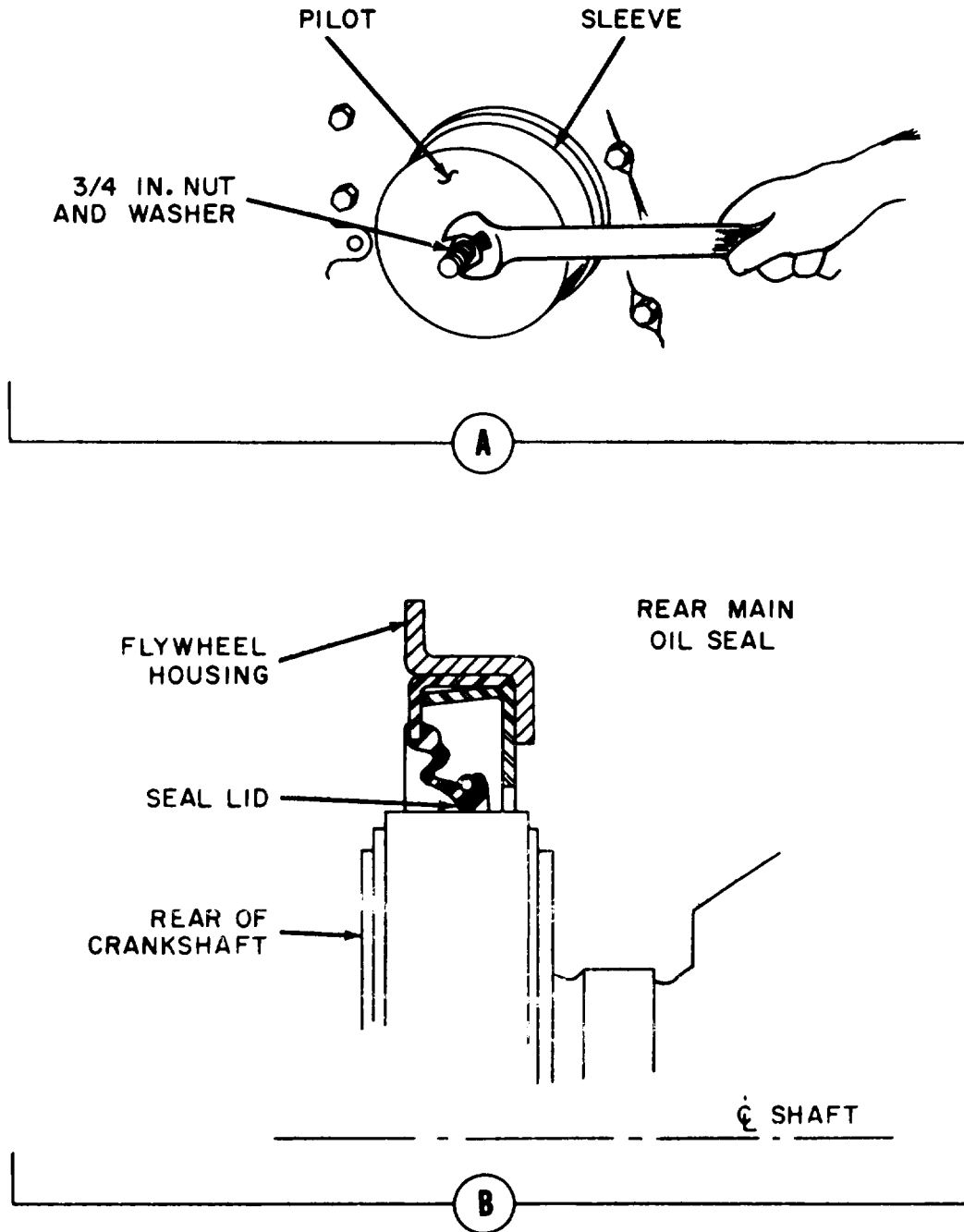


Figure 8-58. Installing crankshaft seal



Figure 8-59. Flywheel housing bore concentricity check



Figure 8-60. Flywheel housing face parallelism check

flywheel housing (21, figure 8-57) bore). Stop and remove tool before recording each reading to ensure accuracy. The maximum total indicator reading must not exceed 0.012 inch.

5. If the flywheel housing (21) bore run-out is excessive, remove flywheel (12) and loosen flywheel housing attaching bolts (14, 16, and 18) slightly and tap the flywheel housing (21) with a soft hammer in the required direction until the run-out is within limits. Re-tighten the attaching bolts (14, 16, and 18), install flywheel (12) and recheck the run-out.

6. Perform parallelism check as shown in figure 8-60. Adjust dial indicator to read zero at twelve o'clock position. Apply continuous pressure to front end of crankshaft and using tool, rotate crankshaft one full revolution, taking readings at 45 degree intervals (8 readings each on flywheel face). Stop and remove tool before

recording each reading to ensure accuracy. The maximum total indicator reading must not exceed 0.006 inch.

7. If the flywheel housing (21, figure 8-57) face run-out is excessive, remove flywheel housing (21), and check for dirt or foreign material (such as old gasket material) between flywheel housing (21) and cylinder block. Install flywheel housing (21) and recheck the run-out. When run-out is correct, bend up lock ring tabs (9, Figure 8-57).

#### 8-203. INSTALLATION.

a. Installation of the flywheel and flywheel housing is accomplished during reassembly (paragraph 8-202).

b. Refer to Operator and Organizational Maintenance Manual and install air cleaner assembly, starter motor, and turbocharger.

c. Install engine assembly (paragraph 2-8).

### Section XXVII. CAMSHAFT GROUP

#### 8-204. GENERAL.

The camshaft group is located on the upper left side of the cylinder block and is driven by the crankshaft gear. The camshaft group consists of a camshaft gear, a thrust washer secured to the cylinder block, and four sleeve type bearings. The cams are forged integrally with the shaft. As the camshaft rotates, the cams move the valve lifters and push rods which activate inlet and exhaust valves.

#### 8-205. REMOVAL.

a. Remove engine assembly (paragraph 2-8).

b. Remove valve cover and valve mechanism group (paragraph 8-181).

c. Remove fan mounting group (paragraph 8-3 1).

d. Remove water pump group (paragraph 8-118).

e. Refer to Operator and Organizational Maintenance Manual and remove alternator.

f. Remove hydraulic tank (precise generator sets only) (paragraph 8-86).

g. Remove hydraulic pump (paragraph 8-94).



h. Remove hydraulic pump drive group (paragraph 8-101).

i. Remove crankshaft pulley, damper, and timing gear cover group (paragraph 8-126).

j. Removal of the camshaft group is accomplished during disassembly (paragraph 8-206).

#### 8-206. DISASSEMBLY.

Refer to figure 8-61 and disassemble camshaft group in the order of index numbers assigned. Pay particular attention to the following:

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

#### CAUTION

Use extreme care when removing camshaft from engine block so that camshaft bearings will not be damaged by cam lobes passing through bearings. Do not rotate crankshaft with camshaft gear removed.

#### 8-207. CLEANING.

Clean components with an approved cleaning solvent and dry thoroughly.

#### 8-208. INSPECTION.

a. Refer to table 1-1 and, using a suitable micrometer and feeler gauge, check for excessive wear as follows:

1. Camshaft bearing journal diameter.
2. Camshaft end clearance.
3. If allowable limits are not met, replace part.

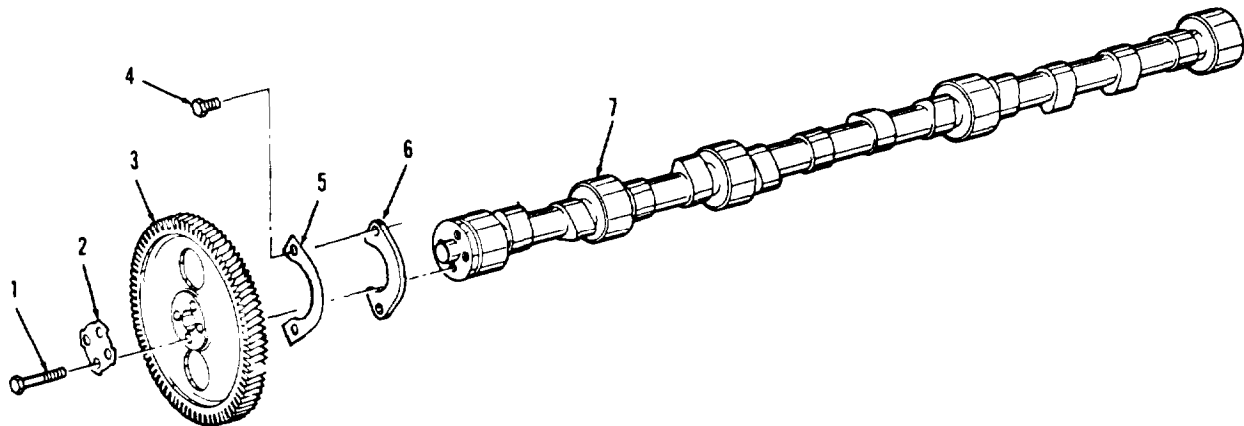


Figure 8-61. Camshaft group, exploded view

Legend to figure 8-61:

- |             |             |
|-------------|-------------|
| 1. Bolt (4) | 5. Lock     |
| 2. Lock     | 6. Washer   |
| 3. Gear     | 7. Camshaft |
| 4. Bolt (2) |             |

b. Measure bearing clearance between bearings and camshaft journals as follows:

NOTE

Camshaft bearing clearance can be determined only when camshaft bearings are pressed into the cylinder block.

1. If camshaft journal dimension measured in step a. indicates that journal wear is within 0.002 inch of each other, clearances between camshaft journals and camshaft bearings can be calculated.

2. Using a suitable inside micrometer, measure the I.D. of the front camshaft bearing in the cylinder block. Subtract the measured diameter of the front camshaft journal from the I. D. of the front camshaft bearing in the cylinder block. The result is the running clearance. Maximum allowable clearance is 0.008 inch.

3. If camshaft journal wear was found to be more than 0.002 inch difference between any two journals, the individual camshaft bearings in the cylinder block will have to be checked using the following procedure.

(a) Refer to Operator and Organizational Maintenance Manual and remove air cleaner assembly and turbocharger group.

(b) Remove flywheel and flywheel housing (paragraph 8-197).

(c) Refer to figure 8-50 and remove bolts (6, 9, and 12), lock washers (7, 10, and 13), and washers (8, 11, and 14). Remove oil pan (20) and gasket (15). Discard gasket.

(d) Remove oil pump group (paragraph 8-173).

4. Rotate cylinder block so that bottom of block is facing up.

5. Using a suitable micrometer, measure I.D. of each camshaft bearing. Measure diameter of camshaft journal that corresponds to bearing just measured. Subtract measured diameter of camshaft journal from measured I.D. of bearing. The result is the running clearance. Maximum allowable clearance is 0.008 inch. If within limit, proceed to step 9. If limit is exceeded, replace all five camshaft bearings. Proceed to step 6.

6. Using a suitable puller, remove all five camshaft bearings.

7. Using a suitable tool, install new camshaft bearings. Front bearing must be recessed 0.06 inch from front face of camshaft bore. Oil hole in bearing must align with oil hole in cylinder block, and joint in bearing must face cylinder block centerline. Intermediate bearings must be flush with front face of bearing bore. Rear bearing must be recessed 0.06 inch from rear face of bore.

8. Recheck running clearance. Refer to step 5.

9. Rotate cylinder block so that top of block is facing up.

10. Install oil pump group (paragraph 8-179).

11. Refer to figure 8-50 and install new gasket (15) and oil pan (20). Install washers (8, 11, and 14), lockwashers (7, 10, and 13), and bolts (6, 9, and 12).

12. Install flywheel and flywheel housing (paragraph 8-203).

13. Refer to Operator and Organizational Maintenance Manual and install turbocharger group and air cleaner assembly.

c. Inspect camshaft gear for nicked or cracked gear teeth. If cracked, replace gear.

d. Inspect camshaft for cracks and distortion. If defective, replace camshaft.

#### 8-209. REPAIR.

Repair minor nicks and burrs on camshaft gear using a suitable file or hone.

#### 8-210. REASSEMBLY.

Refer to figure 8-61 and reassemble camshaft group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Apply a graphite grease to camshaft lobes prior to installing camshaft (7).

b. Align letter C on camshaft gear (3) with letter C on crankshaft gear. Refer to figure 8-30.

c. Measure gear end clearance. End clearance should be 0.025 inch.

d. Camshaft front bearing must be recessed 0.06 inch from front face of bore. Oil hole in bearing must align with oil hole in cylinder block, and joint in bearing must

face cylinder block centerline. Intermediate bearings must be flush with front face of bearing bore. Rear bearing must be recessed 0.06 inch from rear face of bore.

#### 8-211. INSTALLATION.

a. Installation of the camshaft group is accomplished during reassembly (paragraph 8-210).

b. Install crankshaft pulley, damper, and timing gear cover pump (paragraph 8-132).

c. Install hydraulic pump (paragraph 8-99).

d. Install hydraulic tank (precise generator sets only) (paragraph 8-92).

e. Refer to Operator and Organizational Maintenance Manual and install alternator.

f. Install water pump group (paragraph 8-124).

g. Install fan mounting group (paragraph 8-37).

h. Install valve cover and valve mechanism group (paragraph 8-187).

i. Install engine assembly (paragraph 2-8).

### Section XXVIII. CONNECTING RODS AND PISTONS GROUP

#### 8-212. GENERAL.

The connecting rods and pistons group is located in the cylinder block. The

connecting rods and pistons group consists of piston assemblies, connecting rod assemblies, bearings, pins, and retainers. The piston assemblies are attached to the crankshaft by connecting rods.

### 8-213. REMOVAL.

a. Refer to Operator and Organizational Maintenance Manual and remove the following:

1. Air cleaner assembly.
  2. Drain cooling system. Loosen hose clamps and remove top radiator hose and water bypass hose.
  3. Drain crankcase oil.
  4. Remove ether start atomizer.
  5. Remove sensing bulbs from thermostat housing.
  6. Remove oil filter assembly.
- b. Remove lifting frame assembly (paragraph 3-8).
- c. Remove fan mounting group (paragraph 8-31).
- d. Refer to Operation and Organizational Maintenance Manual and remove turbocharger.
- e. Remove exhaust manifold group (paragraph 8-159).
- f. Disconnect fuel lines from fuel injection pump (paragraph 8-142).
- g. Remove valve cover and valve mechanism group (paragraph 8-181).
- h. Remove cylinder head group (paragraph 8-189).
- i. Remove oil pan group (paragraph 8-165).

j. Remove oil pump group (paragraph 8-173).

k. Removal of the connecting rods and pistons is accomplished during disassembly (paragraph 8-214).

### 8-214. DISASSEMBLY .

Refer to figure 8-62 and disassemble connecting rods and pistons group in the order of index numbers assigned. Pay particular attention to the following:

a. Prior to removing piston, note the condition at the top of cylinder liner. If a carbon ridge is present, it must be removed using a suitable ridge reamer.

b. Rotate crankshaft until the connecting rod and piston to be removed is at top dead center. Carefully remove each connecting rod and piston by pushing it out through top of cylinder.

c. Using a suitable retaining ring remover, remove two retaining rings (5). Using a suitable drift, drive out piston pin (6).

d. Using suitable tools, drive out bushing (8) from connecting rod (7).

e. Tag each bearing halve (3), connecting rod assembly (9), and piston assembly (14) indicating which cylinder they were removed from.

f. Use a suitable piston ring expander to remove piston rings (10, 11, and 12) from the pistons (13).

### 8-215. CLEANING.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Clean parts with an approved cleaning solvent and dry thoroughly.

CAUTION

Do not use broken piston rings or carbon scrapers on ring lands since this practice can result in cutting sides of grooves. Be sure bottom of each ring groove is clean and oil return holes in oil ring groove are open.

b. If pistons have carbon on them, soak pistons in cold water overnight and then let them dry (preferably in sunlight). Most of the carbon can then be removed with a hardwood stick.

8-216. INSPECTION.

a. Refer to table 1-1 and inspect parts for dimensional tolerances. Replace defective parts.

b. Inspect piston for burned condition, cracks, distortion, galling, or any other defects. Replace defective piston.

c. Inspect piston pins and rod bearings for scoring, galling, distortion, or cracks. Replace defective bearings.

d. Inspect connecting rod for cracks, breaks, or distortion. Replace defective connecting rod.

NOTE

Bent rods should be discarded. DO not attempt to align rods by bending. Abrasive materials may roll around between bearings (8) and crankshaft journals causing scratches in the bearing without actually becoming embedded in the aluminum. Such scratches are not necessarily harmful and do not indicate that bearings (8, figure 8-62) should be replaced.

e. To measure clearance and gap for each piston ring (10, 11, and 12), insert a piston (13) in cylinder bore in the inverted position. Insert each piston ring, one at a time, about two inches down in the cylinder bore and bring the bottom edge of the piston (13) up against the ring to square the ring in the cylinder bore. Check gap with a feeler gauge. If gap clearance for any ring is not as specified in table 1-1, the ring must be filed or honed to specification, or replaced.

8-217. REPAIR.

a. When installing a new bearing (8) into the connecting rod, the joint on the diameter of the bearing must be at right angles ( $90 \pm 10$  degrees, either left or right) of the vertical centerline of the connecting rod. After pressing new bearing in place machine accurately to dimensions in table 1-1.

b. Connecting rod bearings (3) should always be replaced as a set (two halves make a set). If inspection of one bearing shell indicates minimum thickness, then replace all six connecting rod bearing shells.

8-218. REASSEMBLY.

Refer to figure 8-62 and reassemble connecting rods and pistons group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Reassemble rod (7) on piston (13) so that the etched cylinder number on rod (7) is on the same side as the "V" mark in the piston (13).

b. Use a suitable piston ring expander to install piston rings (10, 11, and 12) on

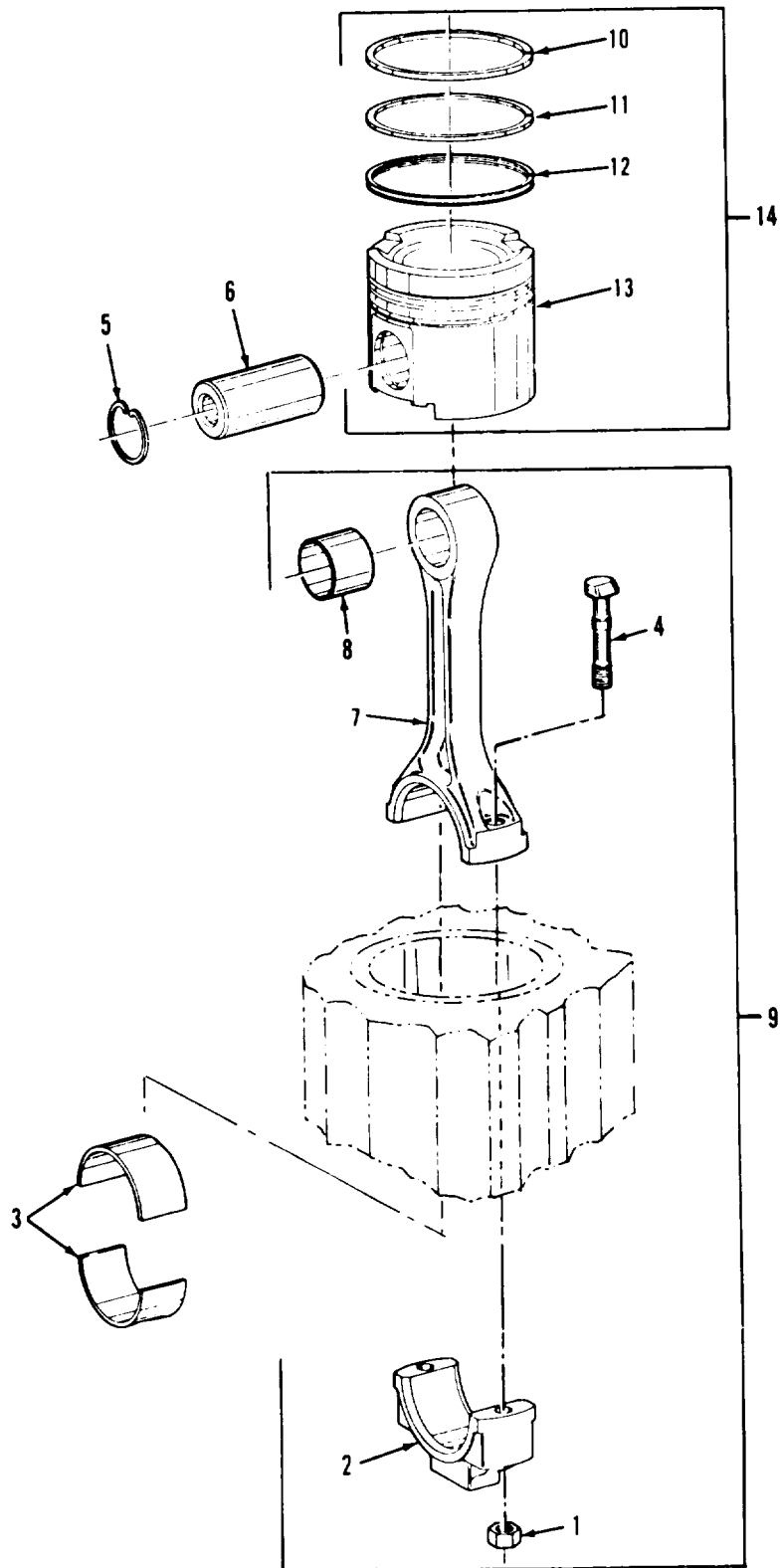


Figure 8-62. Connecting rods and pistons group, exploded view

Legend to figure 8-62:

- |                       |                                |                         |
|-----------------------|--------------------------------|-------------------------|
| 1. Nut (2)            | 6. Pin                         | 11. Ring                |
| 2. Bearing cap (6)    | 7. Rod                         | 12. Ring                |
| 3. Bearing (6)        | 8. Bearing                     | 13. Piston              |
| 4. Bolt (2)           | 9. Connecting rod assembly (6) | 14. Piston assembly (6) |
| 5. Retaining ring (2) | 10. Ring                       |                         |

pistons (13). On each ring, the word "UP" is stamped. Start with ring (12) and install ring with the word "UP" pointing toward the top of the piston. Stagger ring gaps on piston so they are not in line with each other.

c. Lubricate bearings (3 and 8), piston rings (10, 11, and 12), and the liner walls with clean engine oil.

d. Compress piston rings (10, 11, and 12) with a suitable ring compressor tool and install piston (13) so that the "V" mark on top of the piston lines up to the "V" mark on top of the block.

e. When assembling lower bearing cap (2) to connecting rod (7), make sure that protruding tab on back of each bearing half (3) lines up with corresponding recess in connecting rod (7) and bearing cap (2).

f. Guide lower end of each connecting rod (7) over crankshaft journal so as not to damage crankshaft bearing surface.

g. Check connecting rod bearing clearance as follows:

1. Place an approved piece of soft plastic measuring strip between crankshaft journal and lower bearing half, on all six connecting rod assemblies.

2. Install lower bearing caps (2, figure 8-62) and tighten bolts, (4) and nuts (1) from 27 to 33 foot-pounds torque.

3. Remove caps (2) and bearings one at a time and measure thickness of plastic strips. The measurement represents the bearing clearance. If the maximum clearance exceeds 0.010 inch, replace connecting rod bearings. It would be advisable to replace all rod bearings (3) at this time.

#### NOTE

Excessive bearing clearance can also be an indication of crankshaft surface being out-of-round.

g. Install caps (2) and bearings (3) and torque bolts (4) as follows:

1. Lubricate threads of bolts with crankcase oil, and tighten from 27 to 33 foot-pounds torque.

2. Mark bolts and caps. Tighten an additional 85 to 95 degrees from mark.

#### 8-219. INSTALLATION.

a. Installation of the connecting rods and pistons group is accomplished during reassembly (paragraph 8-218),

b. Install oil pump group (paragraph 8-179).

c. Install oil pan group (paragraph 8-171).

d. Install cylinder head group (paragraph 8-195).

e. Refer to Operator and Organizational Maintenance Manual and install turbocharger.

f. Install fan mounting group (paragraph 8-37).

g. Install exhaust manifold (paragraph 8-163).

h. Refer to Operator and Organizational Maintenance Manual and install the following:

1. Install oil filter assembly.
2. Install sensing bulbs to thermostat housing.
3. Install ether start atomizer.
4. Install air cleaner assembly.
5. Connect top radiator hose and water by-pass hose. Tighten clamps.
6. Install lifting frame (paragraph 3-8).
7. Service cooling system.
8. Fill engine crankcase.

## Section XXIX CRANKSHAFT GROUP AND MAIN BEARINGS

### 8-220. GENERAL.

The crankshaft group and main bearings are located in the cylinder block. The crankshaft group and main bearings consist of a crankshaft assembly, main bearings, plates, gear, and plugs. The end thrust of the crankshaft is taken up by flanges on the lower half of the rear main bearing. An oil seal pressed into the timing gear housing cover prevents oil leakage at the front of the engine. An oil seal, pressed into the flywheel housing, bears against the crankshaft flange and prevents leakage at the rear of the engine. Counterweights are forged integrally with the crankshaft and are drilled to obtain shaft balance. The crankshaft timing gear is pressed on the front of the crankshaft. The main bearings and caps support the crankshaft in the cylinder block. Tabs which are punched outward on each bearing half fit into recesses in the cylinder block and bearing cap, securing the bearing and preventing it from rotating.

### 8-221. REMOVAL.

- a. Remove engine assembly (paragraph 2-8).
- b. Remove fan mounting group (paragraph 8-3 1).
- c. Remove water pump group (paragraph 8-118).
- d. Remove hydraulic tank (precise sets only) (paragraph 8-86).
- e. Remove hydraulic pump (precise sets only) (paragraph 8-94).
- f. Remove hydraulic pump drive group (paragraph 8-101).
- g. Refer to Operator and Organizational Maintenance Manual and Remove alternator.



h. Remove crankshaft pulley, damper, and timing gear cover group (paragraph 8-126).

i. Remove oil pan group and related parts (paragraph 8-165).

j. Remove oil pump group (paragraph 8-173).

k. Refer to Operator and Organizational Maintenance Manual and remove air cleaner assembly and turbocharger.

l. Remove flywheel and flywheel housing group (paragraph 8-197).

m. Removal of the crankshaft group and main bearings is accomplished during disassembly (paragraph 8-222).

#### 8-222. DISASSEMBLY.

Refer to figure 8-63 and disassemble crankshaft group and main bearings in the order of index numbers assigned. Pay particular attention to the following:

#### NOTE

If only main bearing removal is required, perform steps a. through e.

a. Turn engine upside down and support in a suitable fixture.

b. Remove bolts (1), washers (2), main bearing caps (3), and lower bearing halves (4).

c. Tag each bearing cap as to which main bearing it was removed from.

#### NOTE

Cylinder block is upside down. The bearing half under the crankshaft is still referred to as the upper bearing half.

d. Place a suitable tool in oil hole in crankshaft, and rotate crankshaft to roll out upper bearing half (4). Bearing half must be rolled out tab end first.

e. Place bearing half with its mating bearing half and bearing cap.

#### NOTE

If crankshaft removal is required, perform steps f. through i.

f. Refer to paragraph 8-214, and remove connecting rod bearing and bearing caps. Tag each cap as to which connecting rod it was removed from.

#### NOTE

Do not remove crankshaft gear (8, figure 8-63) and sleeves (7 and 10) unless excessive wear or damage is noted.

g. Lift crankshaft from block using a suitable web sling around connecting rod journals on crankshaft at cylinder No. 1 and 6 or 2 and 4. Place crankshaft on suitable bench support.

h. Attach each connecting rod bearing cap and insert to the connecting rod from which they were removed.

i. Heat sleeves (7 and 10) and gear (8) to 600°F maximum and remove from crankshaft (11).

#### CAUTION

With crankshaft removed from block, do not attempt to rotate camshaft gear.

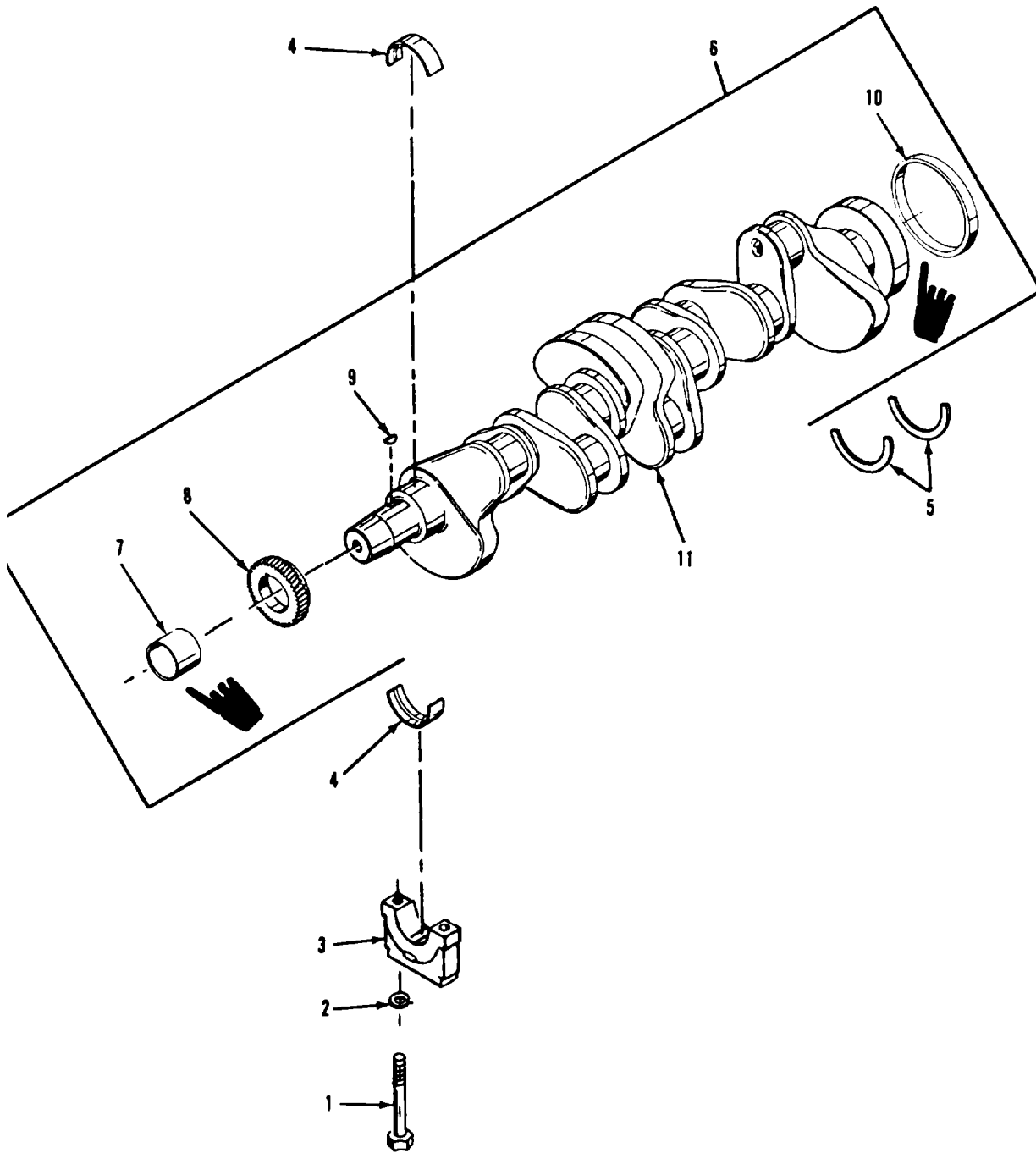


Figure 8-63. Crankshaft group and main bearings,  
exploded view

- Legend to figure 8-63:
- |                        |                        |
|------------------------|------------------------|
| 1. Bolt (14)           | 6. Crankshaft assembly |
| 2. Washer (14)         | 7. Sleeve              |
| 3. Cap (7)             | 8. Gear                |
| 4. Bearing (half) (14) | 9. Key                 |
| 5. Thrust washer (2)   | 10. Sleeve             |
|                        | 11. Crankshaft         |

8-223. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Clean bearing caps and bearing halves in an approved cleaning solvent, and dry thoroughly.

b. Clean crankshaft in an approved cleaning solvent, and dry thoroughly. Lubricate and wrap the bearing journals after cleaning.

c. Clean oil passages in the crankshaft with a small soft brush.

8-224. INSPECTION.

a. Inspect bearing surfaces for scoring, flaring, chipping, and cracks.

b. Inspect main bearing caps for high spots and burrs.

c. Inspect for damaged threads.

d. Refer to table 1-1 and check bearing clearances. If limits are exceeded, replace bearing.

e. Refer to table 1-1 and check bearing to crankshaft clearance as follows:

1. Place a small strip of approved plastic between lower bearing half (4, figure 8-63) and crankshaft. Light grease will hold the plastic strip in position.

2. Install main bearing cap (3) and torque bolts from 165 to 185 foot-pounds.

3. Rotate crankshaft one complete revolution. Remove main bearing cap (3, figure 8-63) and measure the thickness of the plastic strip. This measurement is the main bearing clearance. The maximum allowable clearance is 0.010 inch. If allowable limit is exceeded, replace main bearing. Repeat inspection for each main bearing.

f. Refer to table 1-1 and, using an outside micrometer, check journal diameters for excessive wear. If maximum allowable wear limits have been exceeded, replace crankshaft.

g. Inspect crankshaft for scoring or galling on crankpin and main journals.

h. Inspect crankshaft gear (7) for broken or chipped teeth. If defective, replace gear.

i. Inspect keyway in crankshaft and test woodruff key for a snug fit. Perform this inspection only if crankshaft gear (7) had been removed for repair or replacement.

j. Inspect thrust washer contact area at rear of crankshaft, on either side of rear main crankshaft bearing journal for excessive wear or roughness.

k. Inspect machined surface, at rear of crankshaft that comes into contact with rear oil seal, for a grooved condition.

1. Inspect thrust washers (5, figure 8-63) for excessive wear, distortion, and discoloration. Minimum allowable thickness of washer is 0.175 inch. If limit is not met, replace thrust washer.

8-225. REPAIR.

a. Remove minor nicks and burrs from bearing caps using a smooth file.

b. Dress thrust washer contact area at rear of crankshaft on either side of rear main crankshaft bearing journal with a hone to remove slight imperfections.

c. Polish machined surface, at rear of crankshaft that comes into contact with rear oil seal, to remove slight ridges less than 0.0002 inch in variation, using a crocus cloth wet with fuel oil. Rotate crankshaft and polish the complete circumference of the surface.

8-226. REASSEMBLY.

Refer to figure 8-63 and reassemble crankshaft group and main bearings in the reverse order of index numbers assigned. Pay particular attention to the following:

If crankshaft gear (8) and sleeves (7 and 10) had been removed, install as follows:

1. Heat sleeves (7 and 10) and gear (8) to 600°F maximum and install on crankshaft.

NOTE

Position gear with timing mark toward front. Ensure key (9) is positioned properly in keyway of crankshaft (11).

2. Install key (9) in keyway of crankshaft (11).

3. Heat gear to 600°F maximum and install on crankshaft with timing mark toward the front.

b. Clean main bearing surfaces in cylinder block.

NOTE

If results of inspection in paragraph 8-224 indicated excessively worn bearings, replace bearings at this time. Ensure that bearing tab is aligned with the recess in cylinder block. The upper bearing half has an oil groove machined on the inside of bearing with two oil holes. This bearing half can be installed only as an upper main bearing. It is recommended that all bearings (4, figure 8-63) halves be replaced even if only one bearing must be replaced. When new bearings are installed, proper clearance must be checked as outlined in para. e, steps 1, 2, and 3, above.

c. Lubricate inside surface of bearings with clean engine oil.

d. Install upper main bearing halves (4) in cylinder block.

e. Lift crankshaft using a suitable web sling, and install crankshaft with crankshaft gear timing mark aligned with timing mark on camshaft gear if camshaft has not been removed. Refer to figure 8-30.

f. install thrust washers (5, figure 8-63) on each side of rear main bearing in cylinder block with the words "BLOCK SIDE", that are stamped on each thrust plate, next to the cylinder block half of the upper main bearing.

g. Install lower bearing halves (4) and bearing caps (3) with lower bearing half tab mating with tab on upper bearing half. The bearing caps are numbered to ensure installation on the same journal from which they were removed. Torque bolts as follows :

1. Lubricate thread of bolts (1) with crankcase oil, and tighten from 27 to 33 foot-pounds torque.

2. Mark bolts (1, figure 8-63) and caps (3).. Tighten an additional 85 to 95 degrees from mark.

h. Measure crankshaft end clearance by pushing crankshaft to one end of cylinder block, and using a feeler gauge, measure the clearance between the machined face of the crankshaft flange and the flange of the lower half of rear main bearing. Clearance should be 0.0025 to 0.0145 inch.

i. Refer to paragraph 8-218, and install connecting rod lower bearing and end caps.

#### 8-227. INSTALLATION.

a. Installation of the crankshaft group and main bearings is accomplished during reassembly (paragraph 8-226).

b. Install flywheel and flywheel housing group (paragraph 8-203).

c. Refer to Operator and Organizational Maintenance Manual and install turbocharger group and air cleaner,

d. Install oil pump group (paragraph 8-179).

e. Install oil pan group (paragraph 8-171).

f. Install crankshaft pulley, damper, and timing gear cover group (paragraph 8-132).

g. Refer to Operator and Organizational Maintenance Manual and install alternator.

h. Install hydraulic pump drive group (paragraph 8-107).

i. Install hydraulic pump (precise sets only) (paragraph 8-99).

j. Install hydraulic tank (precise sets only) (paragraph 8-92).

k. Install water pump group (paragraph 8-124).

1. Install fan mounting group (paragraph 8-37).

m. Install engine assembly (paragraph 2-8).

### Section XXX, CYLINDER BLOCK AND COVERS GROUP

#### 8-228, GENERAL,

The cylinder block and covers group consists of replaceable cylinder liners, plugs, covers, pins, and end plates. The cylinder block assembly consists of a cast cylinder block, which forms the main structural part of the engine. The cylinder block has passages that carry coolant to

and around the cylinder liners and other passages that carry lubricating oil to all moving parts. Seals on the liners prevent leakage of coolant into the engine lubricating system. The flywheel housing attaches to the rear of the cylinder block and the timing gear cover and water pump to the front end of the block. The oil pan and plate attach to the bottom of the cylinder block. A compression gasket forms a

tight seal between the cylinder block assembly and the cylinder head assembly.

8-229. REMOVAL.

a. Remove engine assembly (paragraph 2-8).

b. Refer to Operator and Organizational Maintenance Manual and remove the following:

1. Engine wiring harness.
2. Air cleaner assembly,
3. Ether atomizer.
4. Lube oil filter group.
5. Manual throttle control.
6. Day tank assembly.
7. Turbocharger group.
8. Starter motor assembly.
9. Alternator assembly.
10. Water pump group.

c. Remove fan mounting group (paragraph 8-31).

d. Remove tachometer drive group (paragraph 8-54).

e. Remove fuel pump group (paragraph 8-62).

f. Remove oil cooler group (paragraph 8-78).

g. Remove hydraulic tank (precise sets only) (paragraph 8-86).

h. Remove hydraulic pump (precise sets only) (paragraph 8-94).

i. Remove hydraulic pump drive group (paragraph 8-101).

j. Remove governor actuator unit (paragraph 8-109).

k. Remove crankshaft pulley, damper, and timing gear cover group (paragraph 8-126).

l. Remove utility governor group (paragraph 8-134).

m. Remove fuel injection group (paragraph 8-142).

n. Remove accessory drive group (paragraph 8-151).

o. Remove exhaust manifold group (paragraph 8-159).

p. Remove oil pan group and related parts (paragraph 8-165).

q. Remove oil pump group (paragraph 8-173).

r. Remove valve cover and mechanism group (paragraph 8-181).

s. Remove cylinder head group (paragraph 8-189).

t. Remove flywheel and flywheel housing group (paragraph 8-197).

u. Remove camshaft group (paragraph 8-205).

v. Remove connecting rods and pistons group (paragraph 8-213).

w. Remove crankshaft group and main bearings (paragraph 8-221).

8-230. DISASSEMBLY.

Refer to figure 8-64 and disassemble cylinder block and covers group in the order of index numbers assigned. Pay particular attention to the following:

a. Use a suitable puller to remove cylinder liners ( 12) from cylinder block (51). Mark liners in accordance with cylinders they were removed from.

b. Use a suitable puller and remove camshaft bearings (40 and 45).

8-231. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

a. Clean parts with an approved cleaning solvent, and dry thoroughly.

b. Clean all oil passages with a brush or rod, and use compressed air on passages.

c. Remove rust and scale from outside surface of cylinder liners using a stiff brush.

d. Remove rust and scale from water jacket in cylinder Mock.

8-232. INSPECTION.

a. Refer to table 1-1 and, using a suitable micrometer and feeler gauge, check for excessive wear as follows:

1. Liner counterbore depth.

2. Camshaft bearing bore.

3. Camshaft bearing to block clearance.

4. Cylinder line bore.

5. Cylinder liner flange thickness.

6. Install lower main bearing caps, and tighten bolts from 27 to 33 foot-pounds torque. Measure main bearing bore diameter.

7. If allowable limits are exceeded, replace part.

b. Inspect cylinder liners for cracks, scoring, distortion, excessive wear, and other defects.

c. Inspect covers for cracks, breaks, distortion, and other defects.

d. Inspect cylinder bore for an out of round condition.

e. Inspect top of cylinder block for grooving or roughness.

f. Inspect camshaft bearings for grooves or score marks on O. D. of bearings. If noted, this would indicate that bearings have rotated in the block.

g. Inspect for damaged threads.

h. Discard all gaskets and seals.

8-233. REPAIR.

Repair tapped holes that are nicked or burred by retapping with a suitable tap.

8-234. REASSEMBLY.

Refer to figure 8-64 and reassemble cylinder block and covers group in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Install new seals (13) on cylinder liner (12).

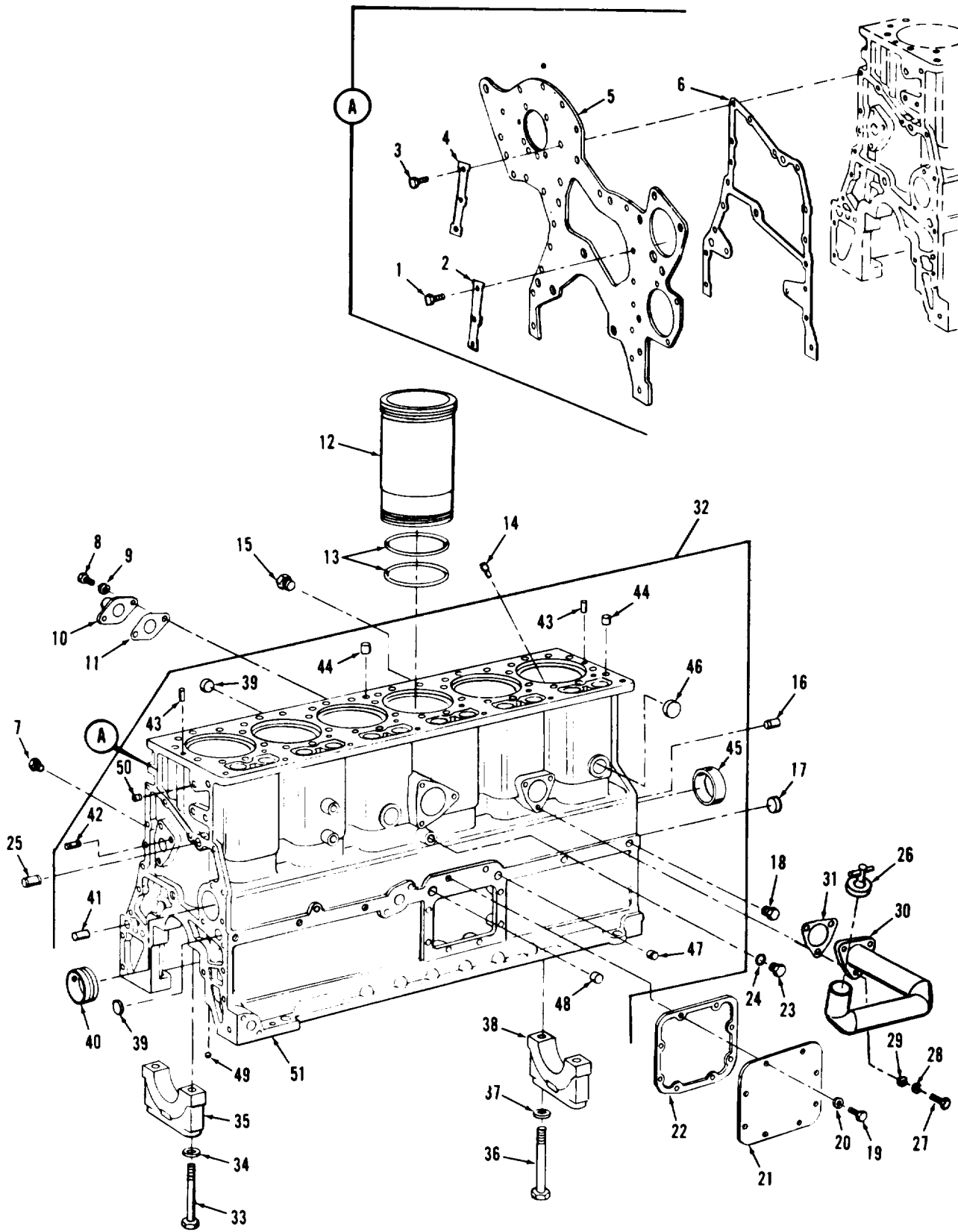


Figure 8-64. Cylinder block and covers group, exploded view  
(sheet 1 of 2)



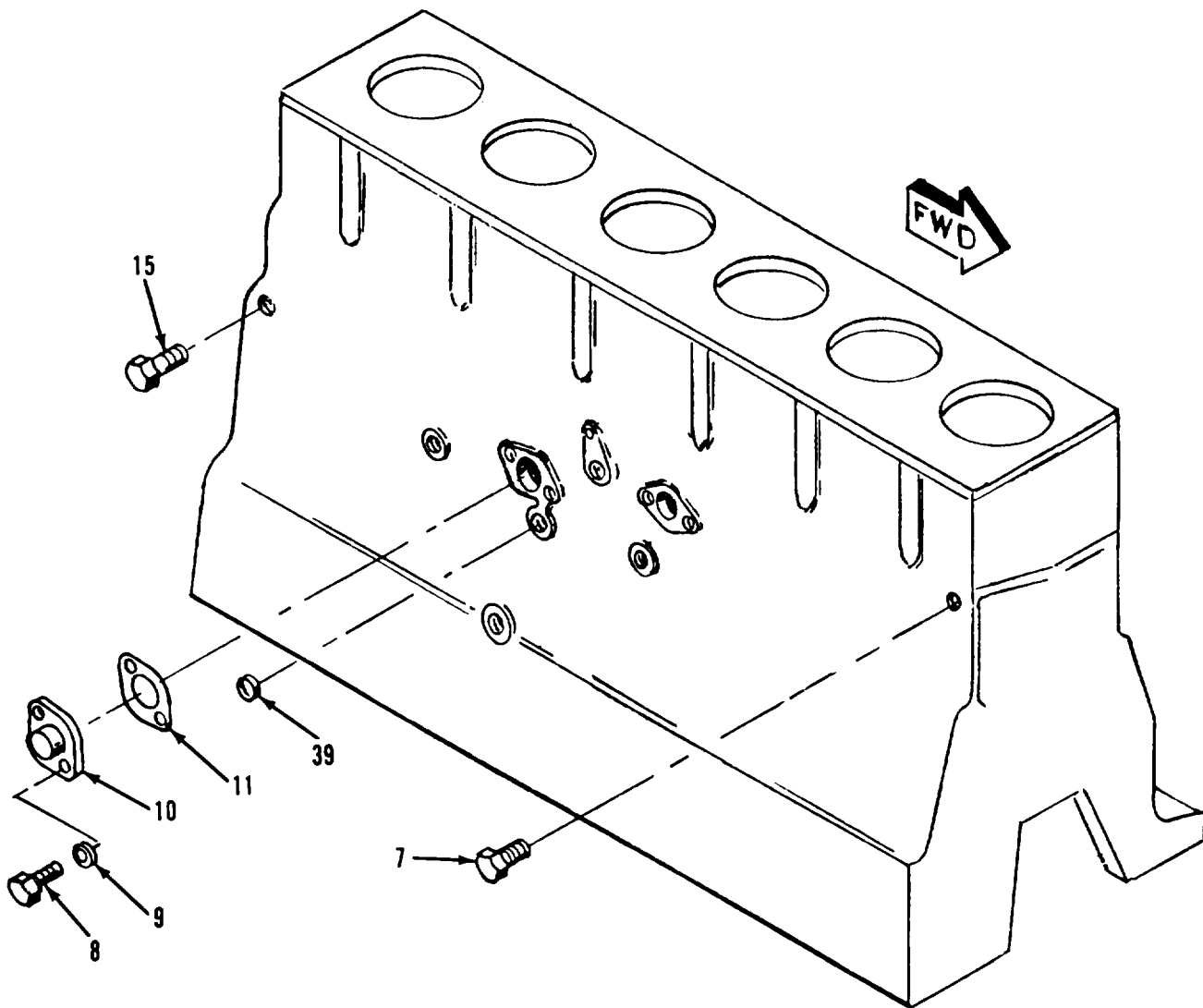


Figure 8-64. Cylinder block and covers group, exploded view  
(sheet 2 of 2)

b. Coat seals (13, figure 8-64) and mating bore with liquid soap before installing cylinder liner (12).

NOTE

Cylinder liner shall be installed in same cylinder bore from which it was removed.

c. Position cylinder liner (12, figure 8-64) in bore chamber. Place a suitable plate on top of cylinder liner (12). Use a block of hard wood over the plate and drive cylinder liner (12) into place.

d. Secure cylinder liner (12) in its bore using a suitable crossbar and two 5/8 inch NC bolts with flat washers as shown in

Legend to figure 8-64:

- |                    |                             |                |
|--------------------|-----------------------------|----------------|
| 1. Bolt (3)        | 18. Plug (5)                | 35. Cap (6)    |
| 2. Lock            | 19. Bolt (8)                | 36. Bolt (2)   |
| 3. Bolt (3)        | 20. Lock washer (8)         | 37. Washer (2) |
| 4. Lock            | 21. Cover                   | 38. Cap        |
| 5. Front plate     | 22. Gasket                  | 39. Plug (2)   |
| 6. Gasket          | 23. Plug                    | 40. Bearing    |
| 7. Plug            | 24. Washer                  | 41. Dowel (2)  |
| 8. Bolt (2)        | 25. Plug                    | 42. Stud       |
| 9. Lock washer (2) | 26. Cap assembly            | 43. Dowel (2)  |
| 10. Flange         | 27. Bolt (3)                | 44. Dowel (2)  |
| 11. Gasket         | 28. Lock washer (3)         | 45. Bearing    |
| 12. Liner (6)      | 29. Washer (3)              | 46. Plug (2)   |
| 13. Seal (12)      | 30. Pipe                    | 47. Dowel      |
| 14. Orifice (6)    | 31. Gasket                  | 48. Dowel      |
| 15. Plug           | 32. Cylinder block assembly | 49. Ball       |
| 16. Dowel (2)      | 33. Bolt (12)               | 50. Plug       |
| 17. Plug           | 34. Washer (12)             | 51. Block      |

figure 8-65. Tighten bolts evenly to 50 foot-pounds torque.

e. Using a suitable depth micrometer, measure cylinder liner (12) projection by measuring down from liner surface

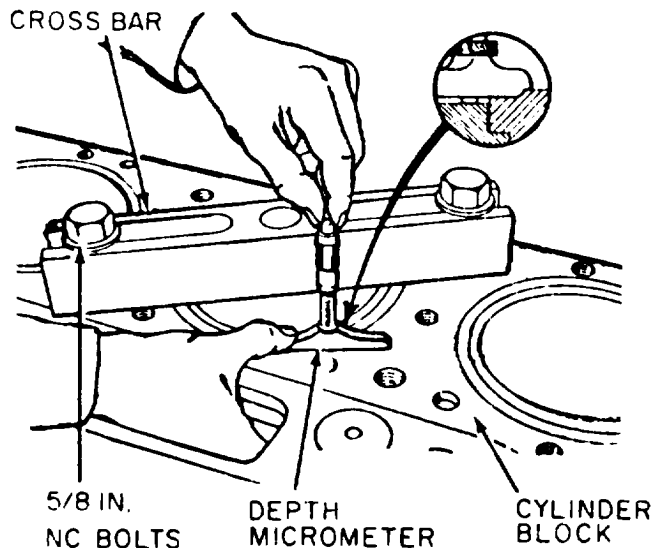


Figure 8-65. Securing cylinder liner in its bore and measuring height projection contacting the head gasket (39, figure 8-54)

to the face of the cylinder block (12, figure 8-64). Liner projection must be 0.002 to 0.005 of an inch.

f. Cylinder block (51) may be pressure tested as follows:

1. Seal off water inlet and outlet holes air tight, using plates and suitable rubber gaskets held in place by bolts.
2. Immerse cylinder block (51) in tank of water. Attach a suitable fitting at one of the water inlet or outlet openings. Apply 60 psi air pressure to water pocket and observe water in tank for bubbles indicating cracks or leaks.

WARNING

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

out passages with dry, compressed air.

g. Install camshaft bearings using a suitable tool. Care must be taken to align oil holes in bearings with oil holes in cylinder block. The front camshaft

bearing (40, figure 8-64) has two oil holes and are positioned in a vertical position. The remaining camshaft bearings (45) have only one hole and must be positioned with hole in a downward position.

h. Camshaft front bearing (40) must be recessed 0.06 of an inch from front face of camshaft bore, oil hole in bearing (40) must align with oil hole in cylinder block (51), and joint in bearing (40) must face cylinder block (51) centerline. Intermediate bearings (45) must be flush with front face of bearing bore. Rear bearing (45) must be recessed 0.06 of an inch from rear face of bore.

i. The maximum allowable clearance between camshaft journal and bearing that is pressed into cylinder block is 0.008 inch. This clearance can be measured by using a suitable inside micrometer and check the I. D. of each camshaft bearing after it has been pressed into the block. Use a suitable outside micrometer and check the corresponding O. D. of each camshaft journal. Subtract the O. D. dimension of the camshaft journal from the I.D. of the camshaft bearing in the block. The result will be the running clearance between the camshaft and the camshaft bearing. If the clearance exceeds 0.008 inch, replace camshaft bearing.

j. Install cylinder block covers using new gaskets.

#### 8-235. INSTALLATION.

a. Installation of cylinder block and covers group is accomplished during reassembly (paragraph 8-234).

b. Install crankshaft group and main bearings (paragraph 8-227).

c. Install connecting rods and pistons group (paragraph 8-219).

d. Install camshaft group (paragraph 8-211).

e. Install flywheel and flywheel housing group (paragraph 8-203).

f. Install cylinder head (paragraph 8-195).

g. Install valve cover and valve mechanism group (paragraph 8-187).

h. Install oil pump group (paragraph 8-179).

i. Install oil pan group and related parts (paragraph 8-171).

j. Install exhaust manifold group (paragraph 8-163).

k. Install accessory drive group (paragraph 8-157).

l. Install fuel injection group (paragraph 8-148).

m. Install utility governor group (paragraph 8-140).

n. Install crankshaft pulley, damper, and timing gear cover group (paragraph 8-132).

o. Install governor actuator unit (paragraph 8-116).

p. Install hydraulic pump drive group (paragraph 8-107).

q. Install hydraulic pump (precise sets only) (paragraph 8-99).

r. Install hydraulic tank (precise sets only) (paragraph 8-92).

s. Install oil cooler group (paragraph 8-84).

t. Install fuel pump group (paragraph 8-68).

u. Install tachometer drive group (paragraph 8-60).

v. Install fan mounting group (paragraph 8-37).

w. Refer to Operator and Organizational Maintenance Manual and install the following:

1. Water pump group.
2. Alternator assembly.
3. Starter motor assembly.
4. Turbocharger group.
5. Day tank assembly.
6. Manual throttle control.
7. Lube oil filter group.
8. Ether atomizer.
9. Air cleaner assembly.
10. Engine wiring harness.

## Section XXXI. ENGINE TEST AFTER OVERHAUL

### 8-236. GENERAL.

Following a complete overhaul or any major repair, involving the installation of piston rings, pistons, cylinder liners, or bearings, the engine should be run-in prior to release for service.

#### NOTE

Make sure all necessary adjustments have been performed and engine is fully serviced before starting test.

### 8-237. ENGINE ASSEMBLY RUN-IN AND ADJUSTMENTS.

Connect engine assembly to a suitable engine dynamometer equipped with a cooling system and means of monitoring engine oil pressure, coolant temperature, and engine RPM.

#### a. PRE-RUN-IN CHECKS.

#### NOTE

Rotate engine in a clockwise direction only, when viewing engine from front.

1. Manually rotate engine by applying a 1-1/8 socket with extension handle to crankshaft nut inside of damper.

2. Hold manual fuel shutdown lever in the closed rack or off position (figure 8-66).

#### CAUTION

Do not crank starter motor for a period of more than 15 seconds.

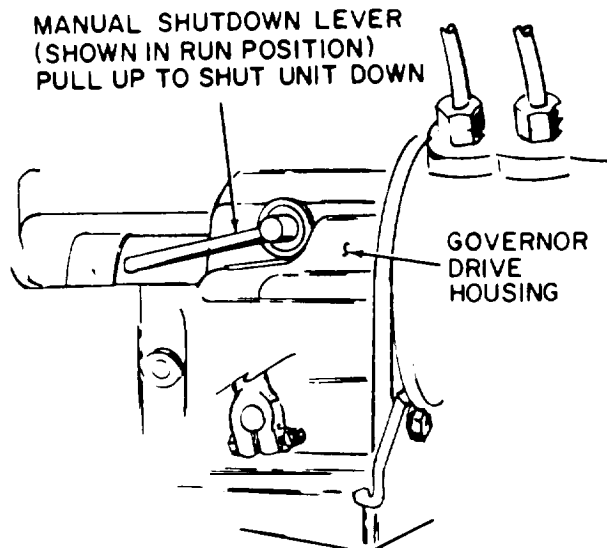


Figure 8-66. Location of manual fuel shutdown lever

3. Turn engine over using starter until oil pressure builds up to  $50 \pm 10$  PSIG. Oil pressure should build up within 15 seconds.

4. Release manual fuel shutdown lever. Inspect all fluid systems for signs of leakage.

b. OPERATIONAL TEST OF OVERSPEED SHUTDOWN DEVICE.

1. Dead crank engine and determine if solenoid plunger (2, Figure 8-31A) pulls in (bottoms). If the solenoid plunger does not bottom or does not have enough power to overcome the spring tension, increase the measurement between the bushings (6 and 9, Figure 3-31A) by adjusting bottom bushing.

2. Each time the engine is started, the solenoid plunger should pull in (bottom) and remain pulled in. This movement of the solenoid plunger should rotate the manual fuel rack lever counterclockwise to almost full on position.

3. Each time the engine is stopped or the governor overspeed switch

is tripped, the solenoid plunger should release (move out of the solenoid) and remain released. This movement of the solenoid plunger should rotate the manual fuel rack lever clockwise to almost full off position.

c. UTILITY GOVERNOR SPEED SETTING ADJUSTMENT. Adjust utility governor low and high speed stops as follows:

1. Loosen nut (5, figure 8-33) and turn low speed stop screw (4) counterclockwise until it is free of speeder spring (46).

CAUTION

Do not crank engine for more than 15 seconds at a time. Permit starter to cool a minimum of three minutes between crankings.

2. Crank engine over with starter and turn low speed stop screw (4) clockwise until governor output shaft (13, figure 8-33) rotates, opening fuel rack. Continue turning low speed stop screw until engine starts.

3. Permit engine to run a minimum of five minutes for warmup and adjust low speed stop screw (4) to obtain 800 RPM idle speed. Clockwise rotation will increase speed. Hold screw in position and tighten nut (5). Recheck RPM setting.

4. Rotate speed adjusting shaft (25) to maximum speed position and monitor engine RPM. Do not exceed 2300 RPM.

5. Engine high speed stop setting should be 2250 RPM. To adjust high speed stop, loosen nut (20) and rotate high speed stop screw (19) to obtain 2250 RPM when speed adjusting shaft (25) is in maximum speed position. Clockwise rotation will increase engine RPM setting. Tighten lock nut and recheck RPM setting.

6. If engine surges during

warmup, remove governor cover (6) while engine is running and move droop bracket (11) and pin (22) towards maximum position (away from governor ball head assembly (57)).

7. When the engine is warmed up, adjust the droop bracket (11) and pin (22) as much towards minimum (toward ball head assembly (57)) as possible while maintaining steady speed. Manually move the engine fuel linkage to cause a temporary engine speed increase. If the engine returns to the original steady speed, the adjustment is satisfactory. If the engine speed does not settle out, increase droop slightly (approximately 1/16 of an inch movement of bracket (11) and test again. Continue to increase the droop until the operation is satisfactory.

d. RUN-IN. During run-in, monitor oil pressure and coolant temperature and check for unusual noise and vibrations. Discontinue run-in if oil pressure drops below 20 psi, if coolant temperature exceeds 217°F, or if unusual noise and vibrations occur.

1. Start engine and operate at idle speed (approximately 800 RPM), no load for 10 minutes.

NOTE

Three-quarter speeds are 1125 RPM for 50 hertz operation, 1350 RPM for 60 hertz operation, and 1500 RPM for 400 hertz operation.

2. Operate engine at 3/4 rated speed and at 50 KW for fifteen minutes.

NOTE

Rated speeds are 1500 RPM for 50 hertz operation, 1800 RPM for 60 hertz operation, and 2000 RPM for 400 hertz operation.

3. Operate engine at rated speed and at 100 KW for 30 minutes.

NOTE

Required tightness for cylinder head bolts after test to be 150 foot-pounds minimum.

4. Shut down engine and tighten all bolts and nuts. Tighten cylinder head bolts, refer to figure 8-56.

5. Inspect engine for leakage.

## CHAPTER 9

### BASE ASSEMBLY, STOWAGE TOOL BOX, AND FUEL TANK REPAIR INSTRUCTIONS

#### Section I. BASE ASSEMBLY

##### 9-1. GENERAL.

The base is a welded structure that supports the generator set and the fuel tank. It consists of tubular cross members, forklift openings, and ground stud. The engine and generator are mounted to the base, the engine front support and generator mounting provide a three point support system for the engine and generator. A battery and rollout tray assembly is mounted in the front end of the base and a stowage tool box in the rear end. Each end of the base is equipped with a tubular cross member which permits connection of a towing device for skidding the generator set, for short distance moving. Openings are provided in the base to permit the generator set to be lifted by a forklift, The base is equipped with a split-stud terminal to permit electrical grounding of the set.

##### 9-2. REMOVAL

Remove the following assemblies from the base assembly:

a. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Drain coolant from the radiator.
2. Drain fuel from the day and fuel tank.
3. Drain lubricating oil from engine crankcase.

#### WARNING

When disconnecting batteries (lead-acid) disconnect negative terminal first.

4. Remove batteries and rollout tray,

b. Remove housing as specified in paragraph 3-2.

c. Remove generator as specified in paragraph 2-7.

ci. Remove engine as specified in paragraph 2-8.

##### 9-3. DISASSEMBLY .

Refer to figure 9-1 and disassemble base assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Tag hoses (1, 2, 3, and 4) with location prior to removal

b. Disassemble stowage tool box (19) as specified in paragraph 9-11.

c. Remove fuel tank (53) through stowage tool box opening. Disassemble fuel tank (53) as specified in paragraph 9-19.

##### 9-4. CLEANING.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Clean parts with an approved cleaning solvent and dry thoroughly. If necessary, remove hand deposits using a bristle brush.

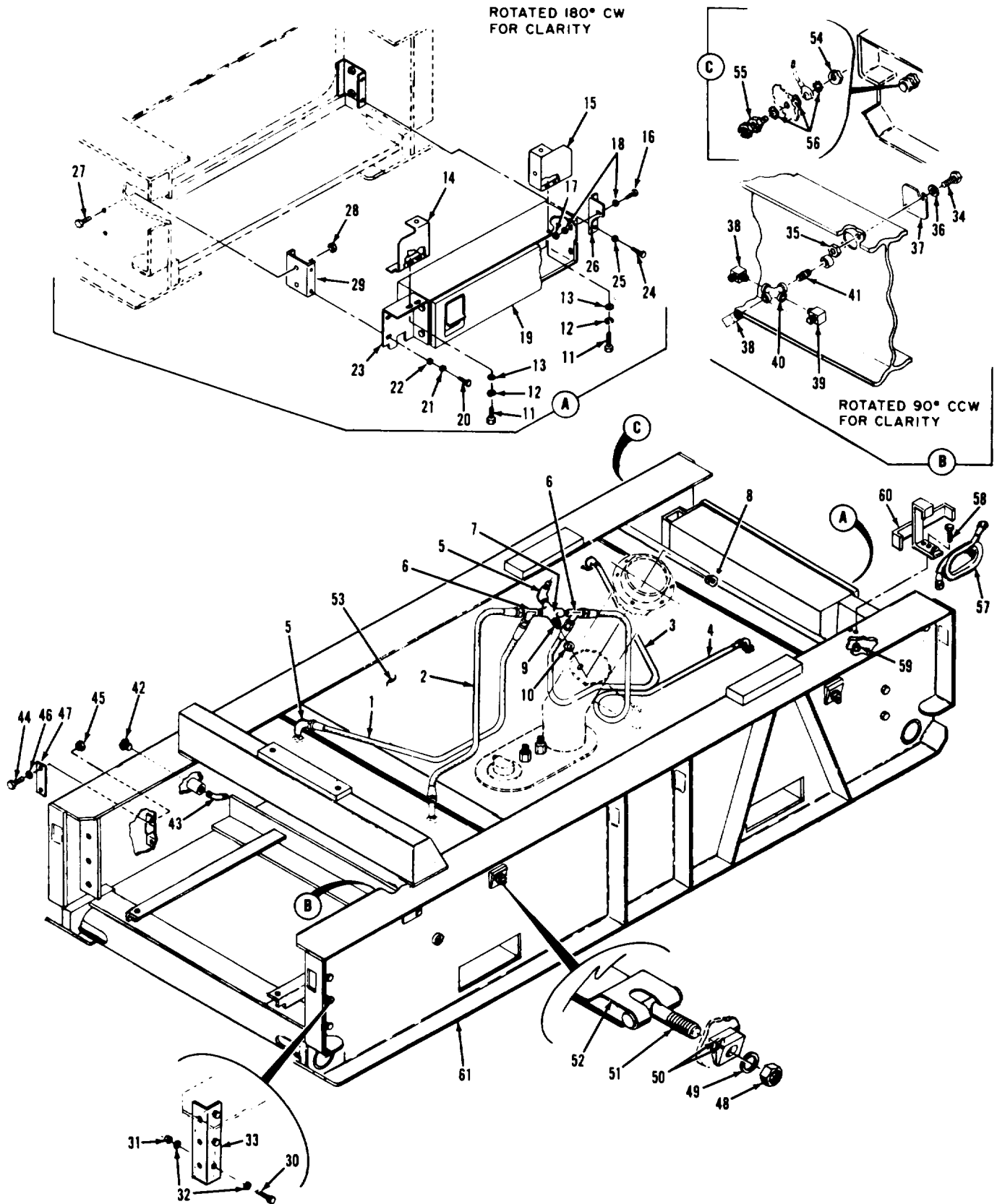


Figure 9-1. Base assembly, exploded' view



Legend to figure 9-1:

1. Hose	22. Washer (1)	42. Plug
2. Hose	23. Filler panel	43. Elbow
3. Hose	24. Screw (2)	44. Screw (2)
4. Hose	25. Washer (2)	45. Nut (2)
5. Elbow (5)	26. Bracket	46. Washer (2)
6. Tee (2)	27. Screw (4)	47. Ground rod plate
7. Cross	28. Nut (4)	48. Nut (4)
8. Nut	29. Rear tank stop (2)	49. Washer (4)
9. Nipple	30. Screw (6)	50. Bevel washer (8)
10. Washer	31. Nut (6)	51. Tee bolt (4)
11. Screw (4)	32. Washer (12)	52. Strap (2)
12. Lock washer (4)	33. Bracket (2)	53. Fuel tank assembly
13. Washer (4)	34. Screw (2)	54. Nut
14. Upper filler panel	35. Nut (2)	55. Ground stud
15. Upper filler panel	36. Washer	*56. Lock washer (3)
16. Screw (4)	37. Heater exhaust plate	57. Auxiliary fuel hose
17. Nut (8)	38. Elbow (2)	58. Screw
18. Washer (4)	39. Elbow	59. Nut
19. Stowage tool box	40. Cross	60. Auxiliary fuel hose mount
20. Screw (2)	41. Nipple	61. Base
21. Lock washer (2)		* Applicable to serial numbers 1 through 130

b. Clean sealant from pipe threads using a wire brush.

9-5. INSPECTION.

a. Inspect parts for cracks, breaks, and defective welds.

CAUTION

If hose blockage is due to deterioration of internal portion of hose, hose shall be replaced.

b. Check hose for blockage, chafing, and condition of end fittings.

c. Inspect bevel washer for deterioration, cracks, and permanent set in washer contact surface.

d. Inspect threads for damage.

e. Inspect support brackets for distortion.

9-6. REPAIR.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

a. Weld cracks, breaks, and defective welds.

b. Repair damaged threads by chasing using a suitable die or tap.

c. Straighten distorted support brackets.

d. Remove damaged paint with a suitable scraper. Blend in edges, prime, and paint damaged areas.

9-7. REASSEMBLY.

Refer to figure 9-1 and reassemble base assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Reassemble fuel tank as specified in paragraph 9-23.

b. Reassemble stowage tool box as specified in paragraph 9-15.

c. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III, to pipe threads prior to installation.

d. Install fuel tank (53) in base (61) through stowage tool box opening, making sure that fuel tank needle valve is toward opening. Push tank against front stops, hold tank in position, and install rear tank stops so that stops hold tank in position.

e. Install bevel washers (50) with thick ends on top.

f. Install and align stowage tool box (19) so that it is flush with base (61).

#### 9-8. INSTALLATION.

Install the following assemblies on the base assembly.

a. Install engine as specified in paragraph 2-8.

b. Install generator as specified in paragraph 2-7.

c. Install housing as specified in paragraph 3-6.

#### WARNING

When connecting lead-acid batteries connect positive terminal first.

d. Refer to Operator and Organizational Maintenance Manual and perform the following:

1. Install batteries and rollout tray.

2. Service engine crankcase, fuel tank, and radiator.

### Section II. STOWAGE TOOL BOX

#### 9-9. GENERAL.

The stowage tool box is utilized for storage of tools and miscellaneous equipment required for generator set operation. The box consists of a hinged cover, seal, and box. The cover covers the box opening and the seal prevents moisture and dirt entering the box.

#### 9-10. REMOVAL.

Refer to figure 9-1 and remove stowage tool box from base by removing screws (16), nuts (17), and washers (18).

#### 9-11. DISASSEMBLY

Refer to figure 9-2 and disassemble the stowage tool box in the order of index numbers assigned.

#### 9-12 CLEANING.

a. Clean seal with a clean lint-free cloth.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean metal parts in an approved cleaning solvent and dry thoroughly.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

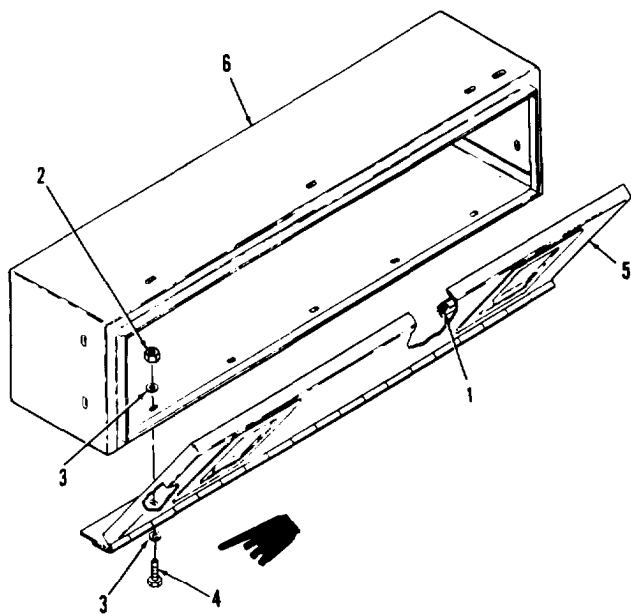


Figure 9-2. Stowage tool box, exploded view

Legend to figure 9-2:

- |                |                |
|----------------|----------------|
| 1. Seal        | 4. Screw (5)   |
| 2. Nut (5)     | 5. Cover       |
| 3. Washer (10) | 6. Stowage box |

9-13. INSPECTION.

- Inspect sheet metal parts for cracks, dents, distortion, and worn hinges.
- Inspect seal for cuts, cracks, and deterioration.
- Inspect paint for damage.

9-14. REPAIR.

- Straighten dented and distorted parts using suitable tools.

- Weld cracks.

- Remove damaged paint with a suitable scraper. Blend in edges, prime, and paint damaged areas.

9-15. REASSEMBLY.

Refer to figure 9-2 and reassemble the stowage tool box in the reverse order of the numbers assigned. Pay particular attention to the following:

- Align cover (5) so that seal (1) makes full contact on stowage box (6) prior to tightening nuts (2).

9-16. INSTALLATION.

Refer to figure 9-1 and install stowage-tool box assembly in base assembly. Pay particular attention to the following:

- Install stowage tool box and secure with screws (16), nuts (17), and washers (18), leaving nuts finger tight.
- Align stowage tool box cover so that it is flush with base assembly and tighten nuts.

### Section III. FUEL TANK ASSEMBLY

#### 9-17. GENERAL.

The baffled fuel tank stores fuel for generator set operation and is located within the base assembly. The fuel tank assembly consists of a fuel level transmitter, plate assembly, and a needle valve. The fuel level transmitter senses the fuel level in the fuel tank and transmits a signal to the fuel gauge on the control cubicle, which indicates a reading corresponding to that of the fuel level transmitter. The needle valve permits draining of the fuel tank and removal of water and sediment from the tank.

#### 9-18. REMOVAL.

Refer to figure 9-1 and remove the fuel tank as follows:

a. Refer to Operator and Organizational Maintenance Manual and drain fuel tank.

b. Disconnect stowage tool box (19) by removing screws (16), nuts (17), and washers (18).

c. Remove filler panels (14, 15, and 23), bracket (26), and rear tank stops (29).

d. Loosen clamp and remove fuel filler hose from fuel tank.

e. Disconnect electrical connector from fuel tank fuel level transmitter.

f. Tag and disconnect fuel and vent lines from fuel tank and plug lines.

g. Remove fuel tank straps (52).

h. Remove the fuel tank (53) from the base through the stowage-tool box opening.

#### 9-19. DISASSEMBLY.

Refer to figure 9-3 and disassemble fuel tank assembly in the order of index numbers assigned. Pay particular attention to the following:

a. Mark alignment marks on plate (4) and fuel tank (15) to insure proper reassembly.

#### 9-20. CLEANING.

a. Remove old gaskets (5) using a suitable scraper.

#### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean parts and exterior of fuel tank with an approved cleaning solvent and dry thoroughly.

c. Clean interior of fuel tank with clean fuel oil. Agitate fuel tank to loosen sediment and pour fuel from tank. Repeat procedure until all sediment is removed from tank.

#### WARNING

Steam cleaning creates hazardous noise levels and severe burn and eye injury potential. Eye, skin and ear protection required.

d. If sediment can not be removed by performing step c. or fuel tank is to be repaired by welding, steam clean tank to remove sediment or to purge tank of fuel vapors.

e. Clean old sealant from pipe threads using a wire brush.

#### 9-21. INSPECTION.

a. Shake transmitter float to check for fuel in float which would indicate a crack or hole in float.

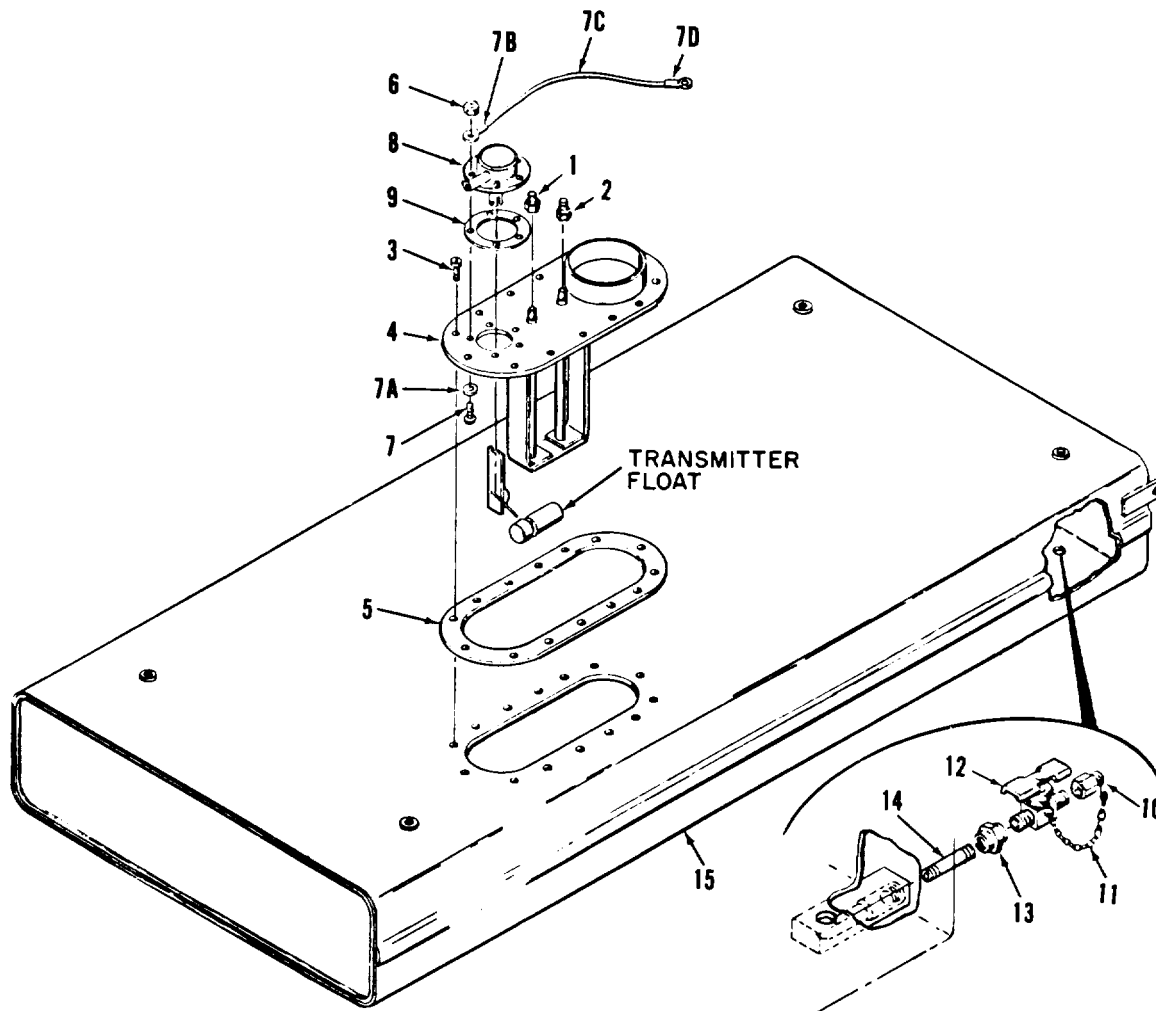


Figure 9-3. Fuel tank assembly, exploded view

Legend to figure 9-3:

- |               |                           |                  |
|---------------|---------------------------|------------------|
| 1. Adapter    | 7. Screw (5)              | 9. Gasket        |
| 2. Adapter    | 7A. Preformed packing     | 10. Cap          |
| 3. Screw (14) | 7B. Lug                   | 11. Hook         |
| 4. Plate      | 7C. Wire                  | 12. Needle valve |
| 5. Gasket     | 7D. Lug                   | 13. Coupling     |
| 6. Nut (5)    | 8. Fuel level transmitter | 14. Nipple       |
|               |                           | 15. Fuel tank    |

b. Using a multimeter, perform resistance test on fuel level transmitter. Resistance shall be 0.00 to 0.50 ohms at empty (down) position, and 29.50 to 31.50 ohms at full (up) position.

c. Connect transmitter float to fuel level transmitter and check float movement. At full (up), float shall be 0.44 to 0.50 inch

from bottom of fuel level transmitter flange. At empty (down), the float shall be 7.50 to 7.62 inches from bottom of fuel level transmitter flange.

d. Check fuel tank for leaks as follows:

1. Plug all fuel tank openings except one. Connect a suitable low pressure

regulated air supply to remaining fuel tank opening.

2. Slowly apply 0.5 PSI air pressure to fuel tank.

3. Apply a soapy water solution to fuel tank and check for bubbles that would indicate leaks. Mark leaks, if any.

4. Reduce air pressure to zero. Remove test equipment from tank. Remove soapy water solution from fuel tank.

e. Connect a suitable pressure supply and gage to needle valve. Turn on pressure supply and bleed test equipment by opening valve. Close valve. Slowly apply 150 PSI and check for external and internal leakage. Reduce pressure to zero and remove test equipment from valve.

f. Check transmitter float linkage for distortion.

g. Inspect for damaged threads.

h. Inspect paint for damage.

#### 9-22. REPAIR.

##### WARNING

Do not weld fuel tank unless tank has been steam cleaned and it is filled with water.

a. Repair cracks and holes in fuel tank as follows:

##### WARNING

Steam cleaning creates hazardous noise levels and severe burn and eye injury potential. Eye, skin and ear protection required.

1. Steam clean tank to remove fuel vapors.

2. Fill tank with water.

##### WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

3. Weld crack or holes. Large

damaged area may be repaired by welding a suitable patch over area.

4. Remove water from fuel tank and dry interior of tank thoroughly.

5. Check repaired areas for leakage as specified in paragraph 9-21, step d.

b. Straighten distorted transmitter float linkage using suitable tools.

c. Repair damaged fuel tank threads using a suitable tap. Fill tap grooves with grease to catch cuttings. Remove all cuttings from fuel tank.

d. Remove damaged paint with a suitable scraper. Blend in edges, prime, and paint damaged areas.

#### 9-23. REASSEMBLY.

Refer to figure 9-3 and reassemble fuel tank assembly in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III, to pipe threads prior to reassembly.

b. Make sure alignment marks on fuel tank (15) and plate (4) are aligned when plate is installed.

#### 9-24. INSTALLATION.

Refer to figure 9-1 and install the fuel tank as follows:

a. Install fuel tank (53) in base (61) through stowage tool box opening, making sure needle valve is toward opening. Position and hold tank against forward stops and install rear tank stops (29), bracket (26), and filler panels (14, 15, and 23).

b. Install and secure fuel tank straps (52), making sure that thick end of bevel washers (50) are on top.

c. Connect fuel and vent lines to fuel tank. Connect electrical connector to fuel level transmitter.

d. Connect fuel filler hose to fuel tank and secure with clamp.

e. Install stowage tool box (19).

f. Refer to Operator and Organizational Maintenance Manual and service fuel tank.





CHAPTER 9A

PAINT AND MARKING REQUIREMENTS AFTER OVERHAUL

9A-1. GENERAL,

a. (AF Only) Paint and markings on the generator sets shall be in accordance with AFR 35-1-3.

9A-2. NOISE LEVEL WARNING.

a. The noise level warning sign shall be stenciled on the top half of both rear (generator end of set) side doors, in accordance with Figure 9A-1.

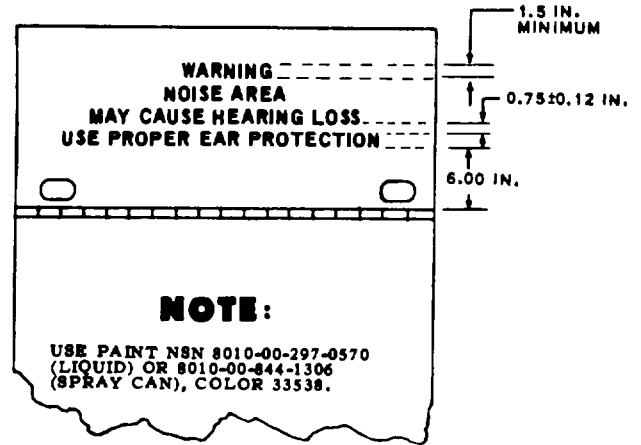


Figure 9A-1. Noise Level Warning Sign



## CHAPTER 10

### TEST AFTER OVERHAUL

#### Section I. PRETEST CHECKS AND ADJUSTMENTS

##### 10-1. GENERAL.

Pretest checks and adjustments shall be performed prior to test after overhaul of the generator set. To perform the pretest checks and adjustments, proceed as follows :

##### 10-2. PRETEST CHECKS AND ADJUSTMENTS.

- a. Perform engine assembly run-in and adjustments paragraph 2-237.
- b. Perform alignment of electric governor actuator unit (precise generator sets only), refer to paragraph 6-246.

#### Section II. TEST AFTER OVERHAUL

##### 10-3. GENERAL.

All tests should be performed under the following conditions:

- a. All tests shall be made at ambient temperatures.
- b. All test instrumentation will be in accordance with Military Standardization Handbook MIL-HDBK-705 and Military Standard MIL-ST D-705, as applicable.
- c. Temperatures will be measured by means of appropriately located thermocouples and properly calibrated read-out devices. Thermocouples will be insulated from contact with other metals. Temperatures will be recorded in degrees Fahrenheit or Centigrade, depending on the instrument scale, but will be reduced in degrees Fahrenheit in all cases. Barometric pressure will be measured by a mercurial barometer,

which will be corrected for the temperature of the scale, the mercury for vapor pressure and for the location of the barometer with regard to altitude and latitude. Aneroid barometers will not be used.

- d. Pretest adjustments shall be completed prior to starting test procedures, refer to paragraph 10-2.
- e. Operational procedures required in support of the individual test specified herein shall be performed as outlined in the Operator and Organizational Maintenance Manual.
- f. Record test results as required by local instructions.

##### 10-4. START AND STOP TEST .

Test the generator set for evidence of abnormal start and stop conditions by

performing the start and shutdown procedures as outlined in the Operator and Organizational Maintenance Manual. The generator set should be capable of starting promptly at any ambient temperatures in the range of +125°F to -25°F without external heat.

a. Operate generator set at rated speed, voltage, and no-load for 15 minutes, then discontinue operation.

b. Operate generator set at rated speed, voltage, and no-load for 15 minutes. Discontinue operation by de-energizing the DC circuit breaker.

c. Repeat start-stop procedures two additional times. If any malfunction is noted, make necessary repairs before subjecting the generator set to the remaining tests.

#### 10-5. INSTRUMENT CHECK.

Test the generator set ammeter, voltmeter, and frequency meter for accuracy by comparing them with master instruments.

#### NOTE

This test shall be done in conjunction with other tests.

a. Adjust the meters to zero as outlined in the Operator and Organizational Maintenance Manual.

#### NOTE

This test shall be repeated at all rated frequencies and at voltages of 120/208 and 240/416.

b. Connect the generator set to a variable load. Operate the generator

set and vary the load as indicated in step c.

c. Record the master instrument reading and the readings of the meters at the following percentages of rated load: 1/4, 2/4, 3/4, 4/4, and 5/4 percent.

d. The accuracy of the instruments should be such that the maximum error will not exceed the following parameters:

1. Voltmeter - 2-1/2 percent of full scale except not greater than 5 volts between 115 and 125 volts, not greater than 10 volts between 200 and 250 volts.

2. Ammeter -2 percent of full scale.

3. Kilowatt meter -2 percent of full scale.

4. Frequency meter - 0.25 percent at any point on scale.

#### 10-6. LOW OIL PRESSURE TRIP TEST .

Perform this test under an artificially produced condition as follows:

a. Install a test adapter with a gage for measuring pressure to the lubricating oil pressure switch, a valve for shutting off flow to pressure switch, and a valve for bleeding off pressure. Operate the generator set at rated speed and no load.

b. Purge air from system through the bleed valve. Close valve and record operating pressure.

#### CAUTION

If unit fails to shut down when oil pressure is below  $15 \pm 3$  PSI, the test should be discontinued and corrective action taken.

c. Close pressure shutoff valve and slowly bleed pressure from system until the generator set shuts down and LOW OIL PRESSURE fault locator indicator illuminates. Record pressure. The generator set shutdown and LOW OIL PRESSURE fault locator indicator shall occur simultaneously at  $15 \pm 3$  PSI.

d. Remove test components from generator set.

#### 10-7. HIGH COOLANT TEMPERATURE TRIP TEST.

Perform the high coolant temperature trip test as follows:

a. Remove coolant temperature transmitter from front of engine thermostat housing and install thermocouple in its place.

#### CAUTION

If the engine fails to shut down when 222 °F is reached, drop the load and unblock the radiator to cool engine.

b. Operate unit at rated speed, block air passing through the radiator and apply sufficient load to raise the unit temperature to the trip point of  $217 \pm 3^\circ\text{F}$ . The high coolant temperature switch shall actuate at  $214^\circ$  to  $220^\circ$  F, causing the load contactor to open, the engine to shut down, and the COOLANT HIGH TEM P fault indicator to illuminate.

c. Remove the thermocouple and replace coolant temperature transmitter.

#### 10-8. LOW FUEL LEVEL TRIP TEST.

Perform the low level trip test as follows :

a. Energize DC circuit breaker and position start-run-stop switch to RUN to fill day tank. When day tank is full, the electric fuel transfer pumps will change pitch indicating they are bypassing fuel internally.

b. Disconnect electrical connector from day tank fuel solenoid valve.

c. Operate the generator set at rated voltage, frequency and at full load until day tank float valve switch actuates, causing the load contactor to open, the engine to shut down and the NO FUEL fault indicator to illuminate.

d. Start generator set and as soon as engine starts, lift red battle short switch guard and position switch to ON. Operate generator set for one minute at rated voltage, frequency and fuel load. Generator set should operate for one minute without running out of fuel. Shut down generator set, but do not de-energize DC circuit breaker.

e. Connect electrical connector to day tank fuel solenoid valve. Position start-run-stop to RUN and fill day tank. Position battle short switch and guard to OFF position and de-energize DC circuit breaker.

#### 10-9. SHORT CIRCUIT TRIP TEST.

Perform the short circuit trip test as follows:

a. Connect a load bank capable of supplying 450 percent of rated current to the generator set load terminals. Reactive load may be used to obtain the required current.

b. Adjust short circuit load to draw 350 percent of rated current.

c. Operate the generator set at rated voltage, rated speed, and rated load.

d. Apply short circuit load of 350 percent rated current (total of 450 percent of rated current) to the generator set in one step.

CAUTION

If output contactor fails to open, instantaneously remove short circuit.

e. The output contactor shall actuate instantaneously when current exceeds  $425 \pm 25$  percent of rated current, causing the SHORT CIRCUIT fault indicator to illuminate.

10-10. OVER AND UNDER VOLTAGE TRIP TEST .

Perform the over and under voltage trip tests as follows:

a. Connect a voltmeter between T9 and T12 of the monitored 120 volt phase.

b. Operate the generator set at no load, rated frequency, and rated voltage with load contactor closed.

c. OVER VOLTAGE TRIP TEST.  
Raise voltage until the engine shuts down and OVER VOLT fault locator indicator illuminates. Record the voltage. The over voltage relay shall actuate when the voltage exceeds  $153 \pm 3$  volts for more than 200 milliseconds causing the load contactor to open within 1 second, the engine to shut-down and the OVER VOLT fault indicator to illuminate.

d. UNDER VOLTAGE TRIP TEST (PRECISE GENERATOR SETS ONLY),

1. Repeat step b. , lower voltage until the UNDER VOLT fault locator indicator illuminates. Record voltage. The load contactor shall open immediately when voltage drops below 48 volts, causing the UNDER VOLT fault locator indicator to illuminate.

2. Repeat step b. , reduce voltage between 65 to 103 volts. The load contactor shall open in  $6 \pm 2$  seconds, causing the UNDER VOLT fault locator to illuminate.

3. Repeat steps b. , 4. 1., and 4.2. two additional times.

10-11. UNDER FREQUENCY TRIP TEST (PRECISE GENERATOR SETS ONLY).

Perform the under frequency trip test as follows:

a. Operate the generator set at no load, rated frequency, and rated voltage with load contactor closed.

b. Lower frequency until the UNDER FREQ fault locator indicator illuminates. The load contactor should open, causing the UNDER FREQ fault locator indicator to illuminate when the frequency drops to the values indicated below:

50 hertz operation -  $46 \pm 1$  hertz

60 hertz operation -  $55 \pm 1$  hertz

400 hertz operation -  $370 \pm 5$  hertz

10-12. PHASE SEQUENCE CHECK.

Perform the phase sequence check as follows:

a. Connect a suitable phase sequence indicator to generator set load terminals as following rotation of set.

b. Operate generator set and determine phase sequence by observing the indicator. The AC output connections shall be of the proper rotation, compare test results with the AC system simplified schematic, figure 1-4 for 50/60 hertz generator sets or figure 1-5 for 400 hertz generator sets.

c. If generator set is equipped with an AC output receptacle box, check phase sequence of each receptacle for proper rotation.

#### 10-13. PHASE BALANCE TEST.

Perform the phase balance test as follows :

a. Operate generator set at 240/416 volts, rated speed and no load. Adjust voltage as necessary until average voltage is 240 volts line to neutral. Measure each line to neutral voltage to the nearest 0.1 volt at load terminals and record.

#### NOTE

Load must be balanced. Record all three line to neutral voltages and obtain the average value. Reduce or raise voltage as required, by the amount that the previously computed average differs from rated voltage. The average of the three phase voltages should be equal to rated voltage.

b. Measure and record each of the line to neutral voltages.

c. The maximum difference in the three line-to-neutral voltage under all balanced loads at rated voltage and speed shall not exceed one percent rated voltage and speed shall not exceed one percent rated line-to-neutral voltage. That is, no phase voltage shall differ from the average by more than 1.2 volts.

d. Formula to compute percentage of voltage unbalance is as follows:

100 x maximum deviation from average

$$(T1-N) + 3 (T2-N) + (T3-N)$$

#### 10-14, FREQUENCY ADJUSTMENT RANGE TEST.

Perform the frequency adjustment range test as follows:

##### a. PRECISE GENERATOR SETS.

1. Operate generator set at full load.

2. Slowly adjust frequency from 58 to 62 hertz (for 50/60 hertz operation) and 390 to 420 hertz (for 400 hertz operation). Clockwise rotation shall increase frequency. Voltage shall remain at rated value throughout the frequency range. The frequency rheostat shall allow frequency adjust over the following ranges at any load:

50 hertz operation - Between 48 and 52 hertz but not below 45 hertz.

60 hertz operation - Between 58 and 62 hertz but not above 65 hertz.

400 hertz operation - Between 390 and 420 hertz but not below 370 hertz or above 430 hertz,

##### b. UTILITY GENERATOR SETS.

1. Operate generator set at full speed by adjusting manual speed control. Record frequency.

2. Turn manual speed control knob 90 degrees. Record frequency. A 90 degree turn of the manual speed control knob shall not cause a change in frequency greater than 1 percent.

3. Repeat step 2. a number of times, both raising and lowering frequency.

4. Rapidly decrease engine speed by turning the manual speed control knob to its lowest possible speed obtainable. Increase engine speed by turning the manual speed control knob to its maximum speed obtainable. The manual speed control shall be adjustable from idle (approximately 1400 RPM) to  $2250 \pm 25$  RPM.

10-15. REGULATOR RANGE TEST.

Perform the regulator range test as follows:

a. Operate generator set at 240/416 volts at full load. Adjust voltage for 480 volts (for 50/60 hertz operation) and 458 volts (for 400 hertz operation). Record voltage and speed. Adjust voltage for 395 volts (for 50/60 or 400 hertz operation. Record voltage and speed.

b. Reduce load to zero. Adjust voltage for maximum attainable voltage. Record voltage and speed. Adjust voltage for minimum voltage attainable. Record voltage and speed.

c. The generator set shall operate at any load between no load and full load at the following line-to-line voltages:

1. Between 380 and 426 volts for 50 hertz operation.

2. Between 375 and 489 volts for 60 hertz operation.

3. Between 395 and 458 volts for 400 hertz operation.

10-16. EXCITER REGULATOR AND GOVERNOR STABILITY AND TRANSIENT RESPONSE TEST .

Perform the exciter regulator and governor stability and transient response test as follows:

a. Operate generator set at 240/416 volts at full load until temperatures have stabilized.

b. Drop and apply the load a sufficient number of times to make sure that the voltage and frequency are within the prescribed band .

c. The governor shall be set at isochronous regulation for precise generator sets and at 2.9 to 3 percent for utility generator sets. Adjust voltage to rated value. No further adjustments shall be made during this test. The recorders in the test circuit are now started.

d. Perform the following load switching sequence starting with full load, waiting approximately 30 seconds between each load change:

Adjust load to full load and starting from no load: full load - 0 - full load - 0 - full load - 0

Adjust load to 3/4 load and starting from no load: 3/4 - 0 - 3/4 - 0 - 3/4 - 0

Adjust load to 1/2 load and starting from no load: 1/2 - 0 - 1/2 - 0 - 1/2 - 0

Adjust load to 1/4 load and starting from no load: 1/4 - 0 - 1/4 - 0 - 1/4 - 0



e. The frequency and voltage requirements are indicated below:

Frequency	Precise	utility
Steady State Band (30 sec)	0.5 percent	2 percent
Recovery Time	3 seconds	4 seconds
Overshoot and Undershoot (Apply Full Load)	6.0 percent	4 percent
Regulation	0.25 percent	2 to 3 percent
Voltage	Precise	Utility
Steady State Band (30 sec)	1.0 percent	2 percent
Regulation	1.0 percent	3 percent

10-17. LONG TERM STEADY STATE STABILITY TEST .

Perform the long term steady state stability test as follows:

a. Operate the generator set at rated speed, voltage, and full load for a period of four hours.

b. Record voltage and frequency at start and finish of the four hour period. The long term steady deviation at constant loads from no load to full load shall be as follows:

1. The bandwidth shall remain within 1 percent (for precise generator sets) and 3 percent (for utility sets) of the rated frequency.

2. The bandwidth shall remain within 2 percent (for precise generator sets) and 4 percent (for utility generator sets) of the rated voltage.

10-18. PARALLEL OPERATION AND REVERSE POWER TEST.

a. PARALLEL OPERATION. Perform the parallel operation test as follows:

1. Operate two or more generator sets in parallel at 240/416 volts at no load, refer to Operator and Organizational Maintenance Manual.

2. If necessary, make fine adjustments to governors and exciter regulator paralleling controls, with generator sets operating in parallel and at no load.

3. Precise generator sets shall divide load in accordance with the following as system load at rated power factor is varied between zero and 100 percent (and vice versa) of the combined rating of the connected sets:

(a) Real power division. - At no time shall the difference between the average individual kilowatt outputs of the three sets, when supplying the system load, be greater than ten percent of the kilowatt rating of one set.

(b) Power exchange. - At any constant system load up to the combined rating of the sets in parallel, power exchange between the sets shall not exceed 10 percent of the KW rating of one set. Power exchange is the difference between

the maximum and minimum power output delivered by one set, for constant system load conditions.

(c) Reactive power division. -

At no time shall the difference in average reactive KVA supplied by any three sets differ by more than ten percent of the reactive KVA rating of one set. For the above requirements, the initial system load shall be equally divided between the sets, both as to active and reactive components; thereafter, there shall be no adjustments to governors, voltage regulators, or any other component as system load is changed. When voltage regulators are not interconnected between sets, the above requirements shall apply also, except that voltage droop not exceeding three percent may be introduced through the voltage regulator reactive droop compensating circuits.

4. Utility generator sets shall divide load in accordance with the following system load at rated power factor is varied between 20 and 100 percent (and vice versa) of the combined rating of the connected sets:

(a) Real power division. - At no time shall the difference between the average individual kilowatt outputs of the three sets, when supplying the system load, be greater than ten percent of the kilowatt rating of one set.

(b) Power exchange. - At any constant system load up to the combined rating of the sets in parallel, power exchange between the sets shall not exceed 10 percent of the KW rating of one set. Power exchange is the difference between the the maximum and minimum power output delivered by one set, for constant system load conditions.

(c) Reactive power division. -

At no time shall the difference in average reactive KVA supplied by any three sets differ by more than ten percent of the reactive KVA rating of one set. For the above requirements, the initial system load shall be equally divided between the sets, both as to active and reactive components; thereafter, there shall be no adjustments to governors, voltage regulators, or any other components as system load is changed.

b. REVERSE POWER TEST. Perform the reverse power test as follows:

1. Operate two generator sets in parallel at no load with load contactors closed, refer to Operator and organizational Maintenance Manual,

2. Lower speed of generator set being tested until the REVERSE POWER fault locator indicator illuminates. Record value of kilowatt load at which the load contactor opens. The load contactor shall open when power flow into the generator sets exceeds 20 percent of rated value, causing the REVERSE POWER fault locator indicator to illuminate.

10-19. ENGINE EFFICIENCY TEST.

Perform the engine efficiency test as follows:

a. Operate the generator set at full rated load, speed, and voltage. Check the engine exhaust for excessive smoke and density of smoke.

b. The engine shall deliver 125 percent of rated load for five minutes. Engine exhaust smoke should be just visible at 100 percent load.

CHAPTER 11

FUEL BURNING WINTERIZATION KIT REPAIR INSTRUCTIONS

Section I. CONTROL BOX

11-1. GENERAL.

The control box is located to the right of the control cubicle and consists of an ON-OFF switch, a circuit breaker, press-to-test indicator light, and two receptacles for interconnection. The ON-OFF switch permits starting of the heater and a means of stopping the heater. When the switch is positioned to OFF, the heater motor will continue to operate for a period of approximately 4-1/2 minutes, to purge heated air and fuel from heater. The circuit breaker is a manual reset type; it protects the heater circuitry in case of an overload. The press-to-test indicator light illuminates to show that the heater is in operation, it is also a means of checking system electrical power.

11-2. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove control box.

11-3. DISASSEMBLY,

Refer to figure 11-1 and disassemble control box in the order of index numbers assigned. Pay particular attention to the following:

CAUTION

Prolonged use of soldering equipment could cause damage to components due to excessive heat.

NOTE

Disassemble control box only to the extent necessary to effect repair.

a. Remove screws (1) and pull plate (2) aside. Tag and disconnect wiring from plate components.

b. Remove connectors (5 and 8). If necessary, remove wires from connectors.

c. Remove cover (10) from frame (26).

d. Remove lens (11), indicator light (15), circuit breaker (21), switch (25) and component board assembly (25 B).

11-4. CLEANING.

a. Clean electrical components with a cloth moistened with an approved cleaning solvent, and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean metal components with an approved cleaning solvent and dry thoroughly.

11-5. INSPECTION.

a. Inspect connectors and each wire for continuity. Refer to table 11-1. Inspect connectors for damaged threads; bent, loose, or missing pins; and for shorts to case and surrounding pins.

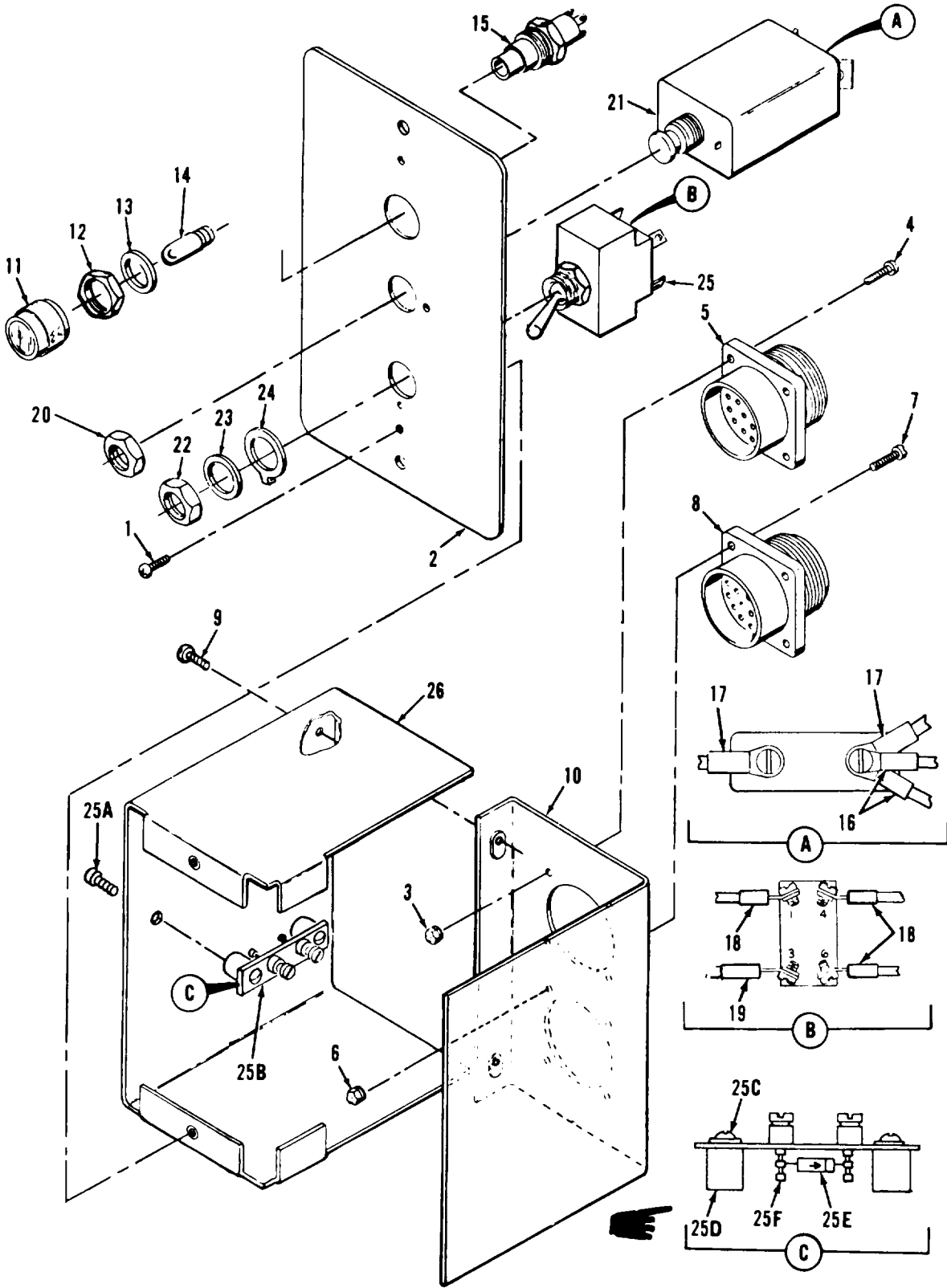


Figure 11-1. Fuel burning winterization kit control box, exploded view

Legend to figure 11-1:

- |                     |                      |                               |               |
|---------------------|----------------------|-------------------------------|---------------|
| 1. Screw (2)        | 10. Cover            | 19. Terminal lug              | 25C. Screw    |
| 2. Plate            | 11. Lens             | 20. Nut                       | 25D. Spacer   |
| 3. Nut assembly (4) | 12. Nut              | 21. Circuit breaker           | 25E. Diode    |
| 4. Screw (4)        | 13. Washer           | 22. Nut                       | 25F. Terminal |
| 5. Connector        | 14. Lamp             | 23. Washer                    | 26. Frame     |
| 6. Nut assembly (4) | 15. Indicator light  | 24. Tab washer                |               |
| 7. Screw (4)        | 16. Terminal lug (2) | 25. Switch                    |               |
| 8. Connector        | 17. Terminal lug (2) | 25A. Screw                    |               |
| 9. Screw (2)        | 18. Terminal lug (3) | 25B. Component board assembly |               |

Table 11-1. Fuel Burning Winterization Kit Control Box Wire Termination Data

FROM	TERMINATION NOTE	TO	TERMINATION NOTE	WIRE TYPE	WIRE LENGTH INCHES
J26A	3	J27A	3	1	3
J26A	3	DS1-1	3, 4	2	4
J26B	3	S1-1	5	2	5
J26C	3	J27C	3	1	3-1/2
J26D	3	S1-6	6	1	6
J26E	3	CB-1	7	1	3-1/2
J26B	3	S1-3	5	2	6
J27D	3	DS1-2	3, 4	2	5
J27E	3	CB-2	7	1	6
CB-2	8	DS1-3	3, 4	2	3
CB-2	8	S1-4	5	2	3

NOTES: 1. Wire is M5086/2-12-9 per MIL-W-5086/2.  
 2. Wire is M5086/2-16-9 per MIL-W-5086/2.  
 3. Solder.  
 4. Make good mechanical connection before soldering.  
 5. Secure end with terminal lug, MS25036-106.  
 6. Secure end with terminal lug, MS25036-111.  
 7. Secure end with terminal lug, MS25036-156.  
 8. Secure end with terminal lug, MS25036-153.  
 9. Refer to Operator and Organizational Maintenance Manual for wiring diagram.

b. Inspect switch, indicator light, and circuit breaker for continuity. Refer to figure 1-29.

c. Inspect terminal lugs for security and condition.

d. Inspect components for dents, cracks, and distortion.

#### 11-6. REPAIR.

##### NOTE

Figure 1-29 is the fuel burning winterization kit and wiring diagram contained in Operator and Organizational Maintenance Manual.

a. Repair or replace defective control box wiring in accordance with table 11-1.

b. Repair dents and distortion using proper tools.

#### 11-7. REASSEMBLY.

Refer to figure 11-1 and reassemble control box in the reverse order of index numbers assigned. Pay particular attention to the following:

a. When installing switch (25), insert tab of tab washer (24) into hole of plate (2).

b. Install circuit breaker (21), indicator light (15), and lens (11).

c. Install connectors (5 and 8) with key located on the top.

d. Attach cover (10) to frame (26).

e. Connect wiring and check for proper connection, refer to table 11-1.

#### 11-8. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install control box.

## Section II. HEATER

#### 11-9. GENERAL.

The heater is a fuel burning type designed to pre-heat the engine for starting at low temperatures down to -65°F by circulating heated coolant through the engine. The heater consists of a blower motor, fuel regulator valve, limit switch, igniter, flame switch, and a coolant pump. The blower motor and fan assembly provides air for combustion; it is also a means for driving the coolant pump. The fuel regulator valve permits the fuel to be turned on and off; it also regulates the fuel flow to the burner. The igniter, which is a high

resistance glow plug, is used to vaporize and ignite the fuel. The flame switch controls the electrical supply to the igniter, blower motor and indicator lamp; its operation is determined by temperature. Recirculation of heated coolant is provided by the coolant pump at a rate of 80 to 100 GPH. Coolant is circulated around the heater combustion chamber where it is heated and then is circulated through the engine.

#### 11-10. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove heater.

11-11. DISASSEMBLY.

Refer to figure 11-2 and disassemble heater in the order of index numbers assigned. Pay particular attention to the following:

a. Remove cover (1). Tag and disconnect wires.

CAUTION

Use care when removing quartz rod (14) as it is easily broken if dropped.

b. Remove receptacle assembly (3), terminal block (5), and flame switch assembly (8).

c. Remove igniter (18), gasket (19),

NOTE

Do not remove regulator valve assembly (21) until after casting (40) has been removed.

d. Remove burner assembly (48), and motor and pump assembly (55) as a complete assembly.

NOTE

Coolant pump (56) cannot be removed as a complete assembly. The unit must be disassembled during removal as the pump rotor (67) is secured to the motor shaft by a set screw (66).

e. Before disassembly of coolant pump, make an alignment mark across adapter (68), cam ring (63), and plate (58) for correct alignment during reassembly.

11-12. CLEANING.

a. Clean electrical components with a cloth moistened with an approved cleaning solvent, and dry thoroughly.

b. Remove carbon deposits from burner assembly using a suitable wire brush.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

● Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

c. Clean orifice assembly by forcing filtered compressed air through orifice in the reverse flow direction.

d. Clean parts with an approved cleaning solvent, and dry thoroughly.

11-13. INSPECTION.

a. Inspect components for cracks, dents, distortion, burrs, nicks, and damaged threads.

b. Inspect insulation for damage.

c. Inspect springs for condition. Inspect spring (60, figure 11-2). Using a suitable spring compressor, apply a load of  $1 \pm 0.1$  pounds and compress spring (60) to a working length of 0.750 inch. Spring should measure 1.164 inches free length after test.

d. Inspect receptacle assembly for loose connections and bent or broken terminal pins. Check for short to case and surrounding pins. Check for continuity between wires and terminal pins.

e. Inspect orifice assembly for proper orifice opening. Opening should be 0.012 inch diameter.

f. Inspect regulator valve assembly (21) as follows:

1. Check resistance of solenoid coil; resistance should be 150 ohms.

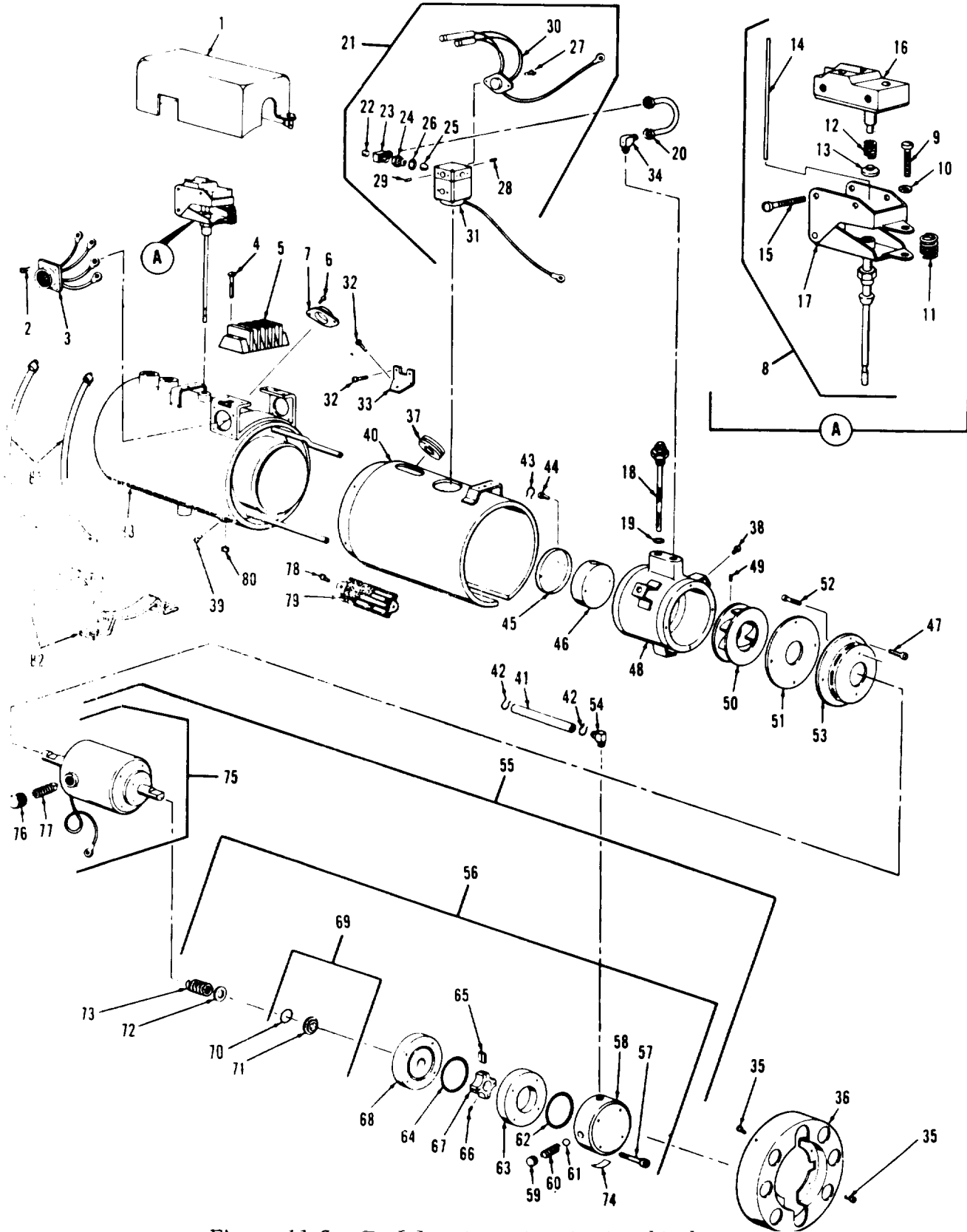


Figure 11-2. Fuel burning winterization kit heater, exploded view



Legend to figure 11-2:

1. Cover	30. Fuel pre-heater assembly	56. Coolant pump assembly
2. Screw (4)	31. Regulator valve assembly	57. Screw (4)
3. Receptacle assembly	32. Screw (6)	58. Plate
4. Screw (4)	33. Bracket (2)	59. Plug
5. Terminal block	34. Elbow	60. Spring
6. Screw (2)	35. Screw (8)	61. Ball
7. Limit switch	36. Cover	62. O-ring
8. Flame switch assembly	37. Grommet	63. Cam ring
9. Adjusting screw	38. Screw (3)	64. O-ring
10. Washer	39. Screw (5)	65. Blade (4)
11. Adjusting spring	40. Casing	66. Set screw
12. Tension spring	41. Hose (2)	67. Rotor
13. Spring pad	42. Clamp (4)	68. Adapter
14. Quartz rod	43. Lockwire	69. Seal assembly
15. Screw (2)	44. Screw (2)	70. Seal cage
16. Micro-switch	45. Retainer	71. O-ring
17. Switch frame assembly	46. Vaporizer	72. Seal washer
18. Igniter	47. Screw (4)	73. Seal spring
19. Gasket	48. Burner assembly	74. Decal
20. Tube assembly	49. Set screw	75. Blower motor assembly
21. Regulator valve assembly	50. Fan	76. Brush cap (2)
22. Plug	51. Plate	77. Brush and spring (2)
23. Orifice assembly	52. Screw (2)	78. Screw
24. Body	53. Inlet	79. Name plate
25. Sintered filter	54. Elbow (2)	80. Drain plug
26. Gasket	55. Motor and pump assembly	81. clamp (2)
27. Screw (2)		82. Bracket (2)
28. Set screw		83. Heat exchanger
29. Set screw		

2. Test fuel flow. Connect filtered 7 PSI fuel supply to regulator valve, and apply 24 VDC to valve solenoid.

3. Using a stop watch, time the fuel flow into a graduated container. Flow should measure 21 to 23 cubic centimeters per minute (approximately 1/4 pint in five minutes).

4. If fuel flow rate is not within these tolerances, adjust valve. Turn adjusting screw clockwise to increase flow rate or counterclockwise to decrease flow rate.

5. Remove 24 VDC from valve solenoid, and check for leakage through valve.

6. Remove test equipment from valve. Replace valve that will not provide proper fuel flow or one that leaks when voltage is removed.

g. Inspect flame switch assembly (8) as follows:

1. Inspect frame for loose pivot points.

2. Check continuity of micro-switch (16) as follows:

(a) Depress the micro-switch button. This will be the ignition or start position of the switch. Continuity should be indicated between the two NO terminals and also between each of the NO terminals and the common terminal. There should be an open circuit between the two NC terminals and also between the common terminal and the two NC terminals.

(b) Release the micro-switch button. This will be the run position of the micro-switch. Continuity should be indicated between the two NC terminals and the common terminal. There should be an open circuit between the NO ignition or start terminals and between the NO terminals and the common terminal.

h. Inspect igniter as follows:

1. Inspect for broken coil or short.
2. Check igniter for proper resistance; resistance should be 1 ohm.

**WARNING**

To prevent burns, do not touch igniter during test, and allow enough time for it to return to ambient temperature before removing test equipment.

3. Connect 24 VDC power source and an ammeter to igniter terminal. Ground igniter. Apply 24 VDC to igniter. The igniter should draw 10.5 amperes and heat to a bright red color in a few seconds.

i. Inspect fan for loose or damaged blades.

j. Inspect heat exchanger and burner assembly for warpage and burned area.

k. Inspect sintered filter for blockage.

1. Using a suitable dial indicator, check end play on shaft of blower motor assembly. Grasp short shaft end and rotate in either direction, at the same time moving in and out. The end play should not exceed 0.010 to 0.025 inch.

m. Inspect adapter for damaged or scored face, warped condition, and damaged seal face. Inspect for motor shaft bore wear. Refer to figure 11-3 for limits.

n. Inspect seal cage for scored or damaged seal face.

o. Inspect rotor and blades for damage and wear. Refer to figure 11-3 for limits.

p. Inspect cam ring for damaged or scored bore. Inspect for warped condition. Both faces must be parallel within 0.001 inch T. I. R.

q. Inspect plate (58, figure 11-2) for damaged or scored face.

11-14. **REPAIR.**

a. Seal face of adapter (68, figure 11-2) and seal face of seal cage (71) can be dressed to remove minor nicks, scratches or scoring. Remove only material necessary to clean up seal face. Seal face must be parallel with rotor side of adapter within 0.001 inch per inch. Replace either part if imperfections cannot be dressed cut.

b. Straighten distorted parts using suitable tools.

c. Remove burrs or nicks using a stone or file.

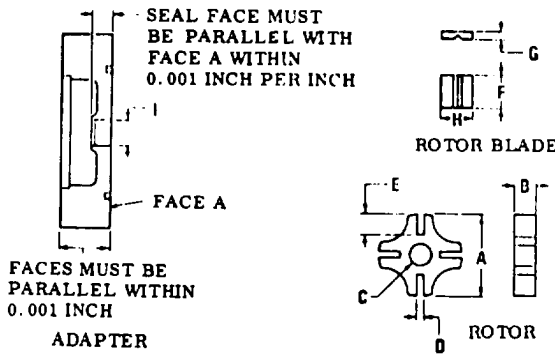
NOTE

The coolant pump (56) cannot be assembled completely and installed as a separate unit. It is assembled as it is installed on the short shaft end of the motor.

a. Apply a thin film of grease to o-rings (62, 64, and 70) and seal cage (71).

b. Install seal spring (73) and seal washer (72) over end of motor shaft. Place o-ring (70) in seal cage (71); then install seal cage over end of motor shaft with seal face facing outward.

c. Install pump adapter (68) over motor shaft and align holes with tapped holes in motor.



ITEM	DIMENSION	DIMENSIONAL LIMITS (INCHES)
ROTOR HEAD DIAMETER	A	0.904-0.906
ROTOR HEAD LENGTH	B	0.246-0.248
ROTOR BORE DIAMETER	C	0.3033-0.3038
ROTOR BLADE SHOT WIDTH	D	0.0935-0.0945
ROTOR BLADE SLOT DEPTH	E	0.263-0.268
BLADE HEIGHT	F	0.247-0.249
BLADE THICKNESS	G	0.091-0.093
BLADE WIDTH	H	0.247-0.249
ADAPTER BORE DIAMETER	I	0.315-0.318

Figure 11-3. Coolant pump wear limits

11-15. REASSEMBLY.

Refer to figure 11-2 and reassemble heater in the reverse order of index numbers assigned. Pay particular attention to the following:

- NOTE
- Make certain that adapter (69) and cam ring (63) are tightly compressed together when determining the 0.002 inch clearance, otherwise a false reading will be obtained.
- d. Install pump rotor (67) on motor shaft and temporarily tighten rotor set screw (66). Place o-ring (64) in groove of pump adapter (68). Place cam ring (63) in position aligning scribe mark. With motor shaft end play taken up in direction of pump, make certain there is at least 0.002 inch clearance between outer face of cam ring (63) and outer face of rotor (67). Move rotor back or forth as necessary to produce this clearance; then tighten set screw (66).
- e. Install rotor blades (65) in rotor slots, making sure that grooves in blades face away from direction of rotation, Pump rotates counterclockwise when viewing end of port plate (58).
- f. Place o-ring (62) in groove of port (58); then position plate against

cam ring (63), Align scribe marks, and tighten screws (57) evenly.

g. Test coolant pump assembly (56). Refer to paragraph 11-16, step a.

h. After coolant pump has been reassembled and tested, flush with corrosive preventive compound, Military Specification MIL-C-6529, and drain.

#### NOTE

Make certain that the lead wire from blower motor assembly (75) is on the side of the blower opposite the name plate.

i. Assemble motor and pump assembly (55), inlet (53), plate (51), and fan (50) before installing into burner assembly (48).

j. Install burner assembly (48) and casing (40).

k. Install cover (36).

1. Install regulator valve assembly (21), gasket (19), and igniter (18).

#### CAUTION

Use care when installing quartz rod (14) as it is easily broken if dropped.

m. After installing quartz rod (14), gently raise the rod up and down to see if it moves freely in the stainless tube. Also make sure at least 1/32 inch extends out of tube when rod is resting on bottom.

n. Install flame switch assembly (8) and terminal block (5).

o. Install receptacle assembly (3) with key located on the top.

p. Adjust flame switch (8), refer to paragraph 11-16, step b.

q. Install cover (1).

#### 11-16. COMPONENT TEST AND ADJUSTMENTS.

The following procedures cover testing and adjustments of individual components.

a. Coolant Pump Assembly. Coolant pump assembly (56, figure 11-2) should be tested before being reinstalled in the heater. Test coolant pump assembly as follows:

1. Connect motor and pump assembly to equipment as shown in figure 11-4.

2. Turn power switch to ON and run-in unit for approximately 15 minutes.

3. Test relief valve by closing manual shut-off valve. Discharge pressure should not exceed 30 to 35 PSI when valve is closed. Open and close valve a few times to check consistency of valve performance. Replace relief valve spring if pressure exceeds 30 to 35 PSI.

4. To check pump for rated flow and pressure, adjust valve in discharge line until a reading of 2 PSI is obtained on pressure gauge.

5. Using a suitable timer, check for rated flow of 80 GPH minimum at 2 PSI discharge pressure. Amperage draw should not exceed 6 amperes during this test.

6. Check motor RPM using a strobe light. Motor shaft speed should be 8500 RPM.

7. Observe smoothness of operation of both pump and motor. Seal leakage of 1 cubic centimeter per hour (seal may show

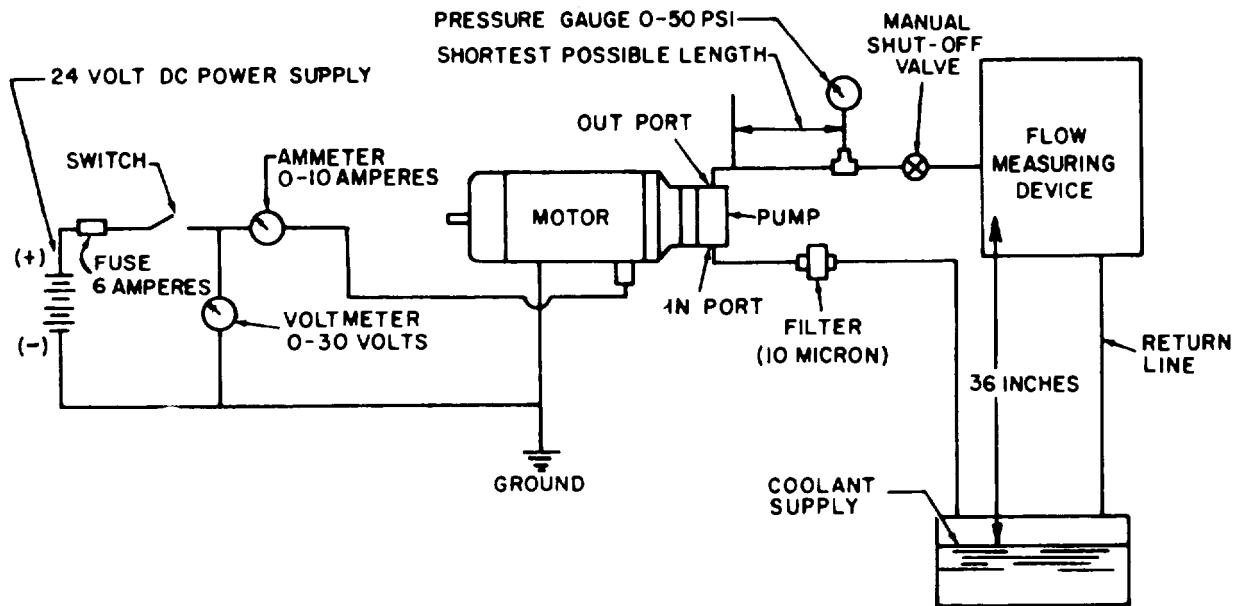


Figure 11-4. Coolant pump test set-up

signs of dampness) is maximum when pump is operating at 2 PSI discharge pressure.

8. Turn power supply to OFF; then remove discharge line and fitting from OUT port. Plug this port and apply 40 PSI hydrostatic pressure for 20 minutes. No leakage shall be evident during this test.

9. Remove test equipment.

b. Flame Micro-Switch. Check micro-switch (16, figure 11-2) as follows:

1. Connect a 24 VDC power supply to heater receptacle, positive to pin C and negative to pin A.

2. Turn adjusting screw (9) counterclockwise until motor starts.

3. Then turn adjusting screw clockwise until motor stops.

4. Turn adjusting screw clockwise an additional 1/2 (180 degrees) turn.

5. Remove power supply.

#### 11-17. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install heater.



CHAPTER 12

ELECTRIC WINTERIZATION KIT REPAIR INSTRUCTIONS

Section I. CONTROL BOX

12-1. GENERAL.

The control box contains the operating controls of the electric winterization kit. Incorporated in the box are the on-off switch, fuse, step down transformer, full wave diode rectifier, and heater indicator. The switch turns kit components on or off and the fuse protect kit components from excessive current. The step down transformer converts input voltage from external power supply to 33 VAC which in turn is converted to approximately 24 VDC by the full wave diode rectifier for coolant pump operation. The indicator illuminates whenever the kit is in operation.

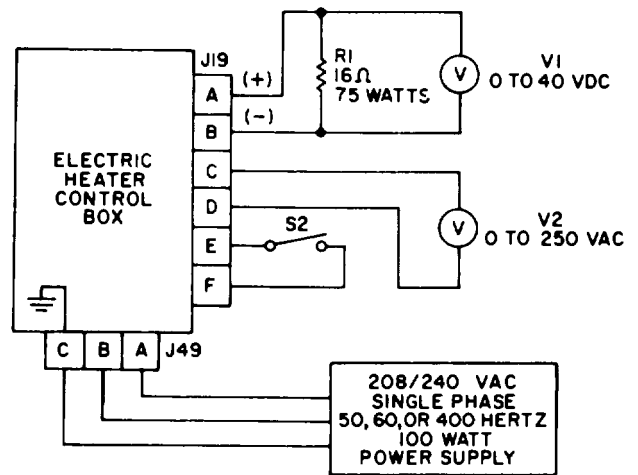


Figure 12-1. Electric winterization kit control box, test setup

12-2. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove the control box.

12-3. TEST.

NOTE

Figure 1-30 is the electric winterization kit schematic.

a. Connect control box to test equipment as illustrated in figure 12-1.

b. Perform test procedures as specified in table 12-1.

12-4. DISASSEMBLY.

Refer to figure 12-2 and disassemble electric winterization kit control box in the order of index numbers assigned. Pay particular attention to the following:

a. Prior to control box disassembly, test box as specified in paragraph 12-3 and then disassemble control box only to the extent necessary to accomplish repair.

b. Remove cover (2). Tag and disconnect harness wires from components and remove harnesses (3 and 9).

c. Tag diodes (11) with location and polarity and remove diodes from terminal strip by removing terminal strip screws.

Table 12-1. Electric Winterization Kit Control Box Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURES
1.	Position heater control box switch to ON and apply 230 VAC. Close switch S2, refer to figure 13-1.	a. Heater control box indicator DS1 should illuminate.	Defective resistor R20.  Defective indicator DS11.	Check resistor value which should be 2.47K ohms.  Check indicator for continuity. There should be continuity.
2.		b. Voltmeter V2 should indicate 230 VAC.	Defective transformer T1.	Measure voltage across secondary leads of T1 with a 0 to 50 VAC voltmeter. Voltage should be approximately 33 VAC.
		c. Voltmeter V1 should indicate approximately 33 VAC.	Defective diodes CR23, CR24, CR25, or CR26.	Check forward and reverse resistance of diodes. Measure from anode (+) to cathode (-), value should be low. Reverse meter leads, value should be infinity.



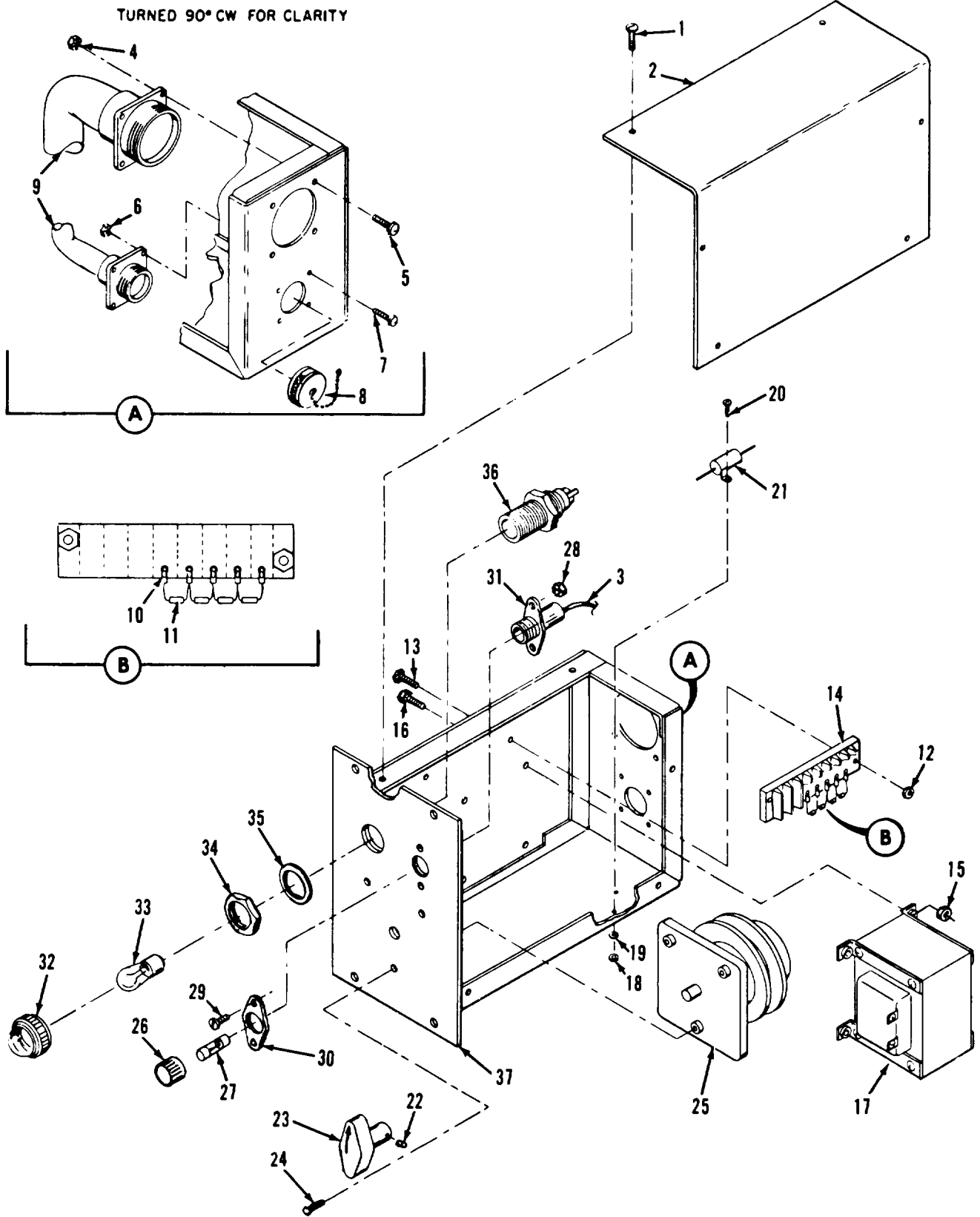


Figure 12-2. Electric winterization kit control box, exploded view

Legend to figure 12-2:

- |                      |                     |                   |
|----------------------|---------------------|-------------------|
| 1. Screw (6)         | 14. Terminal board  | 26. Cap           |
| 2. Cover             | 15. Nut (4)         | 27. Fuse          |
| 3. Harness           | 16. Screw (4)       | 28. Nut (2)       |
| 4. Nut (4)           | 17. Transformer     | 29. Screw (2)     |
| 5. Screw (4)         | 18. Nut (2)         | 30. Plate         |
| 6. Nut (4)           | 19. Lock washer (2) | 31. Fuse holder   |
| 7. Screw (4)         | 20. Screw (2)       | 32. Lens          |
| 8. Cover             | 21. Resistor        | 33. Lamp          |
| 9. Harness           | 22. Setscrew        | 34. Nut           |
| 10. Terminal lug (8) | 23. Knob            | 35. Washer        |
| 11. Diode (4)        | 24. Screw (3)       | 36. Light housing |
| 12. Nut (2)          | 25. Switch          | 37. Chassis       |
| 13. Screw (2)        |                     |                   |

12-5. CLEANING.

a. Clean electrical components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

b. Clean remaining parts in an approved cleaning solvent and dry thoroughly.

12-6. INSPECTION.

a. Inspect sheet metal parts for cracks, distortion, dents, and bent corners.

b. Check threads for damage

c. Inspect terminal board for damaged or cracked insulation.

NOTE

Figure 1-30 is the schematic for the electric winterization kit.

d. Check resistor for proper resistance value, value should be 2.47K ohms.

e. Check switch, lamp, light, fuse, and fuse holder for continuity.

f. Check forward and reverse resistance of diodes. Measured from anode (+) to cathode (-), value should be low. Reverse meter leads, value should be infinity.

g. Inspect transformer for burrs and defective insulation. Apply 240 VAC to transformer terminals 1 and 2. Check output at terminals 3 and 4, output should be 33 VAC.

h. Inspect harness (3, figure 12-2) wires for continuity, refer to figure 12-3.

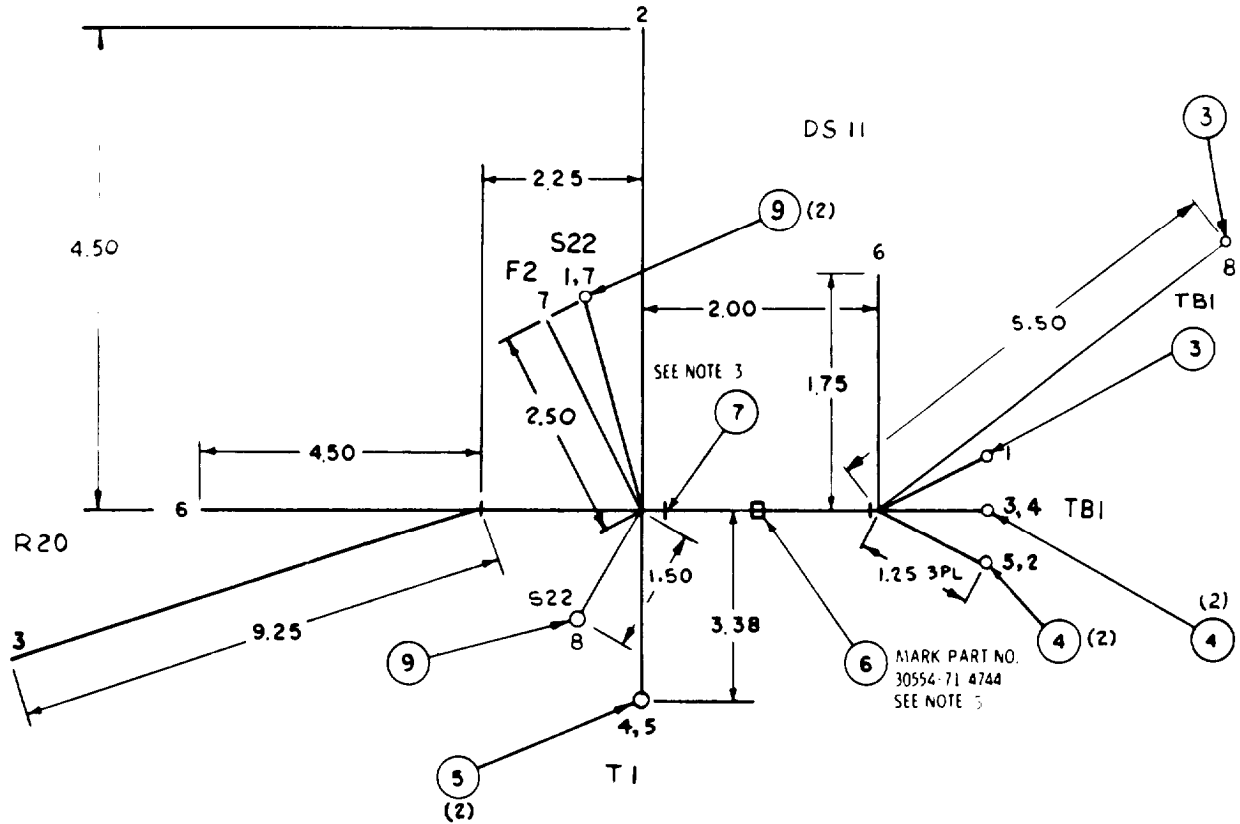
i. Inspect harness (9, figure 12-2) connectors for bent, loose, or missing pins. Check each harness wire for continuity from wire ends to connector pins. Check connector pins for shorts to case and surrounding pins. Refer to figure 12-4.

12-7. REPAIR.

a. Straighten dented or distorted parts using proper tools.

b. Repair or rebuild defective harness (3, figure 12-2) as illustrated in figure 12-3.

c. Repair or rebuild defective harness (9, figure 12-2) as illustrated in figure 12-4.



NOTES:

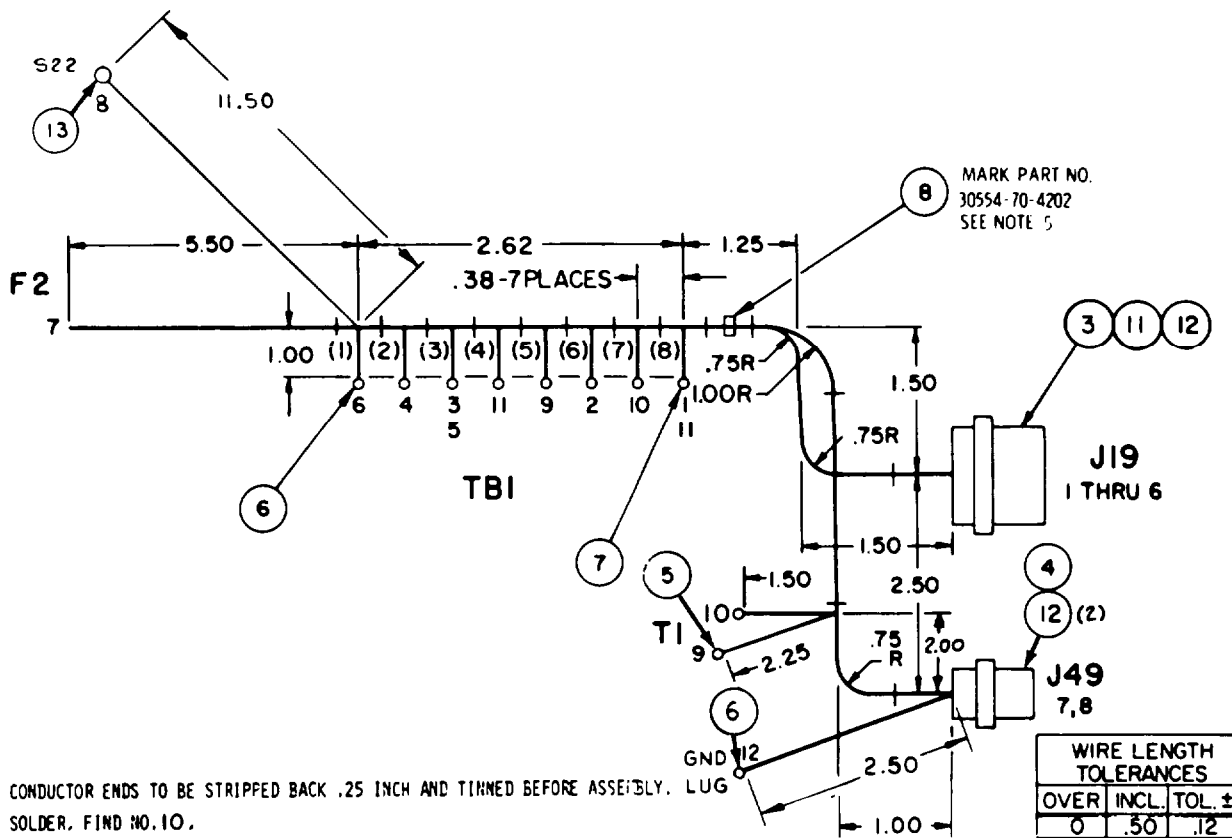
1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 8.
3. CABLE STRAPS, FIND NO. 7 SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	X303A12	TBI-1	3	S22-18	9	5.50
2	BLACK	X304F16	TBI-3	4	DS-11-1	-	7.50
3	BLACK	X301A16	TBI-2	4	R20-2	-	14.50
4	BLACK	X301D16	TBI-2	4	T1-2	5	6.75
5	BLACK	X304C16	TBI-3	4	T1-1	5	7.00
6	BLACK	X305A16	R20-1	-	DS-11-2	-	11.00
7	BLACK	LOOSE WIRE 12 GA	F2-2	-	S22-12	9	5.00
8	BLACK	X301C12	TBI-2	3	S22-17	9	9.00

FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
9			MS25036-156	3	TERMINAL, LUG, CRIMP STYLE		
8			SN60WRAP2	AP	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	
7			MS3367-4-9	4	STRAP, TIEDOWN		
6			MS39020-1	1	BAND, MARKER		
5			MS25036-153	2	TERMINAL, LUG, CRIMP STYLE		
4			MS25036-106	4	TERMINAL, LUG, CRIMP STYLE		
3			MS25036-111	2	TERMINAL, LUG, CRIMP STYLE		
2			MS086/2-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
1			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

Figure 12-3. Electric winterization kit control box wiring harness



NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO. 10.
3. CABLE STRAPS, FIND NO. 9. SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088. EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.

WIRE NO.	WIRE MARKING IDENTIFICATION		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG REF
	COLOR	NUMBER					
1	BLACK	V397B16	J19-A	3	TB1-8	7	4.75
2	BLACK	V306A1F	J19-B	↑	TB1-6	7	5.50
3	BLACK	X304B12	J19-C	↑	TB1-3	6	8.75
4	BLACK	X301B12	J19-D	↑	TB1-2	6	9.50
5	BLACK	X304A12	J19-E	↓	TB1-3	6	8.75
6	BLACK	X303C12	J19-F	3	TB1-1	6	10.25
7	BLACK	X302A12	J49-A	4	F2-1	-	14.00
8	BLACK	X301F12	J49-B	4	S22-16	13	20.00
9	BLACK	X308A16	TB1-5	7	T1-4	5	7.50
10	BLACK	X309A16	TB1-7	7	T1-3	5	6.00
11	BLACK	V307A16	TB1-4	7	TB1-8	7	2.50
12	JUMPER	#12 GA	J49-C	4	GRD LUG	-	2.50

13	MS25036-156	1	TERMINAL LUG CRIMP STYLE	
	TYPE F, FORM UA		TUBING, INSULATION	
12	GRADE A, CL 1	6	.148 ID X .020 WALL X .62 Lg	MIL-I-631
	CATEGORY 1			
	TYPE F, FORM UA		TUBING, INSULATION	
11	GRADE A, CL 1	2	106 ID X .016 WALL X .62 Lg	MIL-I-631
	CATEGORY 1			
10	SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571
9	MS3367-4-9	14	STRAP, TIEDOWN	
8	MS39020-1	1	BAND, MARKER	
7	MS25036-106	6	TERMINAL, LUG, CRIMP STYLE	
6	MS25036-111	5	TERMINAL, LUG, CRIMP STYLE	
5	MS25036-153	2	TERMINAL, LUG, CRIMP STYLE	
4	MS3102R16-10P	1	CONNECTOR, RECEPTACLE	
3	MS3102R28-9S	1	CONNECTOR, RECEPTACLE	
2	MS086/2-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2
1	MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2
FIND NO.	PART OR IDENTIFYING NO.	QTY REQD.	NUMBER, LABELING OR DESCRIPTION	SPECIFICATION

Figure 12-4. Electric winterization kit control box connector wiring harness

12-8. REASSEMBLY.

Refer to figure 12-2 and reassemble the electric winterization kit control box in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Install connectors of harness (9) with keyways on top.

NOTE

Refer to Operator and Organizational Maintenance Manual for electric winterization kit wiring diagram.

b. Prior to installing cover (2), refer to figure 1-30 and check wiring for proper connection.

c. After reassembly, test control box as specified in paragraph 12-3.

12-9. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install the control box.

Section II. ELECTRIC HEATER

12-10. GENERAL.

The electric heater is utilized to preheat generator set engine coolant during cold weather operation. The heater consists of a removable heating element, intake head with integral check valve and coolant tank. The check valve insures that the coolant tank is always full and heating element is submerged in coolant. The heating element heats the coolant in the tank which is in turn circulated through the engine coolant system.

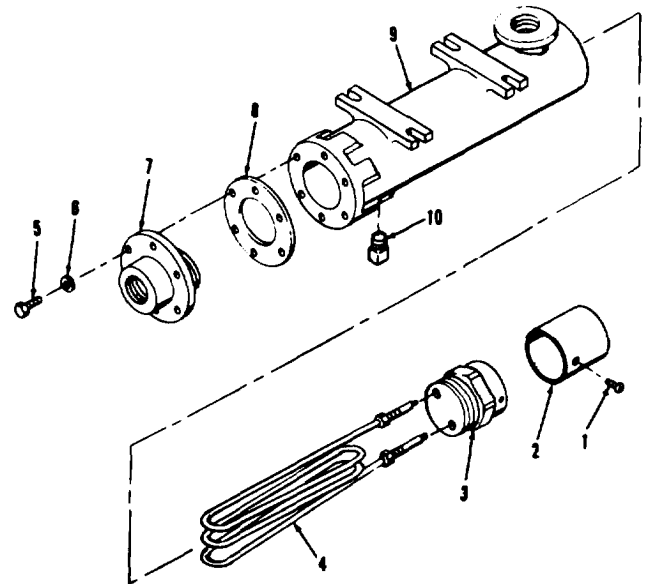


Figure 12-5. Electric winterization kit electric heater, exploded view

12-11. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove the electric heater.

Legend to figure 12-5:

12-12. DISASSEMBLY.

Refer to figure 12-5 and disassemble the electric heater in the order of index numbers assigned.

- |                    |   |
|--------------------|---|
| 1. Screw           | 7. Intake head and check valve assembly |
| 2. Cover           | 8. Gasket                               |
| 3. End Plug        | 9. Tank                                 |
| 4. Heating element | 10. Plug                                |
| 5. Screw (6)       |   |
| 6. Washer (6)      |   |

12-13. CLEANING.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

a. Remove hand coolant deposits from components by boiling components a minimum of 30 minutes in solution of one pound baking soda to each gallon of water.

b. Clean old gasket from intake head and check valve assembly and tank using a suitable scraper. Exercise care not to gouge surfaces.

c. Clean parts with an approved cleaning solvent and dry thoroughly.

12-14. INSPECTION.

a. Inspect threads for damage.

b. Inspect parts for cracks and damaged gasket surfaces.

c. Check flap of check valve for freedom of movement and for proper seating on intake head.

WARNING

Do not handle heating element during test and permit element to cool prior to removing test equipment.

d. Connect single phase 240 volts, 50, 60, or 400 hertz power supply to heating element terminals. Connect suitable ammeter and wattmeter in series with heating element and power supply. Apply 240 VAC and observe ammeter and wattmeter. Heating element should draw 10.8 amperes and 2500 watts. Remove test equipment, replace defective heating element.

12-15. REASSEMBLY.

Refer to figure 12-5 and reassemble the electric heater in the reverse order of index numbers assigned. Pay particular attention to the following:

a. Apply thread sealing compound conforming to Military Specification MIL-S-45180, type III, to threads of end plug (3) and plug (9) prior to installation.

b. When installing intake head and check valve assembly (7), make sure that hole with arrow is on top.

12-16. INSTALLATION.

Refer to Operator and Organizational Manual and install the electric heater.

### Section III. COOLANT PUMP

12-17. GENERAL.

The coolant pump consists of a pump and motor assembly which operates on 24 VDC and provides a minimum of 80 gallons per hour at 2 PSI. The motor is a continuous duty type and rotates in a clockwise direction as viewed from the pump end. The motor is rated at 20 to 32 VDC, 3.3 amperes with a maximum of 7500 RPM.

The motor is equipped with an internal bypass and feed thru capacitor for radio suppression and voltage and current protection. The pump is a rotor type with a built in relief valve that is set at 30 to 35 PSI. If coolant pressure reaches 30 to 35 PSI, the relief valve ball is unseated and coolant is permitted to bypass internally within the pump until pressure is reduced to 30 PSI.

12-18. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove coolant pump.

12-19. TEST.

a. Connect coolant pump to test equipment as illustrated in figure 11-4, except test equipment fuse rating should be 4 amperes.

b. Perform test procedure specified in paragraph 11-16, step a. Test results during test should be the same as provided in test procedure except motor amperage draw should not exceed 3.3 amperes in step a. 5. and motor RPM in step a. 6. should be 7500.

12-20. DISASSEMBLY.

Refer to figure 12-6 and disassemble the coolant pump in the order of index numbers assigned. Pay particular attention to the following:

a. Mark alignment marks on port plate (6), cam ring (8), adapter (13), and motor (23) prior to disassembly to insure proper reassembly.

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

b. Move shell (22) away from motor and unsolder wire (20) from pump.

c. Replace all packings.

12-21. CLEANING.

a. Clean wire and motor with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

Compressed air used for cleaning and drying purposes can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psig. Eye protection is required.

b. Clean brush and spring assembly and brush openings with filtered low pressure compressed air.

c. Clean remaining parts in an approved cleaning solvent and dry thoroughly.

1.2-22. INSPECTION.

a. Inspect springs for cracks, distortion, and broken ends.

b. Test relief valve spring for proper spring rate using a suitable spring tester. Spring rate should be 1 pound  $\pm$  0.1 pound at 0.750 inch working length. After rate test, check spring for proper free length of approximately 1.164 inches.

c. Test seal spring for proper spring rate. Spring rate should be 2.5 pounds  $\pm$  0.25 pound at 0.25 inch working length. After rate test, check spring for proper free length of approximately 0.470 inch.

d. Inspect relief valve ball and ball seat in port plate for grooves, scratches, and nicks.

e. Inspect parts for cracks, damaged contact surfaces, signs of scuffing, nicks, and burrs.

f. Inspect threads for damages.

g. Inspect pump components for wear, refer to figure 11-3.

h. Inspect brush and spring assembly brushes for cracks, chips, and wear by comparing brush with new brush. Replace brush and spring assembly if brush is worn to half its original length.

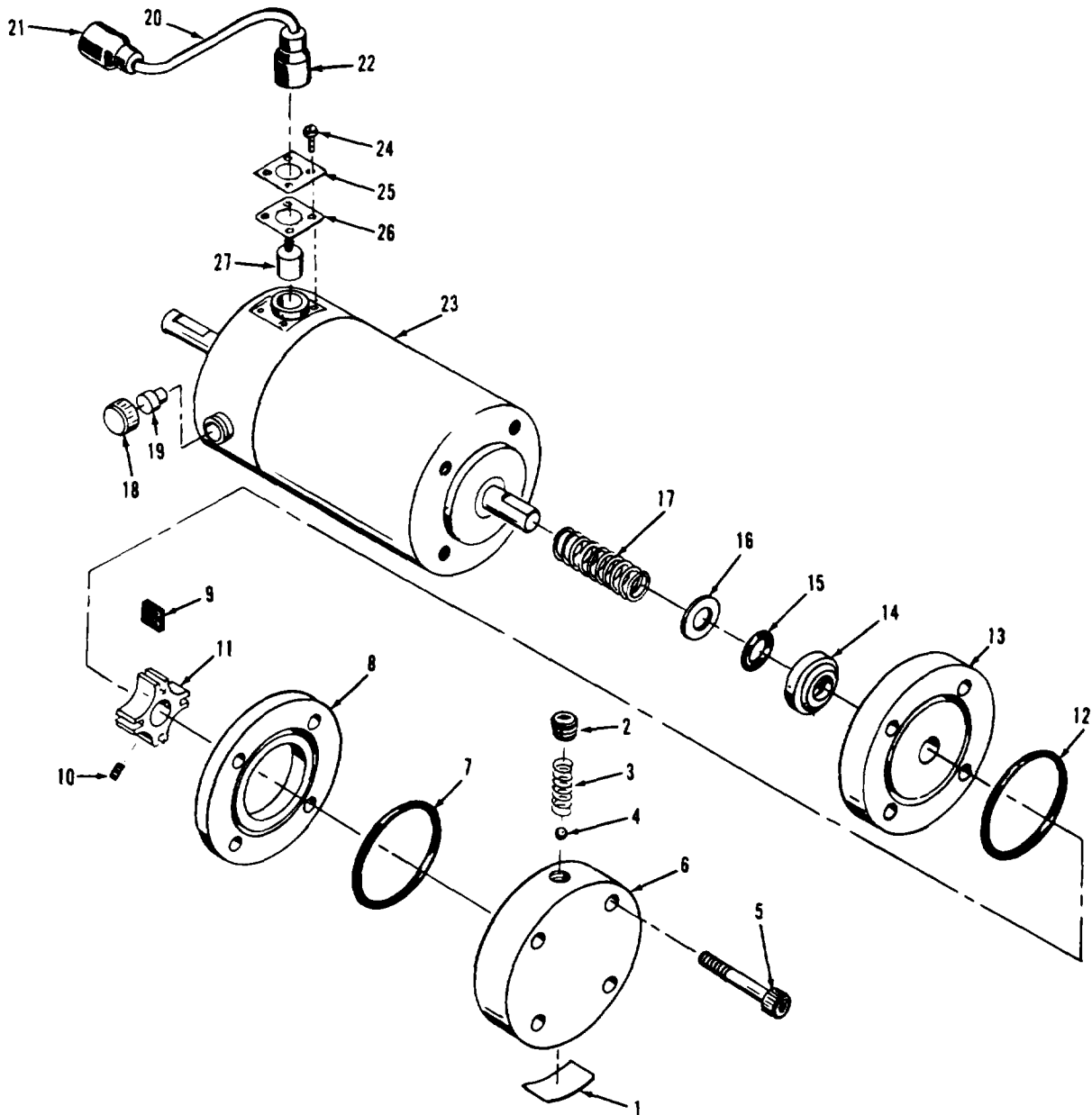


Figure 12-6. Electric winterization kit coolant pump, exploded view

i. Rotate motor shaft and check for smoothness of rotation, rough spots, and excessive side play. Using a suitable dial indicator, check motor shaft end play. End play should be 0.010 to 0.025 inch. Check motor shaft for wear, shaft should be  $0.3125 \pm 0.0005$  inch diameter and  $0.286 \pm 0.005$  inch from flat. Check shaft for grooves on packing contact surface.

j. Check capacitor for open or short.

k. Connect 24 VDC and ammeter to motor terminal and ground motor. Check motor RPM using a suitable strobe light. Motor should draw a maximum of 3.3 amperes and RPM should be approximately 7500.

12-23. **REPAIR.**

a. Remove nicks and burrs using a stone or file.

b. Repair loose nameplate using a suitable adhesive.



Legend to figure 12-6:

- |                        |                   |                                   |
|------------------------|-------------------|-----------------------------------|
| 1. Nameplate           | 10. Setscrew      | 19. Brush and spring assembly (2) |
| 2. Plug                | 11. Rotor         | 20. Wire                          |
| 3. Relief valve spring | 12. Packing       | 21. Shell                         |
| 4. Relief valve ball   | 13. Adapter       | 22. Shell                         |
| 5. Screw (4)           | 14. Seal cage     | 23. Motor                         |
| 6. Port plate          | 15. Packing       | 24. Screw (4)                     |
| 7. Packing             | 16. Washer        | 25. Plate                         |
| 8. Cam ring            | 17. Seal spring   | 26. Gasket                        |
| 9. Blade (4)           | 18. Brush cap (2) | 27. Capacitor                     |

12-24. REASSEMBLY.

Refer to figure 12-6 and reassemble the coolant pump in the reverse order of index numbers assigned. Pay particular attention to the following:

WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

a. Solder wire (20) to motor and position shell (22) on motor to ensure water tight seal.

b. Apply a thin film of grease to packings (7, 12, and 15) and seal cage (14) so that packing will move in groove to form proper seal at time of reassembly. Position on packings in grooves.

c. Install blades (9) in rotor (11). Align alignment marks.

d. Position spring (17), washer (16), packing (15), seal cage (14), adapter (13), and assembled rotor (11) on motor shaft. Align motor setscrew opening with flat of motor shaft. Slide components toward motor, compressing spring (17) and install setscrew (10).

e. Install remaining components. Tighten screws (5) evenly to prevent side loading components.

f. Test coolant pump as specified in paragraph 12-19.

12-25. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install coolant pump.



## CHAPTER 13

### DUMMY LOAD KIT REPAIR INSTRUCTIONS

#### Section I. DUMMY LOAD KIT

##### 13-1. GENERAL.

The dummy load kit is a balanced three phase, four wire, resistive type load bank. The kit is rated for approximately 48 KW with increments loads of approximately 12 KW. It is capable of operating with either 50/60 hertz or 400 hertz generator sets. The kit consists of a control box, resistive heater elements, and wiring enclosed in a ventilated housing. The kit is designed to operate at either 120/208 or 240/416 output voltages. The kit's load is created by the heater elements, as selected by the load switch. The control box and its components are described in Section II of this chapter.

##### 13-2. REMOVAL.

Refer to Operator and Organizational Maintenance Manual and remove dummy load kit.

##### 13-3. DISASSEMBLY.

Refer to figure 13-1 and disassembly dummy load kit in the order of index numbers assigned. Pay particular attention to the following.

##### NOTE

Disassemble dummy load kit only to the extent necessary to effect repair,

- a. Remove cover assembly (6), side panels (17) channels (18 and 19) and end panels (23, 24, and 25) from frame (70).

- b. Tag, disconnect, and remove leads (28) from heater elements (33). Remove heater elements (33), resistor brackets (38, 43, and 48) from frame (70).

- c. Remove control box cover (57), tag and disconnect wire harnesses (52 and 53) from control box components.

- d. Separate control box (63), fire wall (61), panel (62), and end panels (67, 68, and 69) from frame (70).

- e. Refer to paragraph 13-22 for disassembly procedures for the control box.

##### 13-4. CLEANING

- a. Clean electrical components with a clean lint-free cloth moistened with an approved cleaning solvent and dry thoroughly.

##### WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- b. Clean metal parts in an approved cleaning solvent and dry thoroughly.

##### 13-5. INSPECTION AND TEST.

- a. Inspect parts for cracks, dents, and distortion.
- b. Inspect threads for damage.

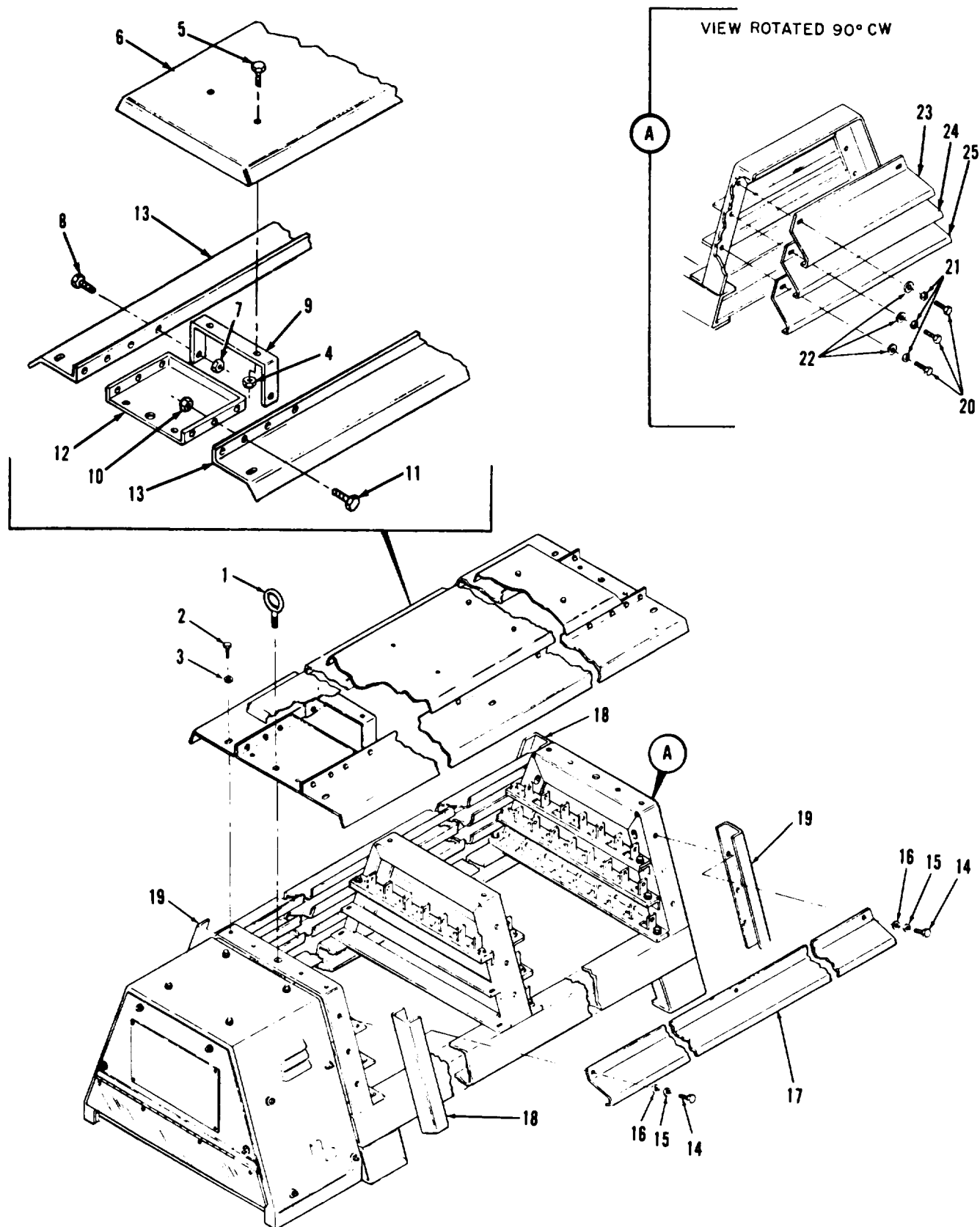


Figure 13-1. Dummy load kit, exploded view (sheet 1 of 2)

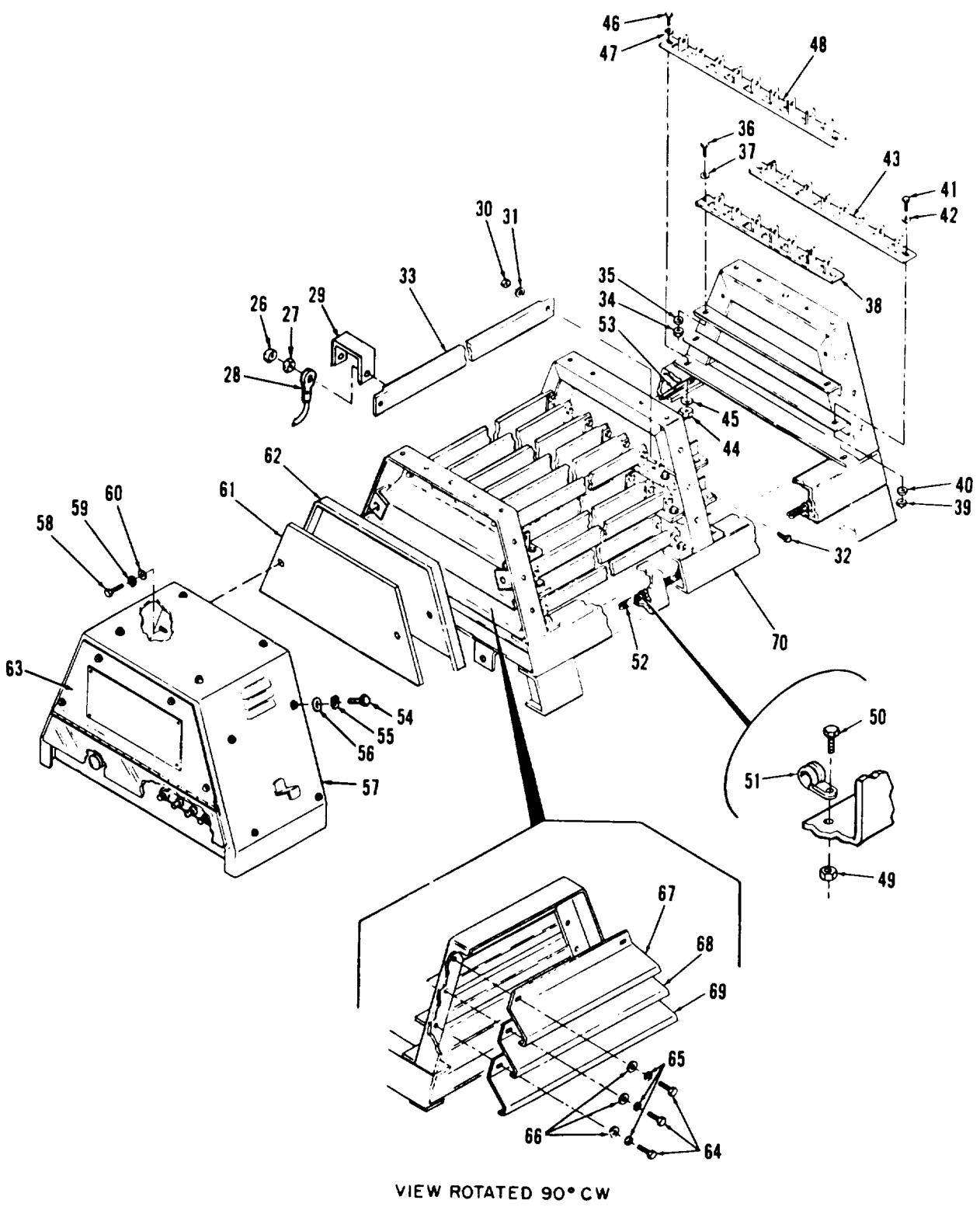


Figure 13-1. Dummy load kit, exploded view (sheet 2 of 2)

Legend to figure 13-1.

- |                         |                                |
|-------------------------|--------------------------------|
| 1. Eye bolt (2)         | 36. Screw (4)                  |
| 2. Screw (6)            | 37. Washer (4)                 |
| 3. Lock washer (6)      | 38. Resistor bracket (4)       |
| 4. Nut (8)              | 39. Nut (4)                    |
| 5. Screw (8)            | 40. Washer (4)                 |
| 6. Cover                | 41. Screw (4)                  |
| 7. Nut (8)              | 42. Washer (4)                 |
| 8. Screw (8)            | 43. Resistor bracket (4)       |
| 9. Bracket (4)          | 44. Nut (4)                    |
| 10. Nut (12)            | 45. Washer (4)                 |
| 11. Screw (12)          | 46. Screw (4)                  |
| 12. Splash pan (2)      | 47. Washer (4)                 |
| 13. Side rail (2)       | 48. Resistor bracket (4)       |
| 14. Screw (18)          | 49. Nut (6)                    |
| 15. Lock washer (18)    | 50. Screw (6)                  |
| 16. Washer (18)         | 51. Clamp (6)                  |
| 17. Side panel (6)      | 52. Wire harness               |
| 18. Channel (2)         | 53. Wire harness               |
| 19. Channel (2)         | 54. Screw (12)                 |
| 20. Screw (6)           | 55. Lock washer (12)           |
| 21. Lock washer (6)     | 56. Washer (12)                |
| 22. Washer (6)          | 57. Control box assembly cover |
| 23. End panel           | 58. Screw (4)                  |
| 24. End panel           | 59. Lock washer (4)            |
| 25. End panel           | 60. Washer (4)                 |
| 26. Nut (96)            | 61. Fire wall                  |
| 27. Washer (96)         | 62. Panel                      |
| 28. Lead (10)           | 63. Control box                |
| 29. Strap (49)          | 64. Screw (6)                  |
| 30. Nut (96)            | 65. Lock washer (6)            |
| 31. Lock washer (96)    | 66. Washer (6)                 |
| 32. Screw (96)          | 67. End panel                  |
| 33. Heater Element (48) | 68. End panel                  |
| 34. Nut (4)             | 69. End panel                  |
| 35. Washer (4)          | 70. Frame                      |

#### NOTE

Dummy load kit wiring diagram is contained in the Operator and Organizational Maintenance Manual.

c. Refer to figure 13-2 and 13-3 and check each harness wire for continuity. Check harness wires for loose terminal lugs and defective installation.

d. A quick test of heater elements may be accomplished without disassembly of dummy load bank. Measure resistance between terminal points 1, 7, 13, 19, 25, 31, 37, 43, 49, 55, 61 and 67 to neutral lead LO on dummy load bank terminal board. Resistance valves should be approximately (1.75 ohms 120/208 voltage connection or (7 ohms 240/416 voltage connections). Refer to figure 1-31.

#### WARNING

Do not touch heater elements during test and permit elements to cool prior to removing test equipment.

e. Test resistance of each heater element, resistance should be 11 to 14 ohms. Test each heater element by connecting a 120 VAC; 50, 60, or 400 hertz power supply and a 0 - 10 ampere AC ammeter to heater element terminals. Turn on power supply, heater element should draw 8.3 amperes. Remove test equipment.

f. Inspect fire wall for deterioration, cracks, and damaged ends.

g. Inspect paint for deterioration, cracks, and damaged ends.

#### 13-6. REPAIR.

#### WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and air-borne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- a. Repair cracks by welding.
- b. Straighten dented or distended parts using suitable tools.
- c. Remove damaged paint. Blend in edges, prime, and paint damaged areas.
- d. Repair damaged harnesses as specified in figure 13-2 or 13-3.

#### 13-7. WIRING HARNESS REBUILD.

- a. Rebuild dummy load kit right side wiring harness as specified in figure 13-2.
- b. Rebuild dummy load kit left side wiring harness as specified in figure 13-3.

#### 13-8. REASSEMBLY.

Refer to figure 13-1 and reassemble dummy load kit in the reverse order of index numbers assigned. Pay particular attention to the following:

- a. Install end panels (67, 68, and 69) on frame (70).
- b. Position wire harnesses (52 and 53) on frame (70) and secure with clamps (51) screws (50) and nuts (49).
- c. Reassemble control box as specified in paragraph 13-28.
- d. Install control box (63), fire wall (61), and panel (62) on frame (70). Connect wire harnesses (52 and 53) to control box components. Install control box cover (57) on control box assembly (63).

#### NOTE

Dummy load kit wiring diagram is contained in the Operator and Organizational Maintenance Manual.

e. Install heater elements (33) and leads (28). Leave screws (32) at center frame loose to permit expansion and travel of heater elements (33). Check wiring for proper connection.

f. Install end panels (23, 24, and 25), channels (18 and 19), side panels (17), and cover assembly.

#### 13-9. INSTALLATION.

Refer to Operator and Organizational Maintenance Manual and install dummy load kit.





WIRE NO.	WIRE		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LG (REF)
	COLOR	GAUGE					
21	WHITE	12GA	A2-7	2	R13-1	3	53.00
22							
23		12GA	A2-11	2	R14-2	3	94.00
24							
25		12GA	A2-12	2	R15-1	3	97.00
26							
27							
28		12GA	A2-31	2	R17-1	3	54.00
29		12GA	A2-35	2	R18-2	3	96.00
210		12GA	A2-36	2	R19-1	3	96.00
211		12GA	A2-55	2	R21-1	3	56.00
212		12GA	A2-59	2	R22-2	3	93.00
213		12GA	A2-60	2	R23-1	3	99.00
214		12GA	A2-19	2	R37-1	3	50.00
215		12GA	A2-23	2	R38-1	3	91.00
216		12GA	A2-24	2	R39-1	3	85.00
217		12GA	A2-43	2	R41-1	3	47.00
218		12GA	A2-47	2	R42-2	3	91.00
219		12GA	A2-48	2	R43-1	3	92.00
220		12GA	A2-57	2	R45-1	3	47.00
221		12GA	A2-71	2	R46-2	3	91.00
222		12GA	A2-72	2	R47-1	3	94.00
223							
224							
225	WHITE	12GA	A2-LO	10	R48-2	3	128.00

11		B	71-4927	AR	SLEEVING, FIBERGLASS		
10			MS25036-158	1	TERMINAL, LUG CRIMP STYLE		
9							
8			MS3367-4-9	8	STRAP, TIEDOWN		
7			MS3367-1-9	29	STRAP, TIEDOWN		
6			MS39020-1	1	BAND, MARKER		AL ALY
5							
4			MS39020-4	16	BAND		
3			MS20659-105	19	TERMINAL, LUG, CRIMP STYLE		
2			MS25036-113	18	TERMINAL, LUG, CRIMP STYLE		
1			TYPE-E-12	AR	WIRE, ELECTRICAL, TEFLON	MIL-W-16878/4A	
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

1. ALL CONDUCTOR TO BE STRIPPED BACK .25 INCH.
2. CABLE STRAPS, FIND NO. 4 AND 7 SHALL BE SPACED AT APPROX 3.00 INCHES APART UNLESS OTHERWISE SPECIFIED.
3. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.
4. EACH WIRE TO BE MARKED WITH WIRE NUMBER AS SPECIFIED IN WIRE TABLE. HOT STAMP WIRE NUMBER IN ACCORDANCE WITH MIL-M-81594, TYPE XIII
5. EXCEPT FOR SECTION A2, SLEEVE ALL LEADS FROM LUG END, FIND NO 3 TO MAIN HARNESS BREAKOUTS, WITH FIND NO 11 PRIOR TO INSTALLING TERMINAL LUGS

Figure 13-2. Dummy load kit right side wiring harness (sheet 2 of 2)

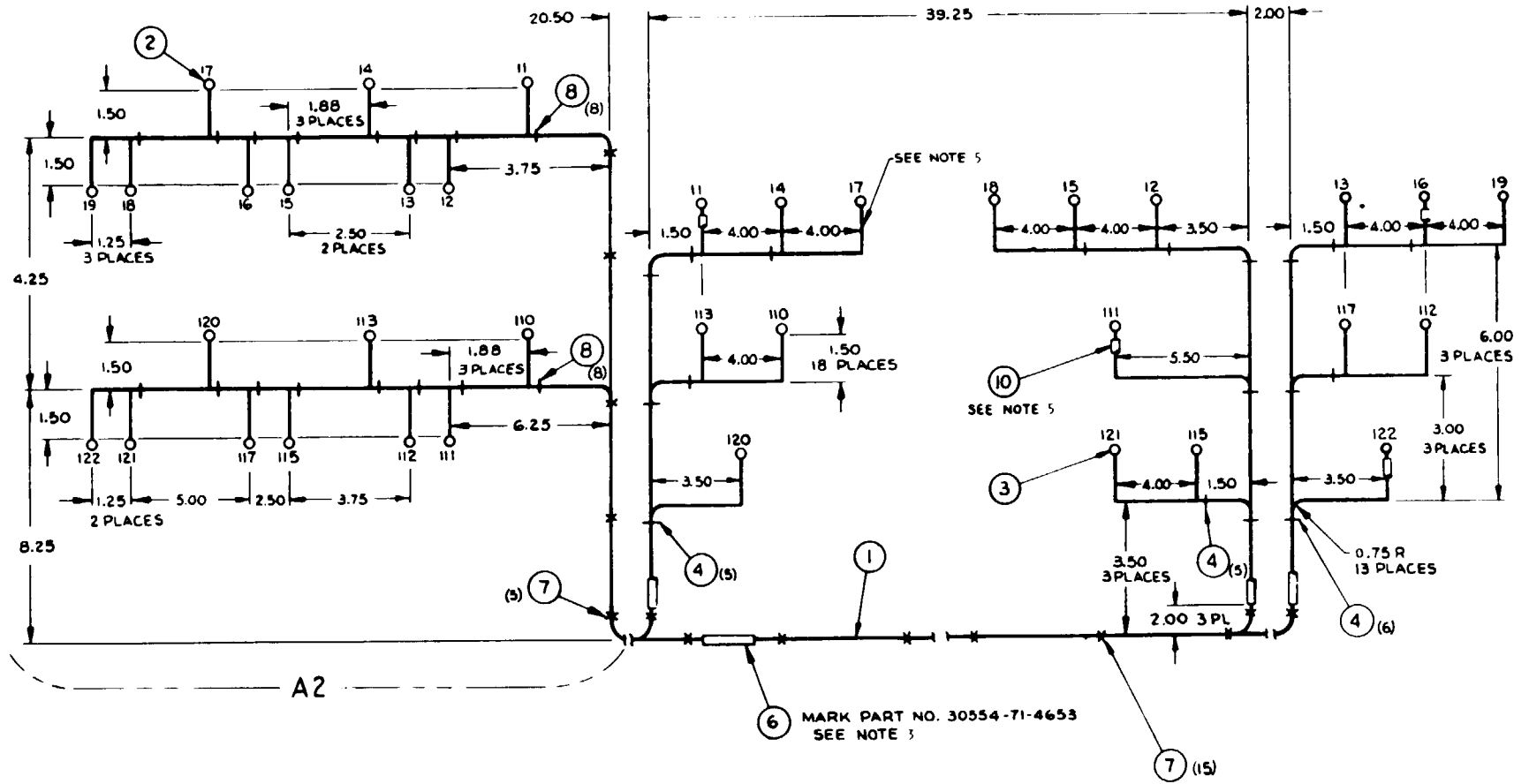


Figure 13-3. Dummy load kit (left side) wiring harness (sheet 1 of 2)

WIRE NO.	WIRE		FROM	TERMN FIND NO.	TO	TERMN FIND NO.	LG (REF)
	COLOR	GAUGE					
11	WHITE	12GA	A2-1	2	R1-1	3	59.00
12		12GA	A2-5	2	R2-2	3	101.00
13		12GA	A2-6	2	R3-1	3	98.00
14		12GA	A2-25	2	R5-1	3	57.00
15		12GA	A2-29	2	R6-2	3	99.00
16		12GA	A2-30	2	R7-1	3	96.00
17		12GA	A2-49	2	R9-1	3	58.00
18		12GA	A2-53	2	R10-2	3	102.00
19		12GA	A2-54	2	R11-1	3	102.00
110		12GA	A2-13	2	R25-1	3	54.00
111		12GA	A2-17	2	R26-2	3	93.00
112		12GA	A2-18	2	R27-1	3	92.00
113		12GA	A2-37	2	R29-1	3	51.00
114							
115		12GA	A2-41	2	R30-2	3	90.00
116							
117		12GA	A2-42	2	R31-1	3	88.00
118							
119							
120		12GA	A2-61	2	R33-1	3	46.00
121		12GA	A2-65	2	R34-2	3	89.00
122	WHITE	12GA	A2-66	2	R35-1	3	86.00

10		B	71-4927	AR	SLEEVING, FIBERGLASS		
9							
8			MS3367-4-9	16	STRAP, TIEDOWN		NYLON
7			MS3367-1-9	20	STRAP, TIEDOWN		NYLON
6			MS39020-1	1	BAND, MARKER		AL ALY
5							
4			MS39020-4	16	BAND		AL ALY
3			MS20659-105	18	TERMINAL, LUG, CRIMP STYLE		
2			MS25036-113	18	TERMINAL, LUG, CRIMP STYLE		
1			TYPE-E-12	AR	WIRE, ELECTRICAL, TEFLON	MIL-W-16878/4A	
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH
2. CABLE STRAPS, FIND NO. 4, 7 AND 8 SHALL BE SPACED AT APPROX 3.00 INCHES APART UNLESS OTHERWISE SPECIFIED.
3. PART NO. MARKING SHALL BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130.
4. EACH WIRE TO BE MARKED WITH WIRE NUMBER AS SPECIFIED IN WIRE TABLE. HOT STAMP WIRE NUMBER IN ACCORDANCE WITH MIL-M 81594, TYPE XIII
5. EXCEPT FOR SECTION A2, SLEEVE ALL LEADS FROM LUG END, FIND NO. 3 TO MAIN HARNESS BREAKOUTS, WITH FIND NO. 11, PRIOR TO INSTALLING TERMINAL LUGS.

Figure 13-3. Dummy load kit (left side) wiring harness (sheet 2 of 2)

## Section II. CONTROL BOX

### 13-10. GENERAL.

a. Control Box. The control box contains the operating controls of the dummy load kit. The box incorporates a harness, load selector switch, load removal switch, voltage change terminal board, load dumping relay, transformer, diodes, resistors, capacitors, relay, transistors and contractors.

b. Load Dumping Relay (K5). The relay contains controls necessary to automatically remove dummy load kit from operation when the automatic load removal switch is positioned to ON. With the switch in the ON position the dummy load kit is removed from operation when the generator set load exceeds 50 percent. After automatic load removal the relay must be manually reset by positioning automatic load removal switch to BY-PASS RESET.

### 13-11. LOAD DUMPING RELAY (K5).

13-12. REMOVAL. Refer to figure 13-4 and remove the load dumping relay as follows :

a. Disconnect cover (11) from frame (91) by removing screws (9) and washers (10).

b. Tag and disconnect harness (51) wires from load dumping relay (45).

c. Disconnect load dumping relay (45) by removing screws (44).

### 13-13. TEST AND BENCH TEST.

a. Connect test equipment to the load dumping relay as illustrated in figure 13-5.

b. Perform test specified in table 13-1.

13-14. DISASSEMBLY. Refer to figure 13-6 and disassemble load dumping relay to the extent necessary to effect repair as follows :

a. Remove relay, relay socket, and terminal strip by removing screws, washers, and nuts.

### WARNING

Avoid breathing fumes generated by unsoldering/soldering. Eye protection is required.

b. Unsolder components from their connection points exercising care not to apply excessive heat to components.

13-15. CLEANING. Clean parts with a clean lint free cloth moistened in an approved cleaning solvent and dry thoroughly.

### 13-16. INSPECTION.

a. Inspect component side of circuit board for damage, burns, discolored areas, and signs of overheating. Check components for security.

b. Inspect printed circuits of board for breaks and damage.

13-17. REPAIR. Repair printed circuits by soldering a jumper wire across defective area exercising care not to apply excessive heat to components. Make sure solder joints do not project more than 0.094 inch beyond surface of board.

13-18. REASSEMBLY. Refer to figure 13-6. and reassembly load dumping relay as follows:

a. Solder components to their connection points exercising care not to apply excessive heat to components.

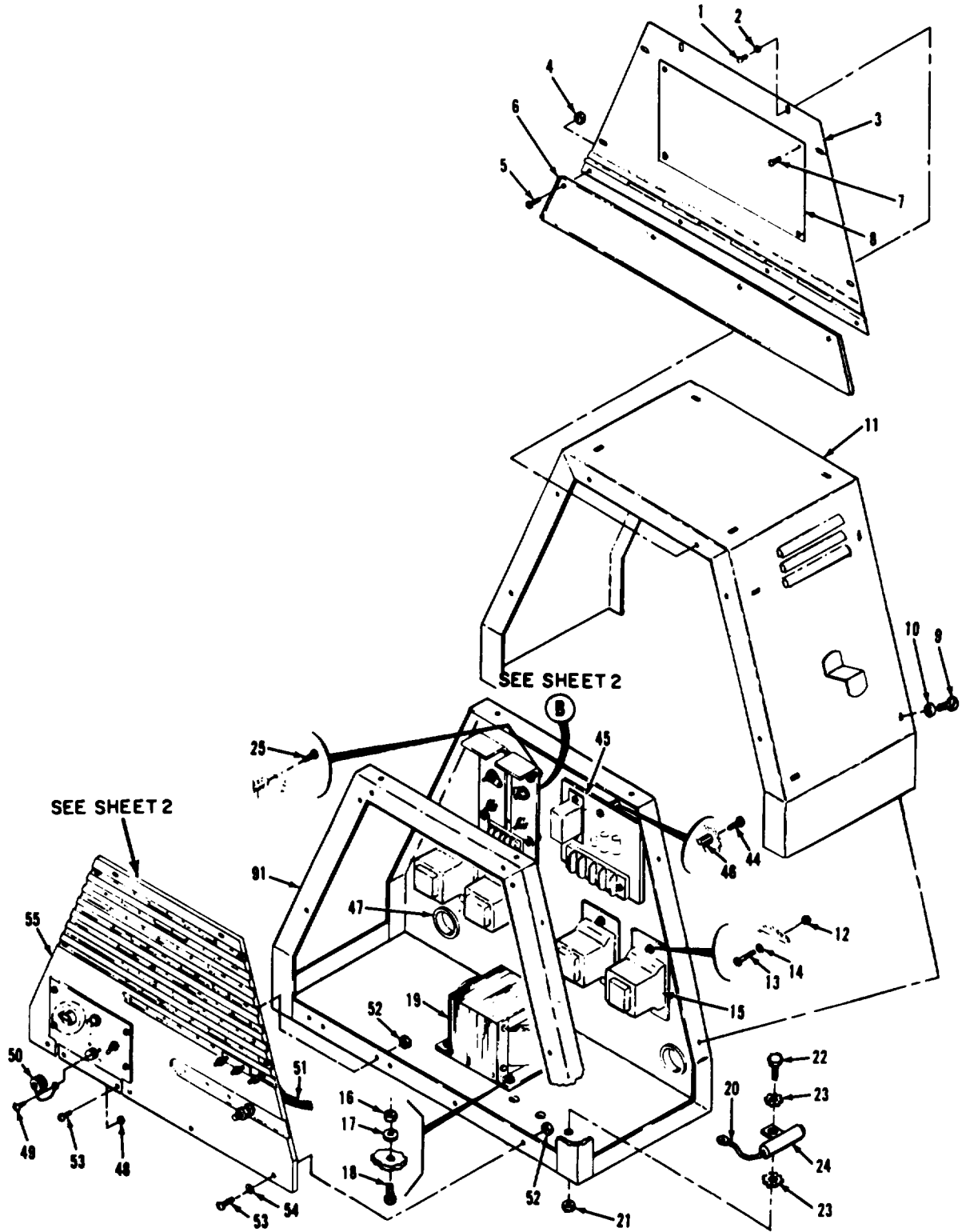


Figure 13-4. Dummy load kit control box, exploded view (sheet 1 of 2)

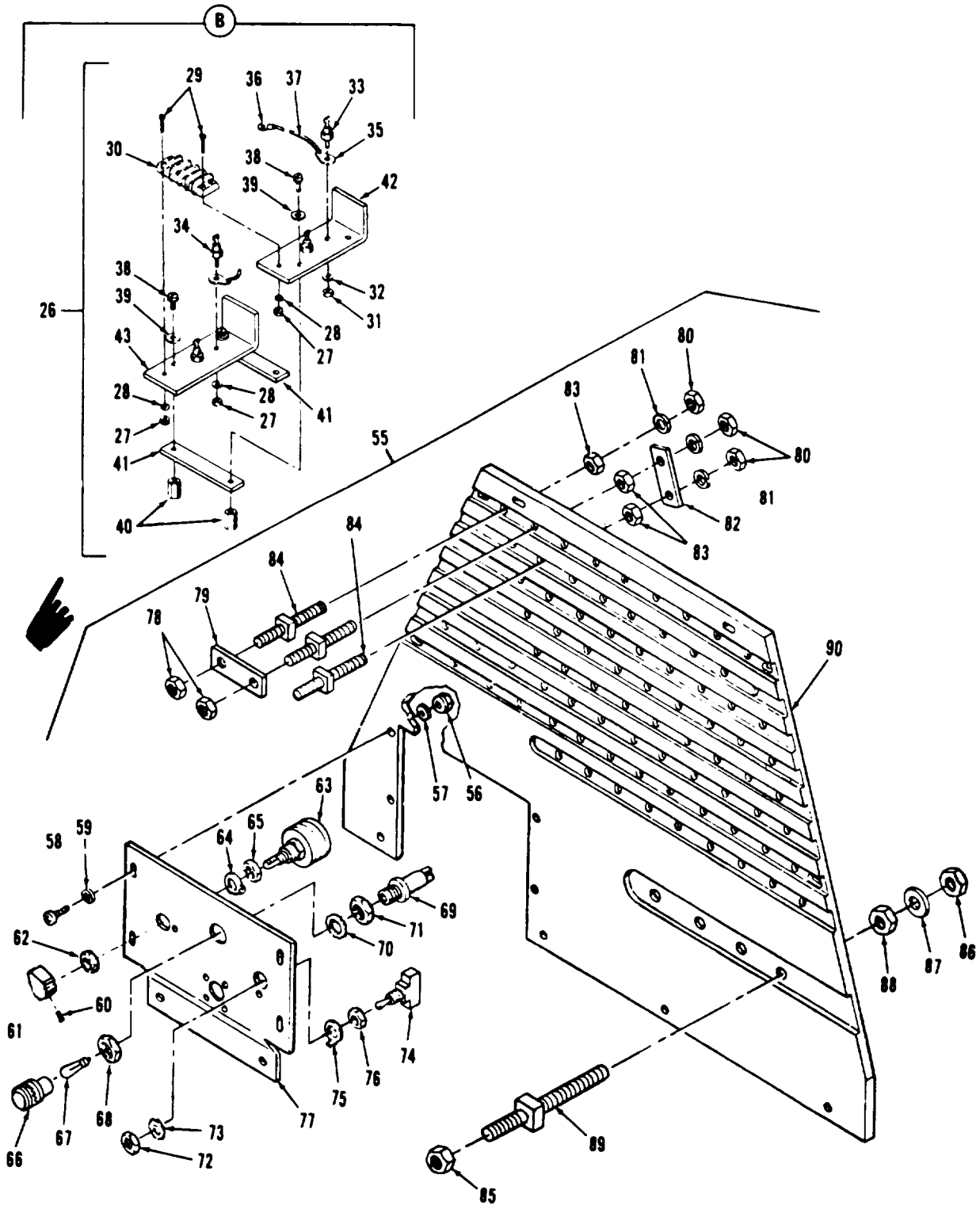
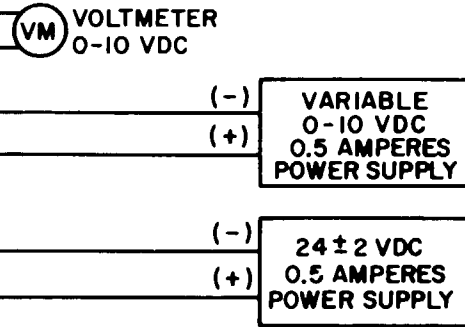
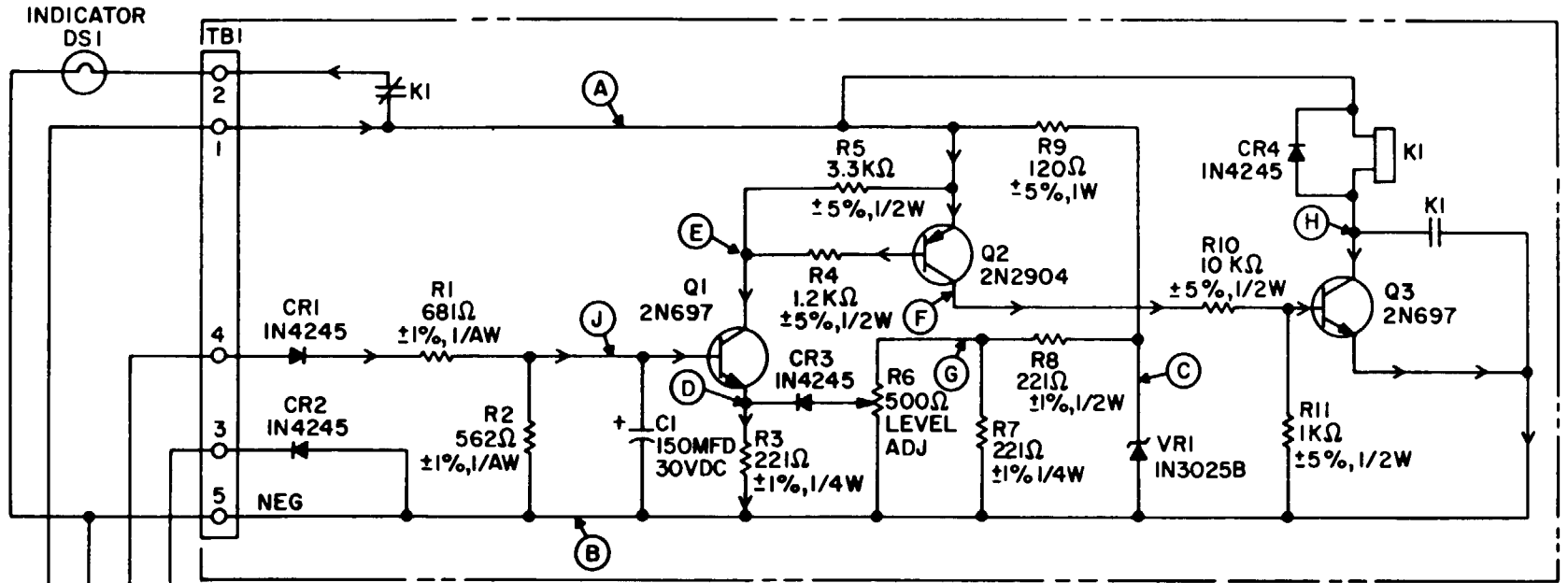


Figure 13-4. Dummy load kit control box, exploded view (sheet 2 of 2)

Legend to figure 13-4:

- |                      |                                 |                                   |
|----------------------|---------------------------------|-----------------------------------|
| 1. Screw (6)         | 20. Lead (3)                    | 56. Nut (4)                       |
| 2. Washer (6)        | 21. Nut (3)                     | 57. Washer (4)                    |
| 3. Upper panel       | 22. Screw (3)                   | 58. Screw (4)                     |
| 4. Nut (4)           | 23. Lock washer (6)             | 59. Washer (4)                    |
| 5. Screw (3)         | 24. Capacitor (3)               | 60. Setscrew                      |
| 6. Lower panel       | 25. Screw (4)                   | 61. Knob                          |
| 7. Rivet (4)         | 26. Bridge rectifier assembly   | 62. Nut                           |
| 8. Instruction plate |                                 | 63. Load selector switch          |
| 9. Screw (12)        | 27. Nut (2)                     | 64. Tab waste                     |
| 10. Washer (12)      | 28. Washer (2)                  | 65. Nut                           |
| 11. Cover            | 29. Screw (2)                   | 66. Lens                          |
| 12. Nut (12)         | 30. Terminal board              | 67. Lamp                          |
| 13. Screw (12)       | 31. Nut (4)                     | 68. Nut                           |
| 14. Washer (12)      | 32. Washer (4)                  | 69. Light                         |
| 15. Contactor (4)    | 33. Diode (2)                   | 70. Washer                        |
| 15A. Deleted         | 34. Diode (2)                   | 71. Nut                           |
| 15B. Deleted         | 35. Terminal lug (2)            | 72. Nut                           |
| 15C. Deleted         | 36. Terminal lug (4)            | 73. Washer                        |
| 15D. Deleted         | 37. Lead (4)                    | 74. Automatic load removal switch |
| 15E. Deleted         | 38. Screw (4)                   | 75. Tab washer                    |
| 15F. Deleted         | 39. Washer (4)                  | 76. Nut                           |
| 15G. Deleted         | 40. Spacer (4)                  | 77. Control board panel           |
| 15H. Deleted         | 41. Insulated plate (2)         | 78. Nut (52)                      |
| 15J. Deleted         | 42. Heatshield                  | 79. Link (26)                     |
| 15K. Deleted         | 43. Heatshield                  | 80. Nut ('78)                     |
| 15L. Deleted         | 44. Screw (3)                   | 81. Lock washer (78)              |
| 15M. Deleted         | 45. Load dumping relay K5       | 82. Rear link (13)                |
| 15N. Deleted         | 46. Spacer (3)                  | 83. Nut ('78)                     |
| 15P. Deleted         | 47. Grommet (2)                 | 84. Terminal stud (78)            |
| 15Q. Deleted         | 48. Nut (4)                     | 85. Nut (4)                       |
| 15R. Deleted         | 49. Screw (4)                   | 86. Nut (4)                       |
| 15S. Deleted         | 50. Cover and chain             | 87. Washer (4)                    |
| Deleted              | 51. Harness                     | 88. Nut (4)                       |
| 15T. Deleted         | 52. Nut (14)                    | 89. Load stud (4)                 |
| 16. Nut (4)          | 53. Screw (10)                  | 90. Terminal board                |
| 17. Washer (4)       | 54. Washer (10)                 | 91. Frame                         |
| 18. Screw (4)        | 55. Reconnection board assembly |                                   |
| 19. Transformer      |                                 |                                   |



TEST POINT	NO INPUT TO TBI-3 AND 4	INPUT AT TBI-3 AND 4 ABOVE TRIP SETTING (5 VDC)
A-B	24	24
C-B	16	16
D-B	1.5	1.5
E-B	24	22
F-B	0	24
G-B	55.5	55.5
H-B	24	0
J-B	0	2.0
ALL READINGS ± 20%		

Figure 13-5. Dummy load kit load dumping relay (K5), test setup



Table 13-1. Dummy Load Kit Load Dumping Relay (K5) Procedural Analysis

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
<p>NOTE</p> <p>Figure 1-31 is the dummy load kit schematic</p>				
1.	Turn on 24 VDC power supply.	DS 1 should be illuminated.	Defective relay K1.	Remove relay and test as specified in figure 6-5.
2.	<p>Adjust variable 0-10 VDC power supply to read 5.2 VDC <math>\pm</math> 5 per cent on test volt meter.</p> <p>NOTE</p> <p>Maintain 5.2 VDC <math>\pm</math> 5 percent on test volt meter through out remaining tests.</p>	<p>DS 1 should be extinguished.</p> <p>NOTE</p> <p>Voltage readings should be <math>\pm</math> 20 per cent through out remaining tests.</p>	<p>Variable resistor R6 adjusted incorrectly.</p> <p>Defective relay K1.</p> <p>Defective printed circuit board component.</p>	<p>Adjust R6 until relay K1 energizes and DS1 extinguishes without changing voltage across TB1 3 and 4.</p> <p>Remove relay and test as specified in figure 6-5.</p> <p>Proceed with steps 3 to 7.</p>
3.	Measure voltage between test points J and B.	Voltage should be 2 VDC.	Defective diode CR1 or CR2; resistor R1 or R2; compacitor C1.	Check components for proper rating.

Table 13-1. Dummy Load Kit Load Dumping Relay (K5) Procedural Analysis (Cont)

STEP	TEST CONDITION	REQUIRED RESULT	PROBABLE CAUSE FOR IMPROPER RESULT	CHECK OUT PROCEDURE
4.	Measure voltage between test points D and B.	Voltage should be 1.5 VDC.	Defective resistor R9, R8 R7 or R3; variable resistor R6; diode CR3; zener diode VR1.	Check components for proper rating.
5.	Measure voltage between test points E and B.	Voltage should be 22 VDC.	Defective resistor R5.  Defective transistor Q1.	Check resistor using ohmmeter.  Check transistor with a transistor checker or multimeter.
6.	Measure voltage between test points F and B.	Voltage should be 24 VDC.	Defective transistor Q2.  Defective resistor R10.	Check transistor with a transistor checker or multimeter.  Check resistor with a multimeter.
7.	Measure voltage between test points H and B.	Voltage should be zero.	Defective transistor Q3.  Defective resistor R10 or R11.	Check transistor with a transistor checker or multi-meter.  Check resistors with ohmmeter.

b. Secure relay, relay socket, and terminal strip in position and secure with screws, washers, and nuts.

c. After replacement of components on the printed circuit board, coat the board with protective coating, conforming to Military Specification MIL-I-46058, grade S, type PUR, 0.0050 minimum thickness. The coating shall be applied so that it anchors the components to the board. Terminals utilized for connection to external circuits shall not be coated.

13-19. **INSTALLATION.** Refer to figure 13-4 and install the load dumping relay as follows :

a. Connect load dumping relay (45) to frame (91) and secure with screws (44).

**NOTE**

Dummy load kit wiring diagrams is contained in the Operator and Organizational Maintenance Manual.

b. Connect electrical wiring to relay. Check wiring for proper connection.

c. Install cover (11) and secure with screws (9) and washers (10).

**13-20. CONTROL BOX.**

13-21. **REMOVAL,** Refer to figure 13-1 and remove control box as follows:

**WARNING**

Make sure dummy load kit is not connected to generator set prior to performing maintenance.

a. Disconnect cover (57) by removing screws (54), and washers (55 and 56).

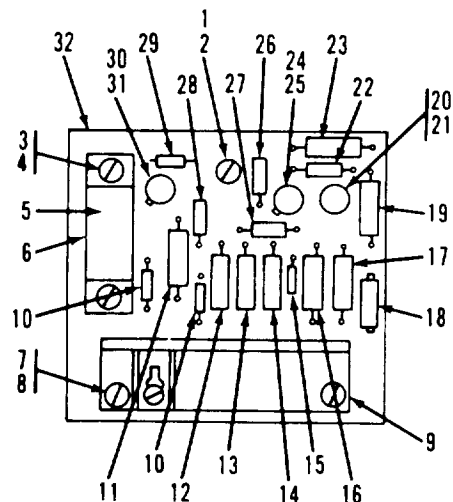


Figure 13-6. Dummy load kits load dumping relay (K5).

Legend to figure 13-6.

- |                    |                       |
|--------------------|-----------------------|
| 1. Screw           | 17. Resistor          |
| 2. Spacer          | 18. Variable resistor |
| 3. Screw (2)       | 19. Resistor          |
| 4. Lock washer (2) | 20. Transistor        |
| 5. Relay           | 21. Transistor pad    |
| 6. Relay socket    | 22. Resistor          |
| 7. Screw (2)       | 23. Resistor          |
| 8. Spacer (2)      | 24. Transistor        |
| 9. Terminal board  | 25. Transistor pad    |
| 10. Diode (2)      | 26. Resistor          |
| 11. Resistor       | 27. Resistor          |
| 12. Capacitor      | 28. Resistor          |
| 13. Resistor       | 29. Diode             |
| 14. Resistor       | 30. Transistor        |
| 15. Diode          | 31. Transistor pad    |
| 16. Zener diode    | 32. Board             |

b. Tag and disconnect frame harness wires from control box components.

c. Disconnect control box (63) from frame (70) by removing screws (58) and washers (59 and 60).

13-22. DISASSEMBLY. Refer to figure 13-4 and disassemble control box in the order of index number assigned. Pay particular attention to the following.

NOTE

Disassemble control box only to the extent necessary to effect repair.

- a. Remove cover (11). Tag and disconnect harness (51) wires from components.
- b. Disassemble load dumping relay as specified in paragraph 13-14, only after performing test specified in paragraph 13-13.
- c. To remove leads (20) from capacitors (24), remove screws and washers securing leads to capacitor terminal.
- d. Tag lead (37) with location prior to removal to insure proper reassembly.
- e. Remove nut (12), screw (13) and washer (14). Remove contactor (15) from control box.

NOTE

Steps f. through h. deleted.

- i. Note position of rear links (82) prior to removal to insure proper reassembly.

13-23. CLEANING.

- a. Clean electrical components with a clean lint-free cloth moistened in an approved cleaning solvent and dry thoroughly.

WARNING

Cleaning Solvents are flammable and moderately toxic to skin, eyes and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

- b. Clean metal parts in an approved cleaning solvent and dry thoroughly.

13-24. INSPECTION.

- a. Inspect harness wires for defective or loose terminal lugs and defective insulation. Check each wire for continuity, refer to figure 13-7. Check connects for bent, loose, or missing pins and for shorts from case to pins and pins to surrounding pins.

NOTE

Figure 1-31 is the dummy load kit schematic.

- b. Check switches and light assembly for continuity.

13-25. TEST.

- a. Test for continuity between contractors K1, K2, K3, and K4 terminals L1 to T1, L2 to T2, and L3 to T3; there should not be continuity. Connect a 24 VDC  $\pm$  4 volt, 5 ampere power supply and 0 - 5 ampere ammeter to contactor terminals C1 and C3. Turn on power supply and observe ammeter. Ammeter should indicate 4.5 amperes pull-in current and 0.9 amperes holding current. Check for continuity between terminals L1 to T1, L2 to T2, and L3 to T3; there should be continuity. Turn off power supply.

- b. Test resistance of transformer windings. Check between terminals 1 and 2, 3 and 4, and 5 and 6; resistance should be 6.5, 7, and 0.06 ohms respectively. Check

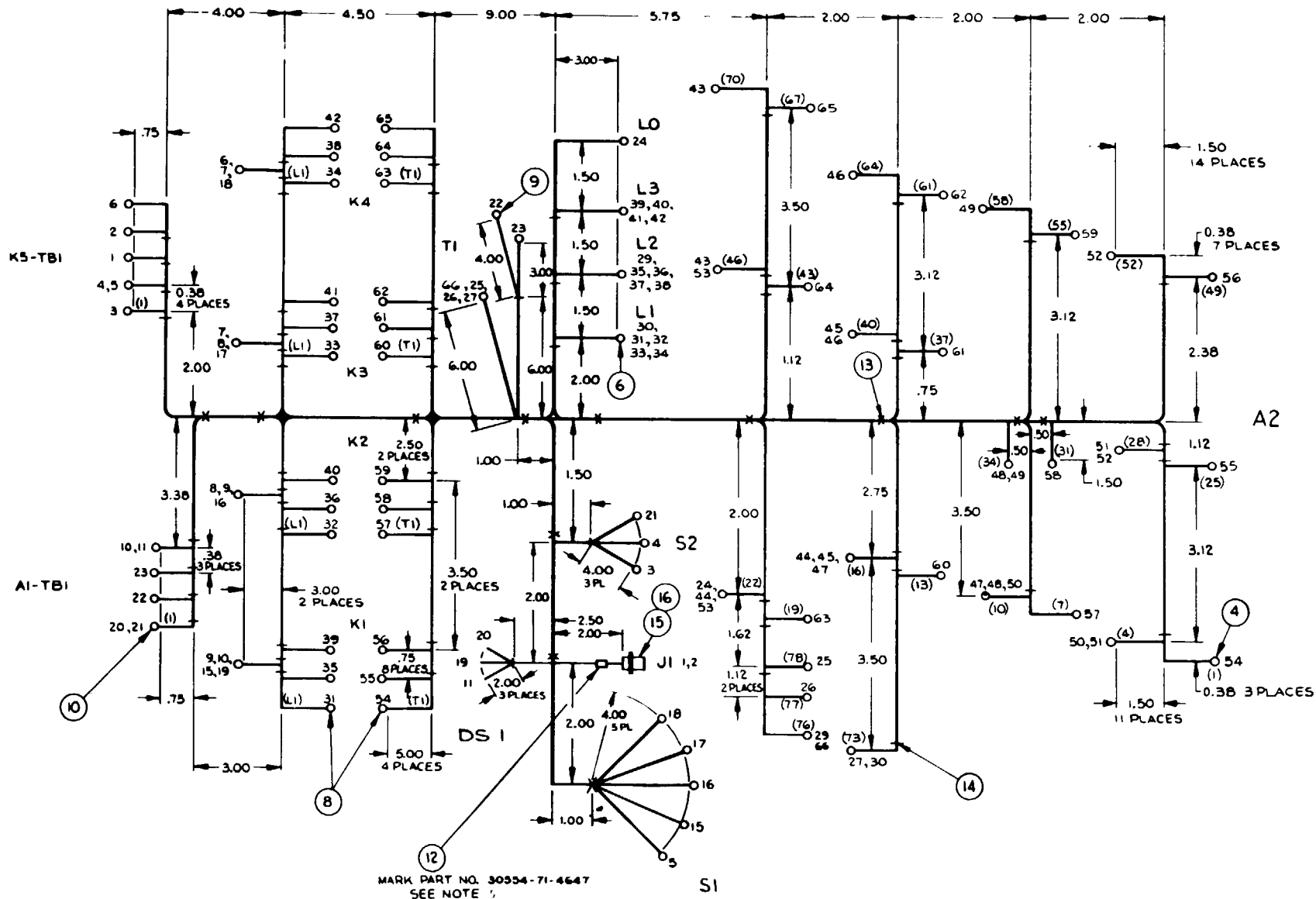


Figure 13-7. Dummy load kit control box harness (sheet 1 of 3)

WIRE NO.	WIRE MARKING		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LO REF
	IDENTIFICATION COLOR	NUMBER					
1	BLACK	V340A1E	J1-A		K5TB1-3	10	28.00
2		V341A1E	J1-B		K5TB1-4	10	29.00
3		P342A1E	K5TB1-1	10	S2-1	10	30.00
4		P343A1E	K5TB1-2	10	S2-3	10	30.00
5		P343B1E	K5TB1-2	10	S1-11	10	26.00
6		P344A1E	K5TB1-5	10	K4-C3	10	6.00
7		P344B1E	K4-C3	10	K3-C3	10	6.00
8		P344C1E	K3-C3	10	K2-C3	10	8.50
9		P344D1E	K2-C3	10	K1-C3	10	6.00
10		P344E1E	K1-C3	10	A1TB1-4	10	6.50
11		P344F1E	A1TB1-4	10	DS1-1	-	23.00
12							
13							
14							
15		P345A1E	S1-15	10	K1-C1	10	18.00
16		P346A1E	S1-25	10	K2-C1	10	23.00
17		P347A1E	S1-35	10	K3-C1	10	28.00
18		P348A1E	S1-45	10	K4-C1	10	31.00
19		P345B1E	K1-C1	10	DS1-2	-	23.00
20		P349A1E	A1TB1-1	10	DS1-3	-	23.00
21		P349B1E	S2-2	10	A1TB1-1	10	24.00
22		X350A1E	T1-5	9	A1TB1-1	10	14.00
23		X351A1E	T1-6	9	A1TB1-3	10	15.00
24		X352A1E	L0	6	A2-22	4	10.00
25		X353A1E	T1-1	9	A2-78	11	18.00
26		X354A1E	T1-4	9	A2-77	11	19.00
27		X355A1E	T1-3	9	A2-73	11	19.00
28							
29		X357F1E	A2-76	11	L2	7	14.00
30		X355B1E	A2-73	11	L1	7	12.00
31		X355C1E	L1	6	K1-L1	8	24.00
32		X355D1E	L1	6	K2-L1	8	21.00
33		X355E1E	L1	6	K3-L1	8	18.00

WIRE NO.	WIRE MARKING		FROM	TERMIN FIND NO.	TO	TERMIN FIND NO.	LO REF
	IDENTIFICATION COLOR	NUMBER					
34		X355F1E	L1	6	K4-L1	8	21.00
35		X357A1E	L2	6	K1-L2	8	24.50
36		X357B1E	L2	6	K2-L2	8	21.50
37		X357C1E	L2	6	K3-L2	8	20.00
38		X357D1E	L2	6	K4-L2	8	23.00
39		X358A1E	L3	6	K1-L3	8	25.00
40		X358B1E	L3	6	K2-L3	8	22.00
41		X358C1E	L3	6	K3-L3	8	21.50
42		X358D1E	L3	6	K4-L3	8	25.00
43		X352K1E	A2-46	4	A2-70	4	5.50
44		X352D1E	A2-22	4	A2-16	4	2.50
45		X352E1E	A2-16	4	A2-40	4	9.00
46		X352F1E	A2-40	4	A2-64	4	9.00
47	BLACK	X352H1E	A2-16	4	A2-10	4	2.50
48	BLACK	X352J1E	A2-10	4	A2-34	4	13.50
49		X352K1E	A2-34	4	A2-58	4	10.00
50		X352L1E	A2-10	4	A2-4	4	2.50
51		X352M1E	A2-4	4	A2-28	4	6.00
52		X352N1E	A2-28	4	A2-52	4	6.00
53		X352B1E	A2-22	4	A2-46	4	5.50
54		X359A1E	K1-T1	8	A2-1	4	28.00
55		X360A1E	K1-T2	8	A2-25	4	27.00
56		X361A1E	K1-T3	8	A2-49	4	28.00
57		X362A1E	K2-T1	8	A2-7	4	23.00
58		X363A1E	K2-T2	8	A2-31	4	22.00
59		X364A1E	K2-T3	8	A2-55	4	26.00
60		X365A1E	K3-T1	8	A2-13	4	19.00
61		X366A1E	K3-T2	8	A2-37	4	20.00
62		X367A1E	K3-T3	8	A2-61	4	22.00
63		X368A1E	K4-T1	8	A2-19	4	20.00
64		X369A1E	K4-T2	8	A2-43	4	20.00
65	BLACK	X370A1E	K4-T3	8	A2-67	4	23.00
66	BLACK	X357E1E	A2-76	11	T1-2	9	25.00

Figure 13-7. Dummy load kit control box harness (sheet 2 of 3)

insulation resistance using a 500 volt megger, resistance should be greater than 1 megohm. Connect a 50, 60, or 400 hertz 0.5 ampere power supply to terminals 1 and 2 of transformer. Connect a 0-3 ampere ammeter in series with power supply and terminal 1. Connect a 0-50 VAC voltmeter across transformer terminals 5 and 6. Turn on power supply, ammeter should indicate less than 0.05 amperes and

voltmeter should indicate 35 volts. Connect power supply and ammeter to terminals 3 and 4 with ammeter in series with terminal 3. Turn on power supply, ammeter should indicate less than 0.05 amperes and voltmeter should indicate 35 volts, Remove test equipment from transformer.

c. Test forward and reverse resistance of diodes. Measured from anode (t)

17			SN60WRAP2	AR	SOLDER, LEAD-TIN ALLOY, ROSIN CORE	QQ-S-571	
16			MS3102R10SL-3P	1	CONNECTOR, RECEPTACLE		
15			TYPE F, FORM Ua GRADE A, CL1 CATEGORY 1	2	TUBING, INSULATION .106 I. D. X .016 WALL X .62 LG	MIL-1-631	
14			MS3367-4-9	56	STRAP, TIEDOWN		NYLON
13			MS3367-1-9	12	STRAP, TIEDOWN		NYLON
12			MS39020-1	1	BAND, MARKER		AL ALY
11			MS25036-109	6	TERMINAL, LUG, CRIMP STYLE		
10			MS25036-106	33	TERMINAL, LUG, CRIMP STYLE		
9			MS25036-153	6	TERMINAL, LUG, CRIMP STYLE		
8			MS25036-112	24	TERMINAL, LUG, CRIMP STYLE		
7			MS25036-155	2	TERMINAL, LUG, CRIMP STYLE		
6			MS25036-158	13	TERMINAL, LUG, CRIMP STYLE		
5							
4			MS25036-113	35	TERMINAL, LUG, CRIMP STYLE		
3			MS086/2-12-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
2			MS086/2-16-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
1			MS086/2-10-9	AR	WIRE, ELECTRICAL	MIL-W-5086/2	
FIND NO	CODE IDENT	DWG SIZE	PART OR IDENTIFYING NO	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL

WIRE LENGTH TOLERANCES		
OVER	INCL.	TOL. ±
0	.50	.12
.50	2	.19
2	6	.25
6	12	.38
12	36	.50
36	100	1
100	200	1.50
200	UP	2

NOTES:

1. ALL CONDUCTOR ENDS TO BE STRIPPED BACK .25 INCH AND TINNED BEFORE ASSEMBLY.
2. USE SOLDER, FIND NO.17 ,
3. CABLE STRAPS, FIND NO.13 AND 14 , SHALL BE SPACED AT APPROX. 3.00 APART UNLESS OTHERWISE SPECIFIED.
4. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-W-5088, EXCEPT THAT INTERVALS SHALL NOT EXCEED 6.00 IN.
5. PART NO. MARKING TO BE METAL STAMPED IN ACCORDANCE WITH MIL-STD-130

Figure 13-7. Dummy load kit control box harness (sheet 3 of 3)

to cathode (-), value should be low. Reverse meter leads, value should be infinity.

d. Test load dumping relay K5 as specified in paragraph 13-13.

e. Inspect parts for cracks, breaks, distortion and dents.

f. Inspect threads for damage.

13-26. REPAIR.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and air-borne particles. Welding goggles, with proper tinted lenses, apron or jacket and welder's boots are required.

- a. Repair cracked metal parts by welding.
- b. Straighten damaged or distorted sheet metal parts using suitable tools.
- c. Repair wiring harness as specified in figure 13-7.

13-27. WIRING HARNESS REBUILD. Re-build dummy load kit control box harness as specified in figure 13-7.

13-28. REASSEMBLY. Refer to figure 13-4 and reassemble control box assembly in the reverse order of index numbers as s i g n e d . Pay particular attention to the following.

a. Reassemble load dumping relay (45) as specified in paragraph 13-18.

b. When installing links (79), set links for desired voltage output, refer to Operator and Organizational Maintenance Manual.

NOTE

Steps c. through g. deleted.

NOTE

Dummy load kit wiring diagram is contain in Operator and Organizational Maintenance Manual.

h. Prior to installing cover (11) check harness (51) wires and rear links (82) for proper connection.

i. Coat all solder connections with-fungus resistant varnish conforming to Military Specification MIL-U-173B prior to installing cover (n).

13-29. INSTALLATION. Refer to figure 13-1 and install control box as follows.

NOTE

Control box cover must be removed prior to installation.

a. Position panel (62), firewall (61), and control box (63) on frame (70) and secure with screws (58) and washers (59 and 60).

NOTE

Dummy load bank wiring diagram is contain in Operator and Organizational Maintenance Manual.

b. Connect frame harness wires to control box components. Check wires for proper connection.

c. Install cover (57) and secure switch screws (54) and washers (55 and 56).

All data on pages 14-1 through 14-8, including figures 14-1 and 14-2 deleted.



APPENDIX A

REFERENCES

A-1. FIRE PROTECTION.

TB5-4200-200-10 Hand Portable Fire Extinguisher Approved for Army Users

A-2. LUBRICATION.

C91001L Fuels, Lubricants, Oils and Waxes

L05-6115-458-I.2 End Item Lubrication Order

A-3. PAINTING.

T.O. 35-1-3 Painting and Marking of USAF Aerospace Ground Equipment

TM 9-213 Painting Instructions for Field Use

A-4. RADIO SUPPRESSION.

MIL-STD-461 Radio Interference Suppression

TM 11-483 Radio Interference Suppression

A-5. MAINTENANCE.

T.O. 00-25-225 Repair of External Power Cables, Aerospace Ground Equipment

T.O. 00-25-234 General Shop Practice Requirements for the Repair, Maintenance and Test of Electronic Equipment

T.O. 1-1-1 Cleaning of Aerospace Equipment

T.O.1-1A-14 Installation Practices for Aircraft Electric and Electronic Wiring

T.O. 1-1A-15 General Maintenance Instruction for Support Equipment

T.O. 31-1-75 General Maintenance Practices

T.O. 35-1-11 Organization, Intermediate and Depot Level Maintenance for FSC 6115 Non-Airborne Equipment

T.O. 35-1-12 Compounds and Procedures for Cleaning Aerospace Ground Equipment

T.O. 35-1-26 Repair/Replacement Criteria for FSC 6115 Aerospace Ground Equipment

T.O. 35-1-524	USAF Equipment Registration Number System Applicable to FSC 6115 Equipment
TM 9-1870-1	Care and Maintenance of Pneumatic Tires
TB ORD 651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
TM 38-750	The Army Maintenance Management System.
TM 5-6115-458-12	Operator and Organizational Maintenance Manual
TM 5-6115-458-35	Intermediate (Field) (Direct and General Support) and Depot Maintenance Manual
TM 5-6115-458-25P	Organizational, Intermediate (Field) (Direct Support and General Support) and Depot Maintenance Repair Parts and Special Tools Lists
TM 9-2920-232-34	Starter Motor Field Maintenance Manual
TM 9-6140-200-15	Operation and Organizational Field and Depot Maintenance Storage Batteries, Lead Acid Type
TM 5-764	Electric Motor and Generator Repair
MIL-HDBK-705	Military Standardization Handbook, Generator Sets, Electrical Measurements and Instruments
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-I-25135	Inspection Materials, Penetrant
MIL-STD-120	Gauge Inspection
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-705	Generator Sets, Engine-Driven Methods of Test and Instructions
MIL-STD-1261 (MR)	Welding Procedures for Construction Steels
MIL-T-27730	Tape, Antiseize, Polytetrafluoroethylene, with Dispenser
MS 33540	Safety Wiring and Cotter Pinning, General Practices for

A-6. SHIPMENT AND STORAGE.

T.O. 35-1-4	Processing and Inspection of Aerospace Ground Equipment for Storage and Shipment
T. O. 38-1-5	Processing and Inspection of Non-Mounted, Non-Aircraft Gasoline and Diesel Engines for Storage and Shipment
TB 740-90-1	Administrative Storage of Equipment

TB 740-93-2	Preservation of USAM EC Mechanical Equipment for Shipment and Storage
TM 38-230	Preservation, Packaging and Packing of Military Supplies and Equipment
MIL-S-207	Sulfuric Acid, Electrolyte: Packaging, Packing, and Marking for Shipment and Storage of

A-7. DESTRUCTION OF MATERIEL.

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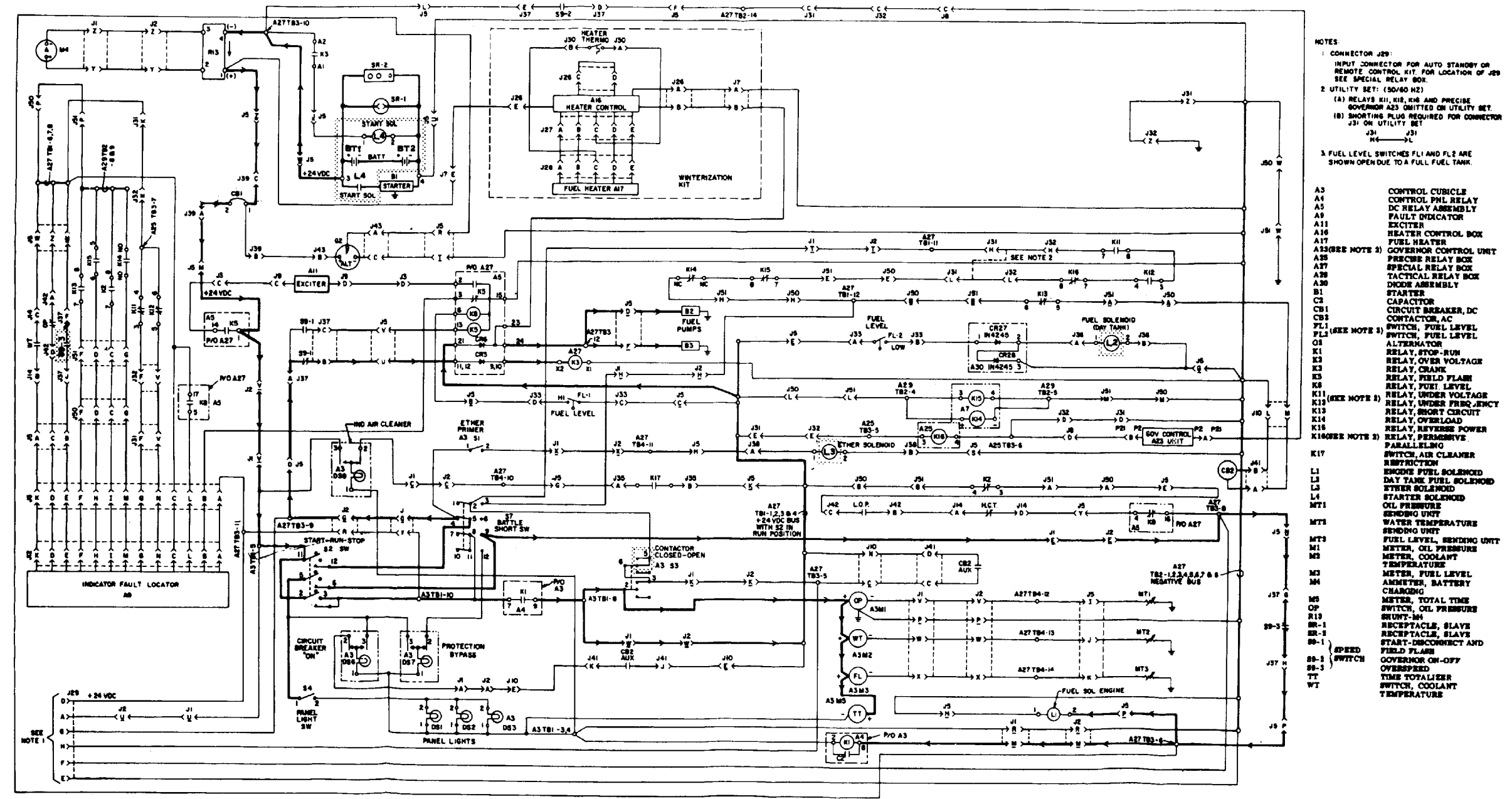
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**To be distributed in accordance with DA Form 12-25D, direct end general support maintenance requirements for Generator Sets: 60KW, 60 HZ Precise Power, 60 KW, 400 HZ Precise Power, 60 KW, 60 HZ Utility.**

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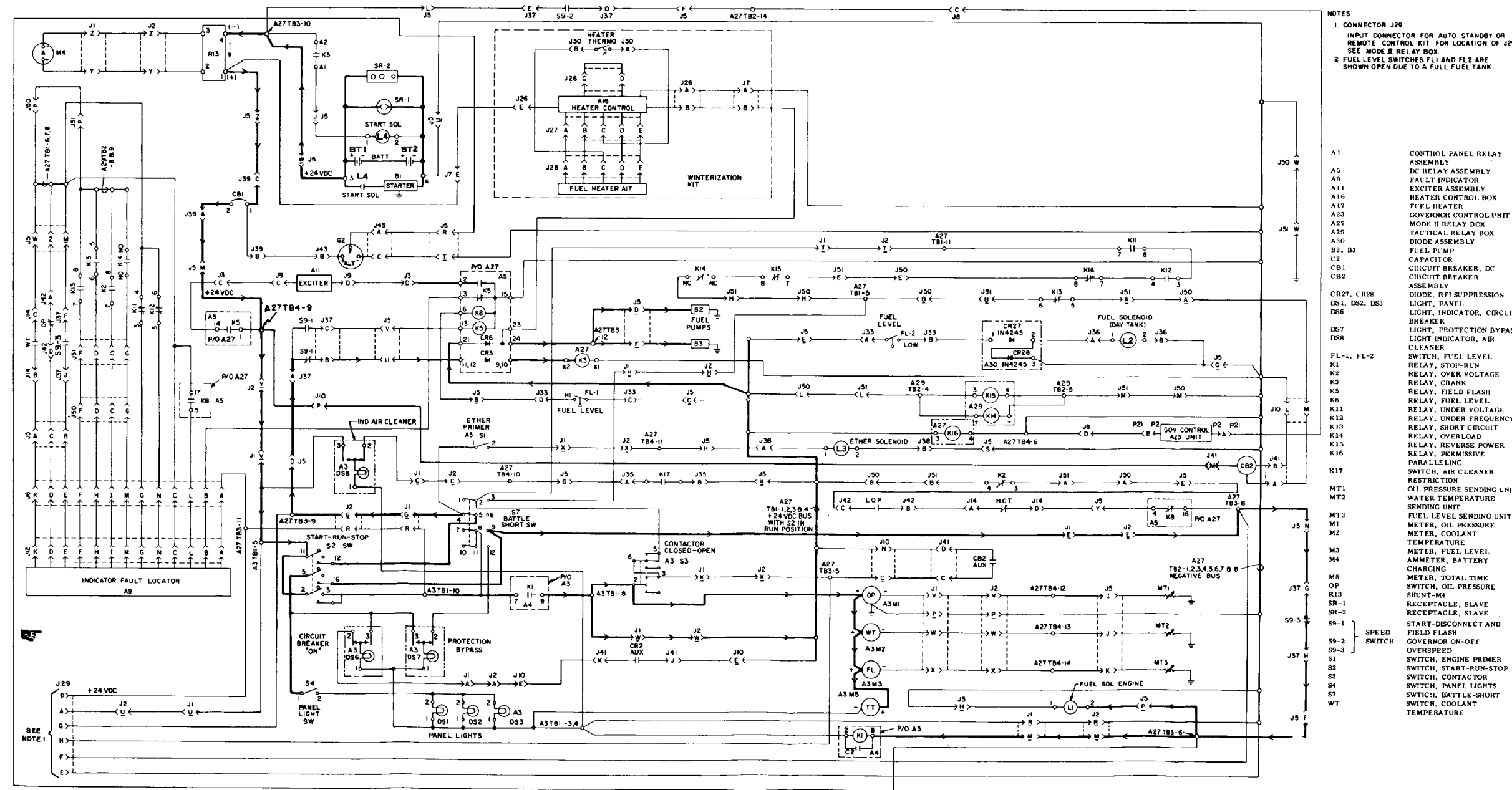




NOTES:  
 1. CONNECTOR J26:  
 INPUT CONNECTOR FOR AUTO STANDBY OR  
 REMOTE CONTROL KIT. FOR LOCATION OF J26  
 SEE SPECIAL RELAY BOX.  
 2. UTILITY SET: (50/60 HZ)  
 (A) RELAYS K11, K12, K16 AND PRECISE  
 GOVERNOR A23 OMITTED ON UTILITY SET.  
 (B) SHORTING PLUG REQUIRED FOR CONNECTOR  
 J31 ON UTILITY SET.  
 3. FUEL LEVEL SWITCHES FL1 AND FL2 ARE  
 SHOWN OPEN DUE TO A FULL FUEL TANK.

- A3 CONTROL CUBICLE
- A4 CONTROL PNL RELAY
- A5 DC RELAY ASSEMBLY
- A9 FAULT INDICATOR
- A11 EXCITER
- A16 HEATER CONTROL BOX
- A17 FUEL HEATER
- A18 (SEE NOTE 2) GOVERNOR CONTROL UNIT
- A23 PRECISE RELAY BOX
- A27 SPECIAL RELAY BOX
- A28 TACTICAL RELAY BOX
- A30 DDCM ASSEMBLY
- B1 STARTER
- C2 CAPACITOR
- CB1 CIRCUIT BREAKER, DC
- CB2 CONTACTOR, AC
- FL1 (SEE NOTE 3) SWITCH, FUEL LEVEL
- FL2 (SEE NOTE 3) SWITCH, FUEL LEVEL
- O1 ALTERNATOR
- K1 RELAY, STOP-RUN
- K2 RELAY, OVER VOLTAGE
- K3 RELAY, ORANGE
- K5 RELAY, FIELD FLAMM
- K6 RELAY, FUEL LEVEL
- K11 (SEE NOTE 2) RELAY, UNDER VOLTAGE
- K12 RELAY, UNDER P/BQ, ENCY
- K13 RELAY, SHORT CIRCUIT
- K14 RELAY, OVERLOAD
- K16 RELAY, REVERSE POWER
- K18 RELAY, PERMISSIVE
- K17 (SEE NOTE 2) PARALLELING SWITCH, AIR CLEANER
- L1 RESISTOR, FUEL SOLENOID
- L2 RESISTOR, FUEL SOLENOID
- L3 RESISTOR, FUEL SOLENOID
- L4 RESISTOR, FUEL SOLENOID
- MT1 STARTER SOLENOID
- MT2 OIL PRESSURE SENDING UNIT
- MT3 WATER TEMPERATURE SENDING UNIT
- MT4 FUEL LEVEL, SENDING UNIT
- MT5 METER, OIL PRESSURE
- M1 METER, COOLANT TEMPERATURE
- M2 METER, FUEL LEVEL
- M3 AMMETER, BATTERY CHARGING
- M4 METER, TOTAL TIME
- OP SWITCH, OIL PRESSURE
- R19 RECEPTACLE, SLAVE
- SR-1 RECEPTACLE, SLAVE
- SR-2 START-DISCONNECT AND FIELD FLAMM GOVERNOR ON-OFF
- SS-1 OVERSPEED
- SS-2 TIME TOTALIZER
- TT SWITCH, COOLANT TEMPERATURE
- WT

Figure 1-2. 50/60 Hertz DC system schematic



- NOTES:  
 1. CONNECTOR J29: INPUT CONNECTOR FOR AUTO STANDBY OR REMOTE CONTROL KIT FOR LOCATION OF J29. SEE MODE II RELAY BOX.  
 2. FUEL LEVEL SWITCHES FL1 AND FL2 ARE SHOWN OPEN DUE TO A FULL FUEL TANK.
- A1 CONTROL PANEL RELAY ASSEMBLY
  - A5 DC RELAY ASSEMBLY
  - A9 FAULT INDICATOR
  - A11 EXCITER ASSEMBLY
  - A16 HEATER CONTROL BOX
  - A17 FUEL HEATER
  - A23 GOVERNOR CONTROL UNIT
  - A27 MODE II RELAY BOX
  - A29 TACTICAL RELAY BOX
  - A30 DIODE ASSEMBLY
  - B2, B3 FUEL PUMP
  - C2 CAPACITOR
  - CB1 CIRCUIT BREAKER, DC
  - CB2 CIRCUIT BREAKER ASSEMBLY
  - CR27, CR28 DIODE, RFI SUPPRESSION
  - DS1, DS2, DS3 LIGHT, PANEL
  - DS6 LIGHT, INDICATOR, CIRCUIT BREAKER
  - DS7 LIGHT, PROTECTION BYPASS
  - DS8 LIGHT, INDICATOR, AIR CLEANER
  - FL-1, FL-2 SWITCH, FUEL LEVEL
  - K1 RELAY, STOP-RUN
  - K2 RELAY, OVER VOLTAGE
  - K3 RELAY, CRANK
  - K5 RELAY, FIELD FLASH
  - K8 RELAY, FUEL LEVEL
  - K11 RELAY, UNDER VOLTAGE
  - K12 RELAY, UNDER FREQUENCY
  - K13 RELAY, SHORT CIRCUIT
  - K14 RELAY, OVERLOAD
  - K15 RELAY, REVERSE POWER
  - K16 RELAY, PERMISSIVE PARALLELING
  - K17 SWITCH, AIR CLEANER RESTRICTION
  - MT1 OIL PRESSURE SENDING UNIT
  - MT2 WATER TEMPERATURE SENDING UNIT
  - MT3 FUEL LEVEL SENDING UNIT
  - M1 METER, OIL PRESSURE
  - M2 METER, COOLANT TEMPERATURE
  - M3 METER, FUEL LEVEL
  - M4 AMMETER, BATTERY CHARGING
  - M5 METER, TOTAL TIME
  - OP SWITCH, OIL PRESSURE SHUNT-M4
  - R13 RECEPTACLE, SLAVE
  - SR-1 RECEPTACLE, SLAVE
  - SR-2 RECEPTACLE, SLAVE
  - S9-1 START-DISCONNECT AND FIELD FLASH
  - S9-2 GOVERNOR ON-OFF
  - S9-3 OVERSPEED
  - S1 SWITCH, ENGINE PRIMER
  - S2 SWITCH, START-RUN-STOP
  - S3 SWITCH, CONTACTOR
  - S4 SWITCH, PANEL LIGHTS
  - S7 SWITCH, BATTLE-SHORT
  - WT SWITCH, COOLANT TEMPERATURE

Figure 1-3. 400 Hertz DC system schematic

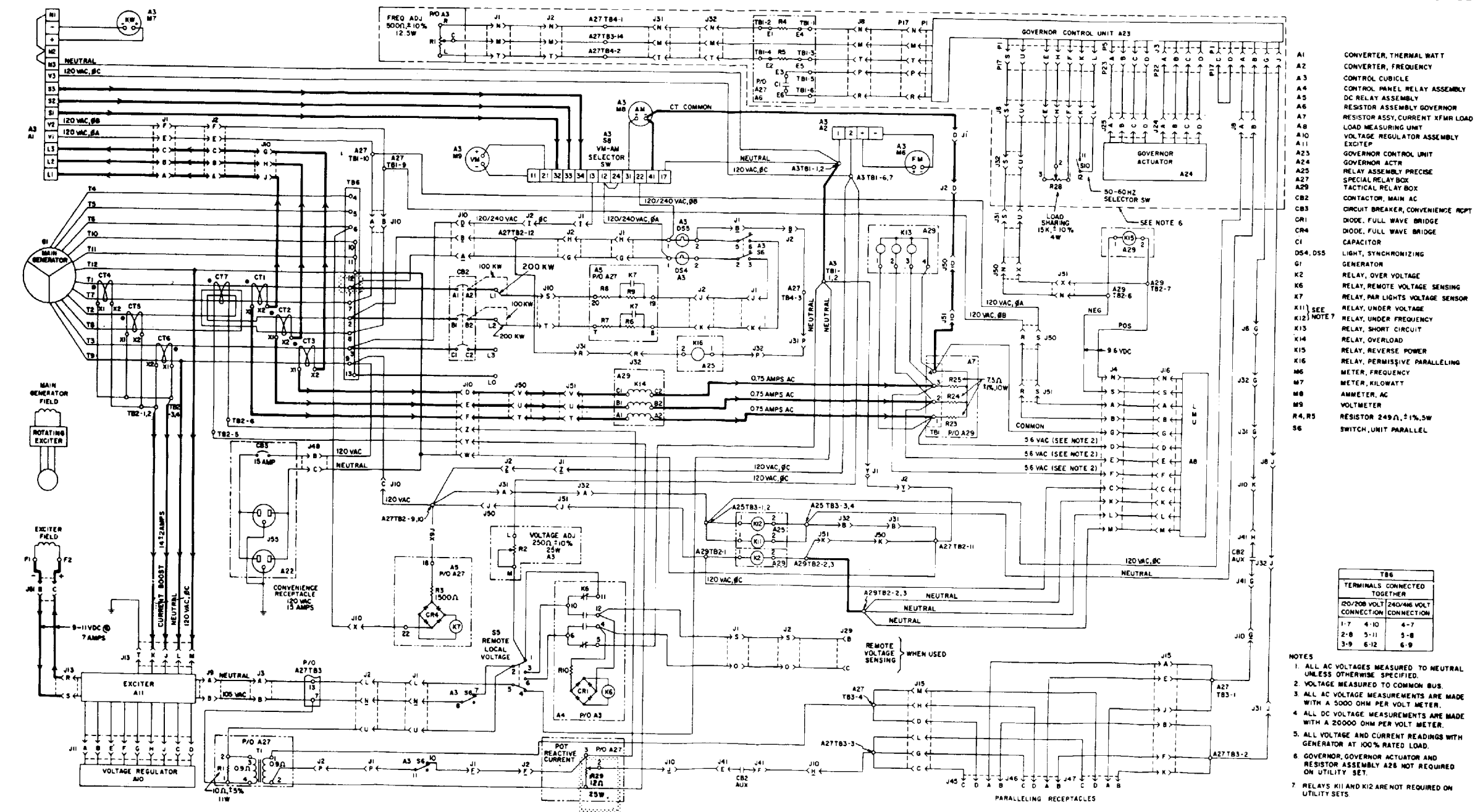
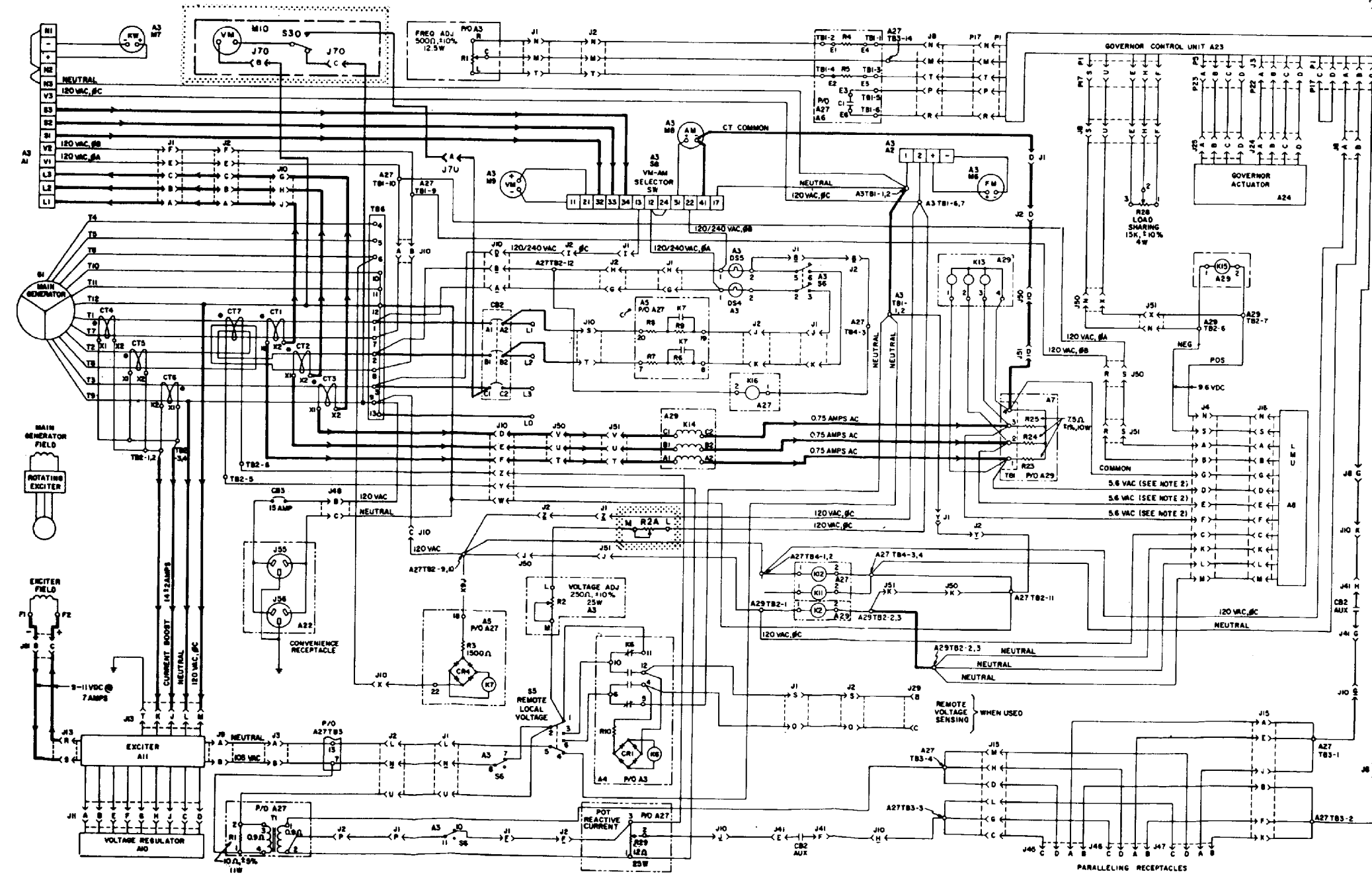


Figure 1-4. 50/60 Hertz AC system schematic



- A1 CONVERTER, THERMAL WATT
- A2 CONVERTER, FREQUENCY
- A3 CONTROL CUBICLE
- A4 CONTROL PANEL RELAY ASSY
- A5 DC RELAY ASSEMBLY
- A6 RESISTOR ASSEMBLY, GOVERNOR
- A7 RESISTOR ASSY, CURRENT XFMR LOAD
- A8 LOAD MEASURING UNIT
- A9 VOLTAGE REGULATOR ASSEMBLY
- A10 EXCITER ASSEMBLY
- A23 GOVERNOR CONTROL UNIT
- A24 GOVERNOR ACTUATOR
- A27 MODE II RELAY BOX
- A29 TACTICAL RELAY BOX
- CB2 CIRCUIT BREAKER ASSY, AC
- CB3 CIRCUIT BREAKER, CONVENIENCE REPT
- CR1 DIODE, FULL WAVE BRIDGE
- CR4 DIODE, FULL WAVE BRIDGE
- C1 CAPACITOR
- DS4, DS5 LIGHT, SYNCHRONIZING
- G1 GENERATOR
- K2 RELAY, OVER VOLTAGE
- K6 RELAY, REMOTE VOLTAGE SENSING
- K7 RELAY, PAR LIGHTS VOLTAGE SENSOR
- K11 RELAY, UNDER VOLTAGE
- K12 RELAY, UNDER FREQUENCY
- K13 RELAY, SHORT CIRCUIT
- K14 RELAY, OVERLOAD
- K15 RELAY, REVERSE POWER
- K16 RELAY, PERMISSIVE PARALLELING
- M6 METER, FREQUENCY
- M7 METER, KILOWATT
- M8 AMMETER, AC
- M9 VOLTMETER
- M10 VOLTMETER, EXPANDED SCALE
- R1 (A3) RHEOSTAT, FREQUENCY ADJUSTING
- R2 RHEOSTAT, VOLTAGE ADJUSTING
- R2A RHEOSTAT, VOLTAGE RANGE
- R3, R4, R5 RESISTOR
- R6, R7, R8 RESISTOR
- R9, R10, R23 RESISTOR
- R24, R25 RESISTOR
- R28 RHEOSTAT, LOAD SHARING
- R29 RHEOSTAT, REACTIVE CURRENT
- S5 SWITCH, LOCAL REMOTE VOLTAGE
- S6A, S6B SWITCH, UNIT PARALLEL
- S8 SWITCH, AMMETER-VOLTMETER XFR
- S30 SWITCH, EXPANDED SCALE VOLTMETER
- TB6 TERMINAL BOARD, RECONNECTION

TB6		
TERMINALS CONNECTED TOGETHER		
120/208 VOLT CONNECTION	240/480 VOLT CONNECTION	
1-7	4-10	4-7
2-8	5-11	5-8
3-9	6-12	6-9

- NOTES
1. ALL AC VOLTAGES MEASURED TO NEUTRAL UNLESS OTHERWISE SPECIFIED.
  2. VOLTAGE MEASURED TO COMMON BUS.
  3. ALL AC VOLTAGE MEASUREMENTS ARE MADE WITH A 3000 OHM PER VOLT METER.
  4. ALL DC VOLTAGE MEASUREMENTS ARE MADE WITH A 20000 OHM PER VOLT METER.
  5. ALL VOLTAGE AND CURRENT READINGS WITH GENERATOR AT 100% RATED LOAD.

Figure 1-5. 400 Hertz AC system schematic

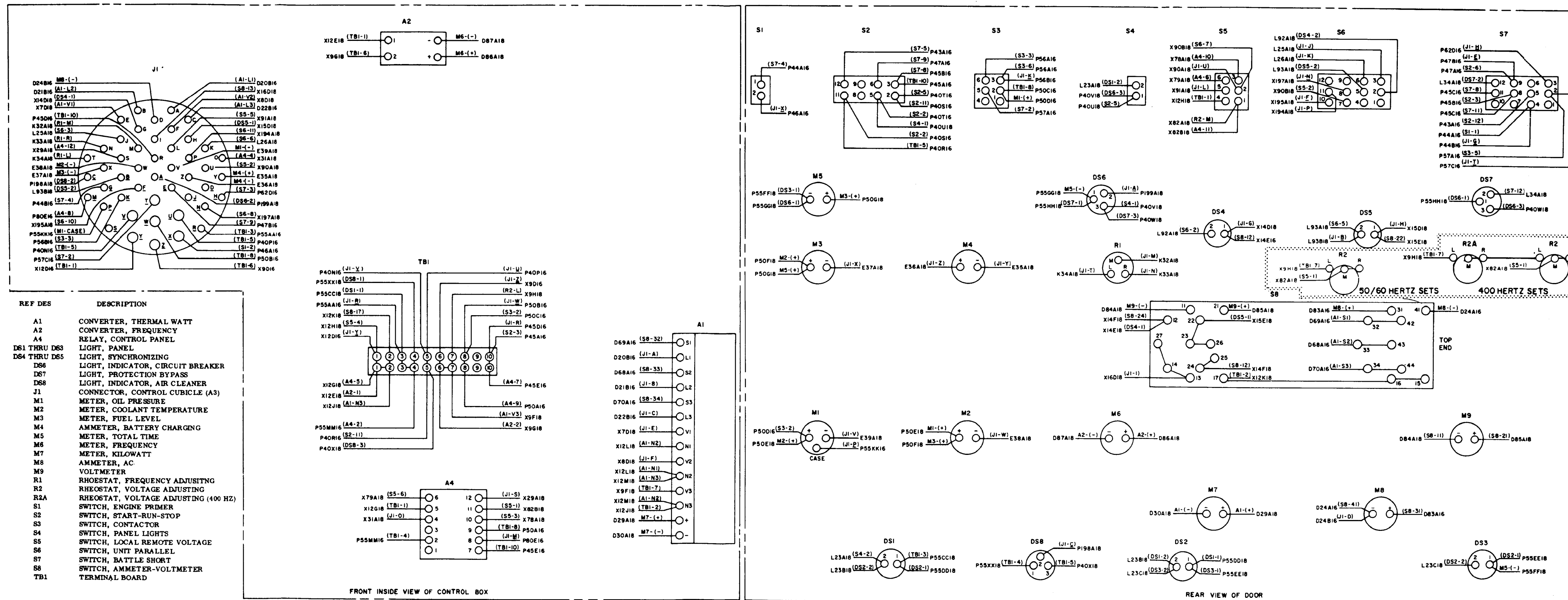
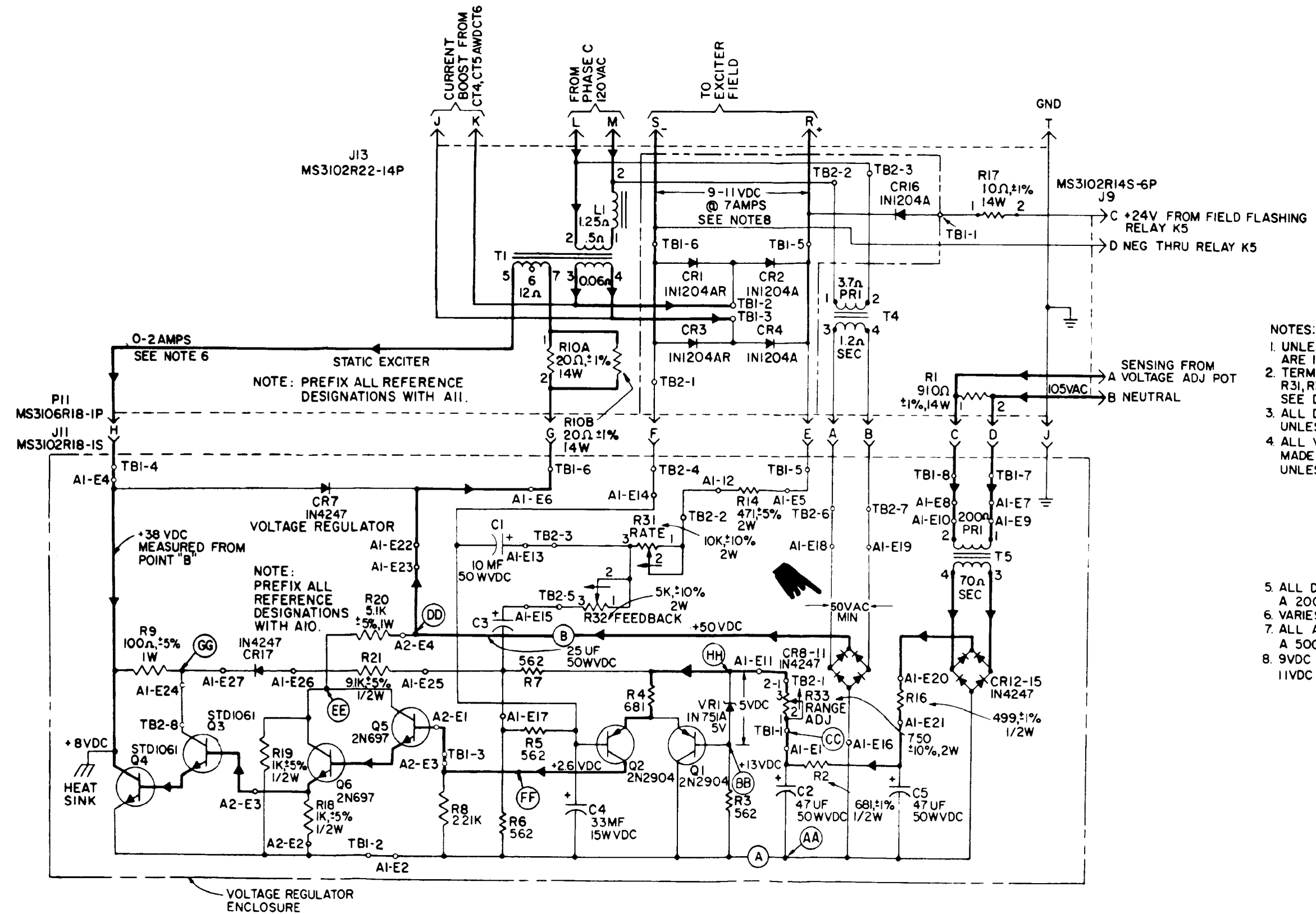


Figure 1-7. Control cubicle (A3) wiring diagram

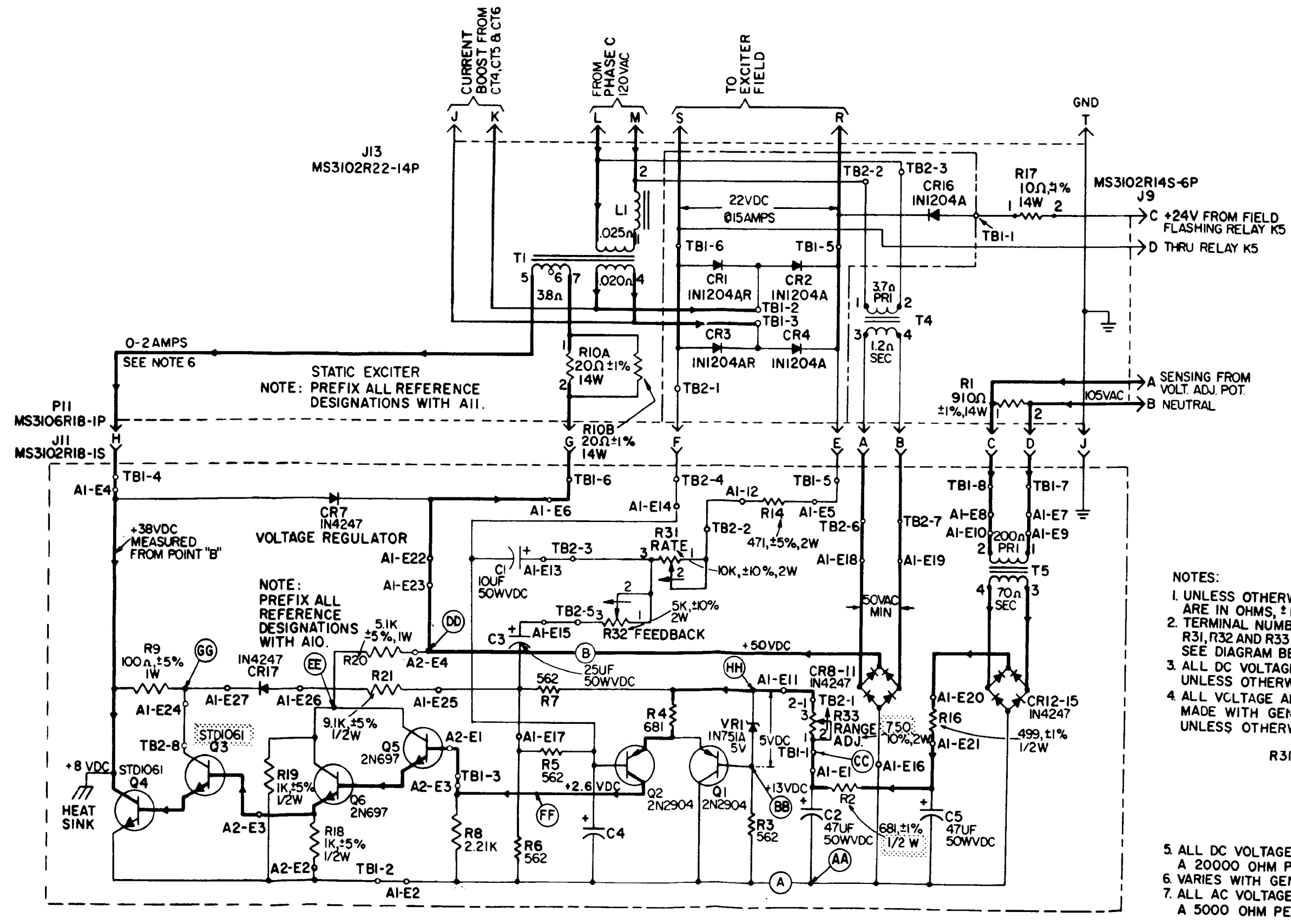


- NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS, ±1%, 1/4 WATT.
  2. TERMINAL NUMBERING FOR POTENTIOMETERS R31, R32 AND R33 ARE FOR REFERENCE ONLY SEE DIAGRAM BELOW.
  3. ALL DC VOLTAGES MEASURED TO POINT (A) UNLESS OTHERWISE SPECIFIED.
  4. ALL VOLTAGE AND CURRENT MEASUREMENTS MADE WITH GENERATOR AT 100% RATED LOAD UNLESS OTHERWISE SPECIFIED.
- R31, R32 AND R33

5. ALL DC VOLTAGE MEASUREMENTS ARE MADE WITH A 20000 OHM PER VOLT METER.
6. VARIES WITH GENERATOR LOAD.
7. ALL AC VOLTAGE MEASUREMENTS ARE MADE WITH A 5000 OHM PER VOLT METER.
8. 9VDC @ 7AMPS FOR 50/60HZ, 100KW SETS. 11VDC @ 7AMPS FOR 50/60HZ, 200KW SETS.

Figure 1-10. Exciter regulator (A10 and A11) 50/60 Hertz schematic





- NOTES:
- UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS,  $\pm 1\%$ , 1/4 WATT.
  - TERMINAL NUMBERING FOR POTENTIOMETERS R31, R32 AND R33 ARE FOR REFERENCE ONLY SEE DIAGRAM BELOW.
  - ALL DC VOLTAGES MEASURED TO POINT (A) UNLESS OTHERWISE SPECIFIED.
  - ALL VOLTAGE AND CURRENT MEASUREMENTS MADE WITH GENERATOR AT 100% RATED LOAD UNLESS OTHERWISE SPECIFIED.
- R31, R32 AND R33
- Figure 1-12. Exciter regulator (A10 and A11) 400 Hertz schematic



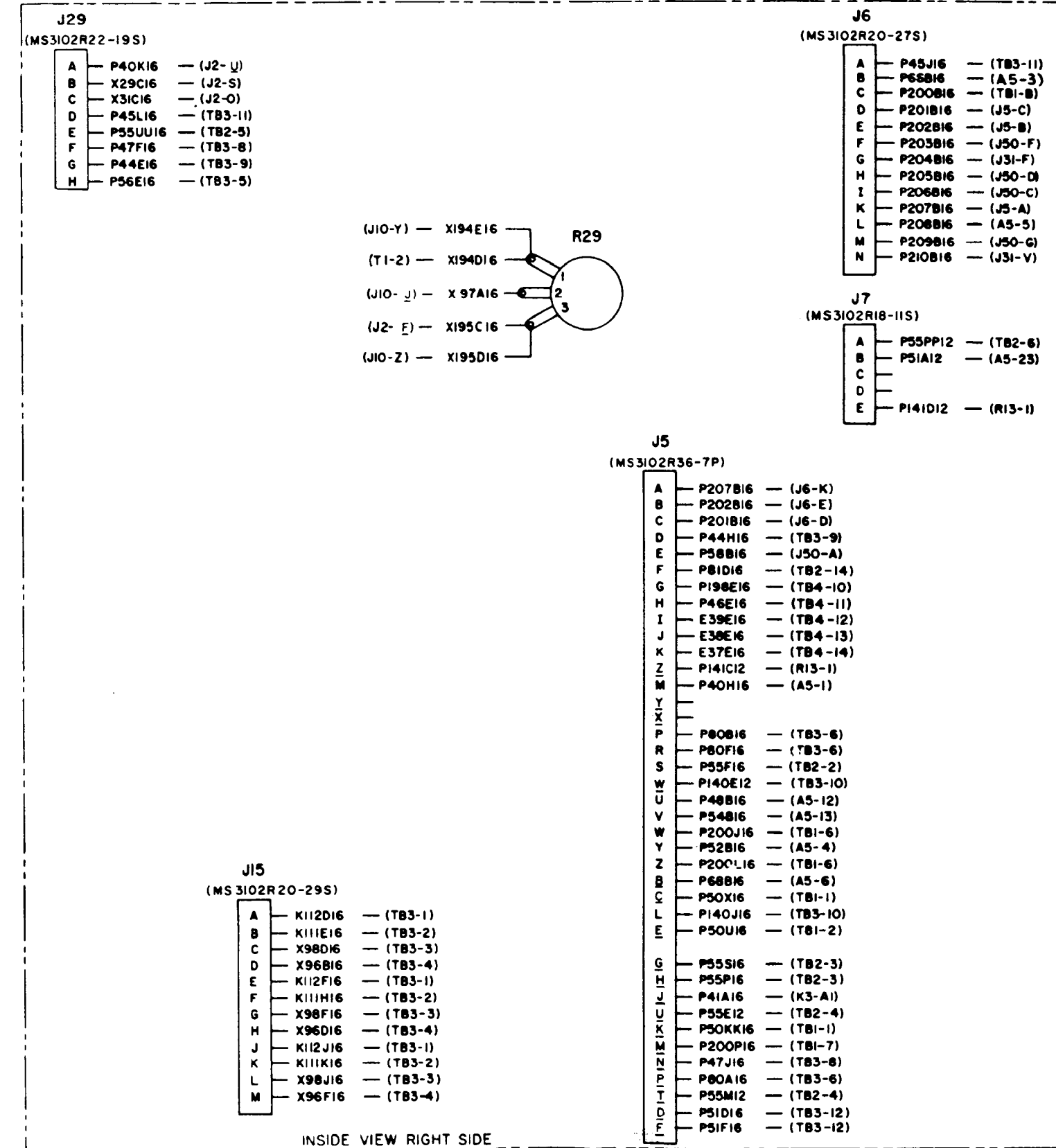
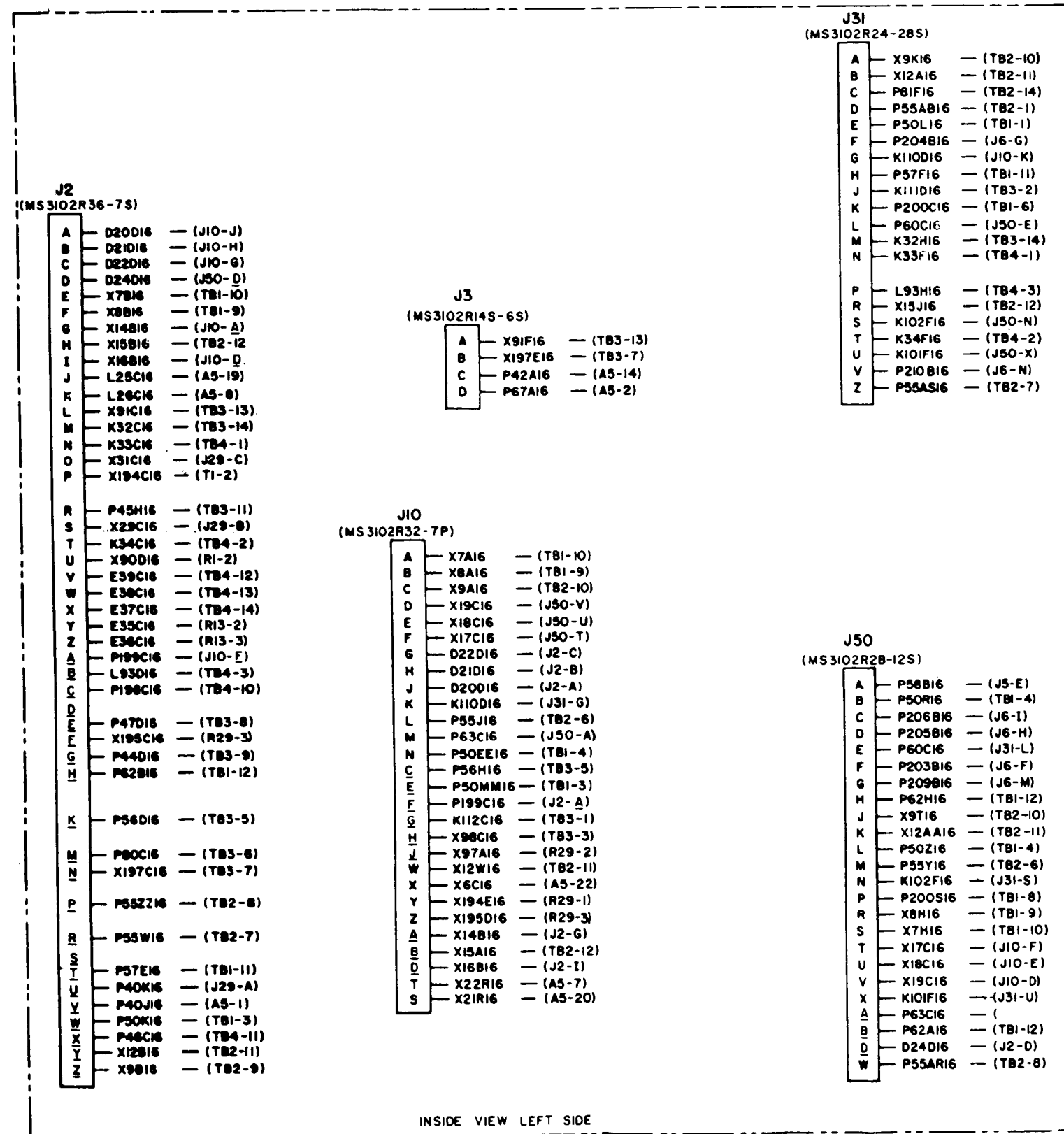
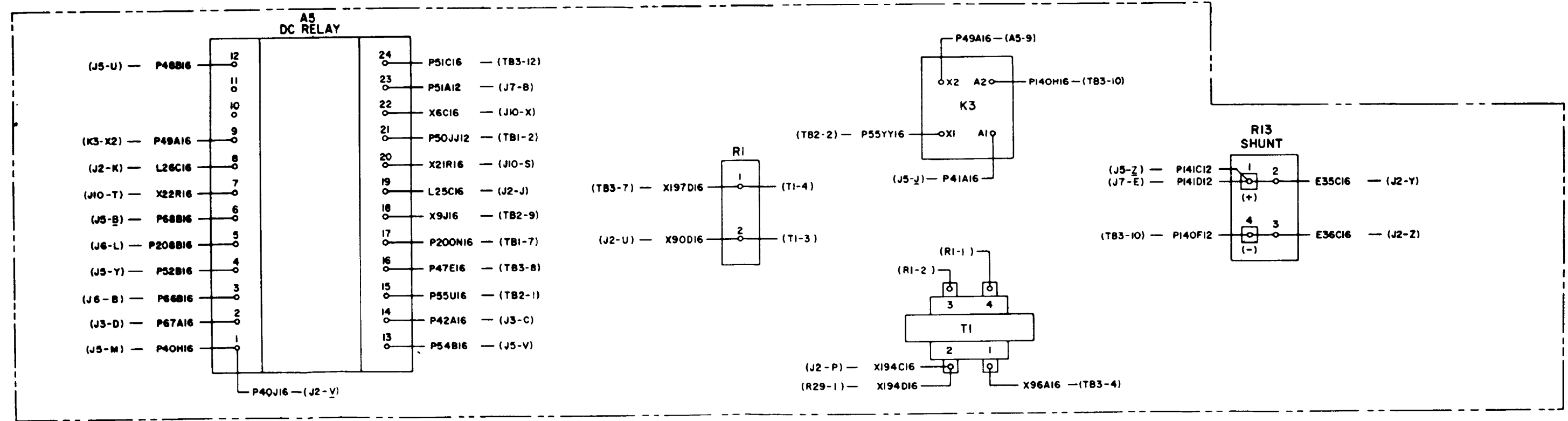
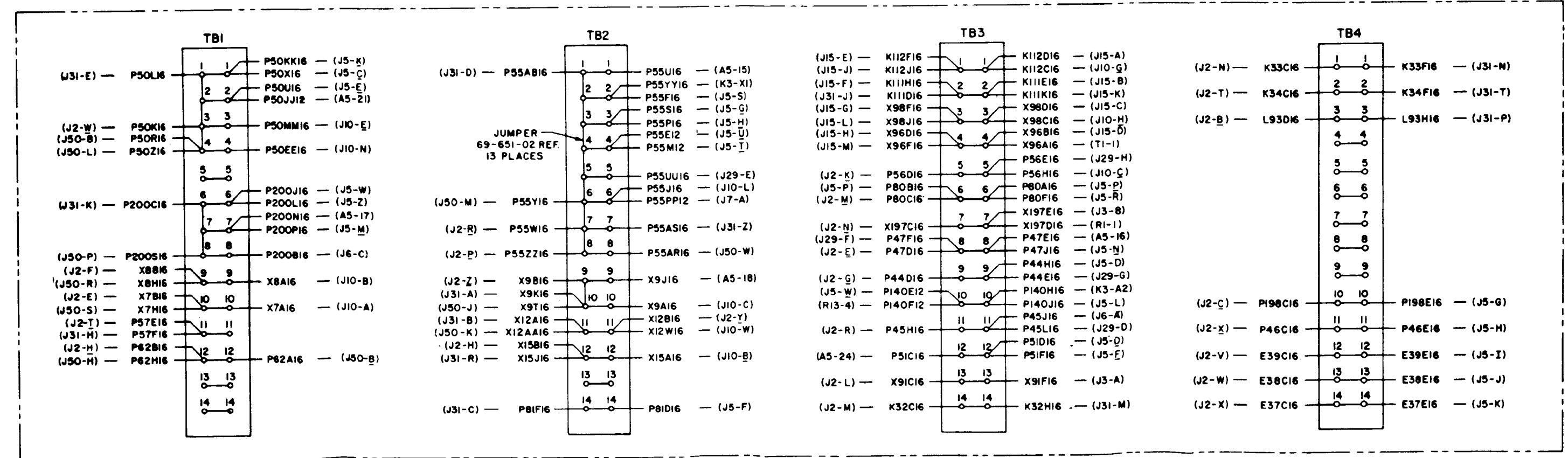


Figure 1-15. Mode I relay box (A27) wiring diagram 50/60 Hertz generator sets (sheet 1 of 2)



INSIDE VIEW REAR PANEL



INSIDE VIEW, FORWARD PANEL

Figure 1-15. Mode I relay box (A27) wiring diagram 50/60 Hertz generator sets (sheet 2 of 2)

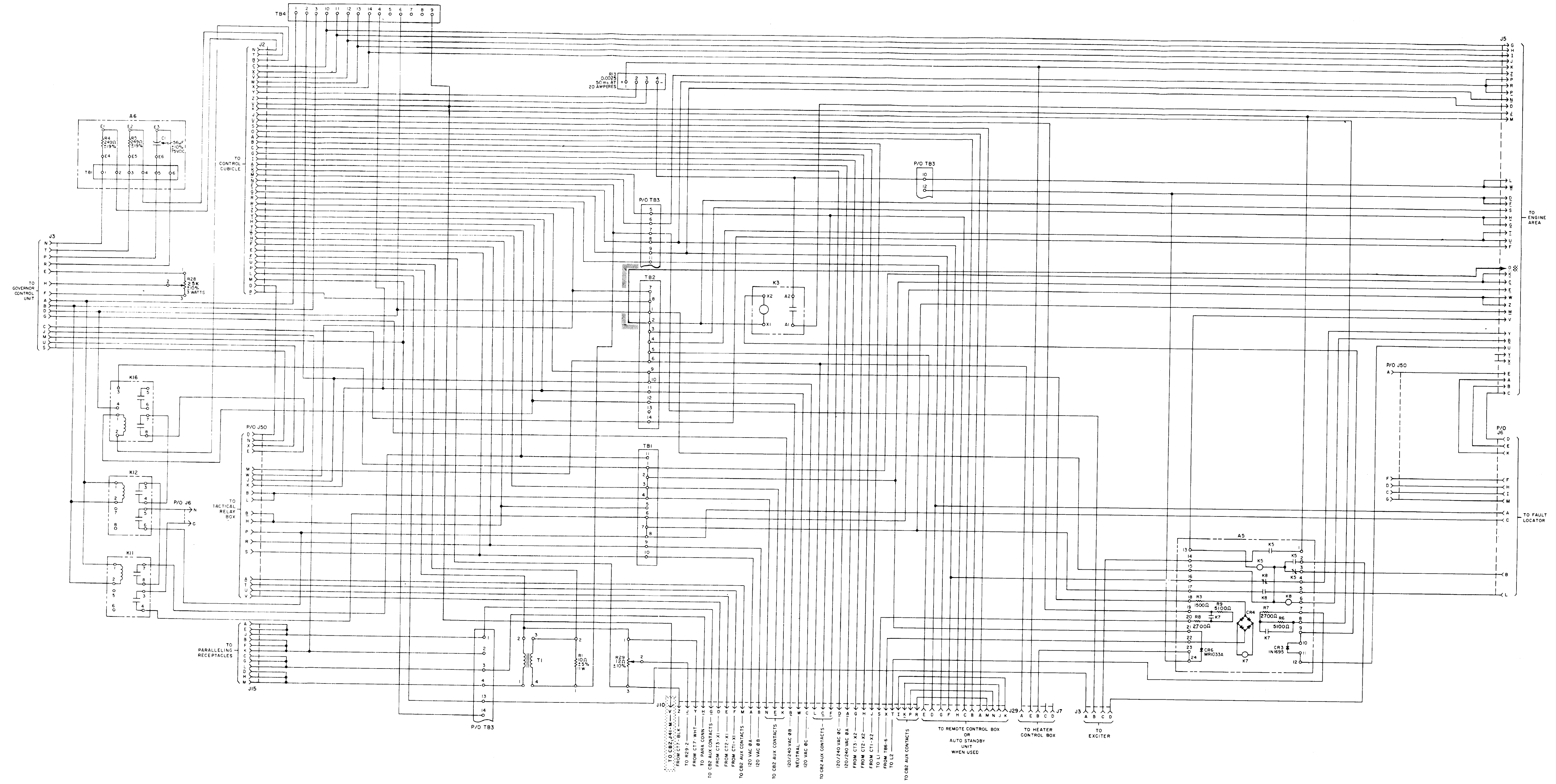
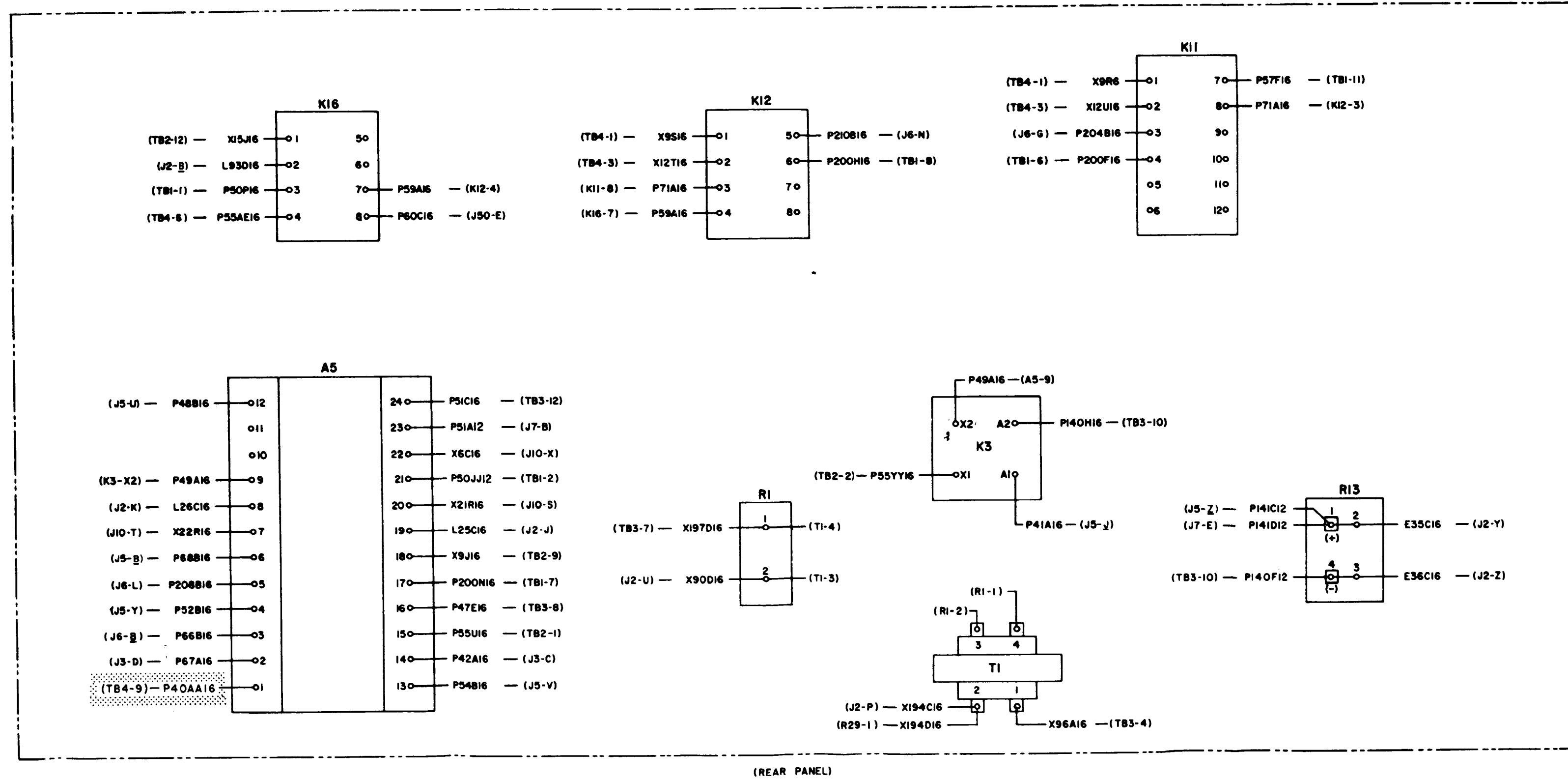


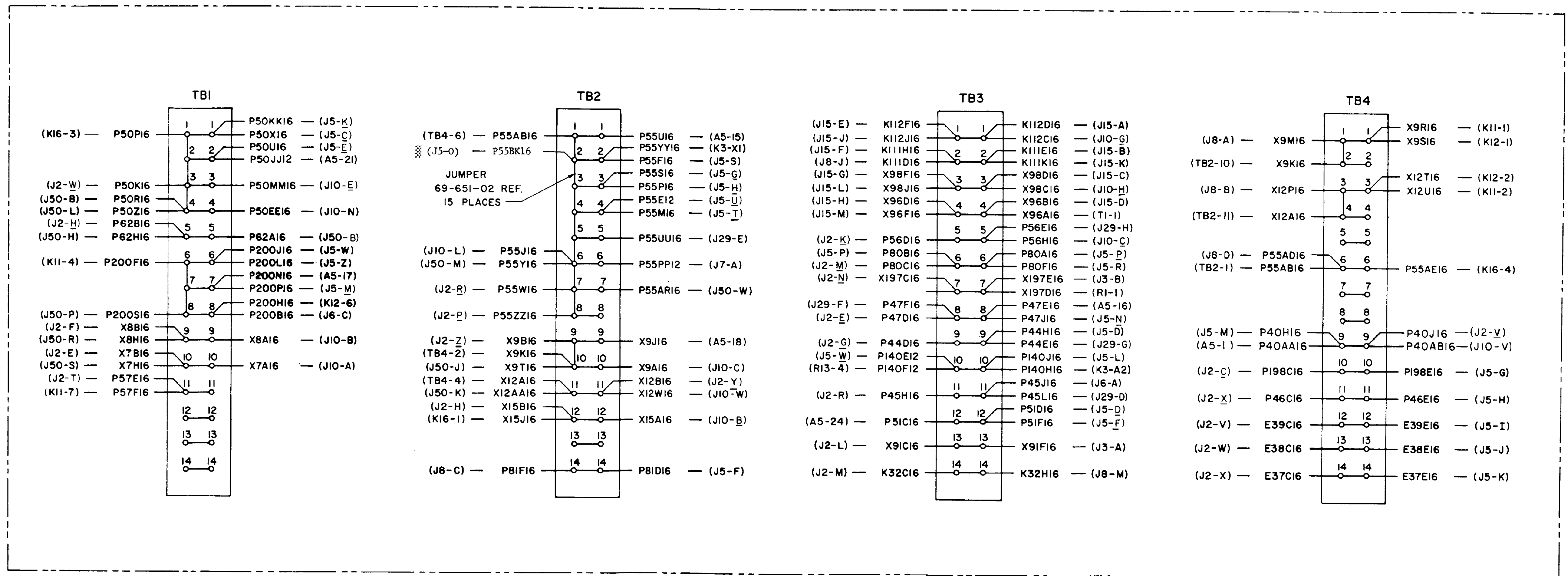
Figure 1-16. Mode II relay box (A27) schematic 400 Hertz generator sets





(REAR PANEL)

Figure 1-17. Mode II relay box (A27) wiring diagram 400 Hertz generator sets (sheet 2 of 3)



(FORWARD PANEL)

Figure 1-17. Mode II relay box (A27) wiring diagram 400 Hertz generator sets (sheet 3 of 3)



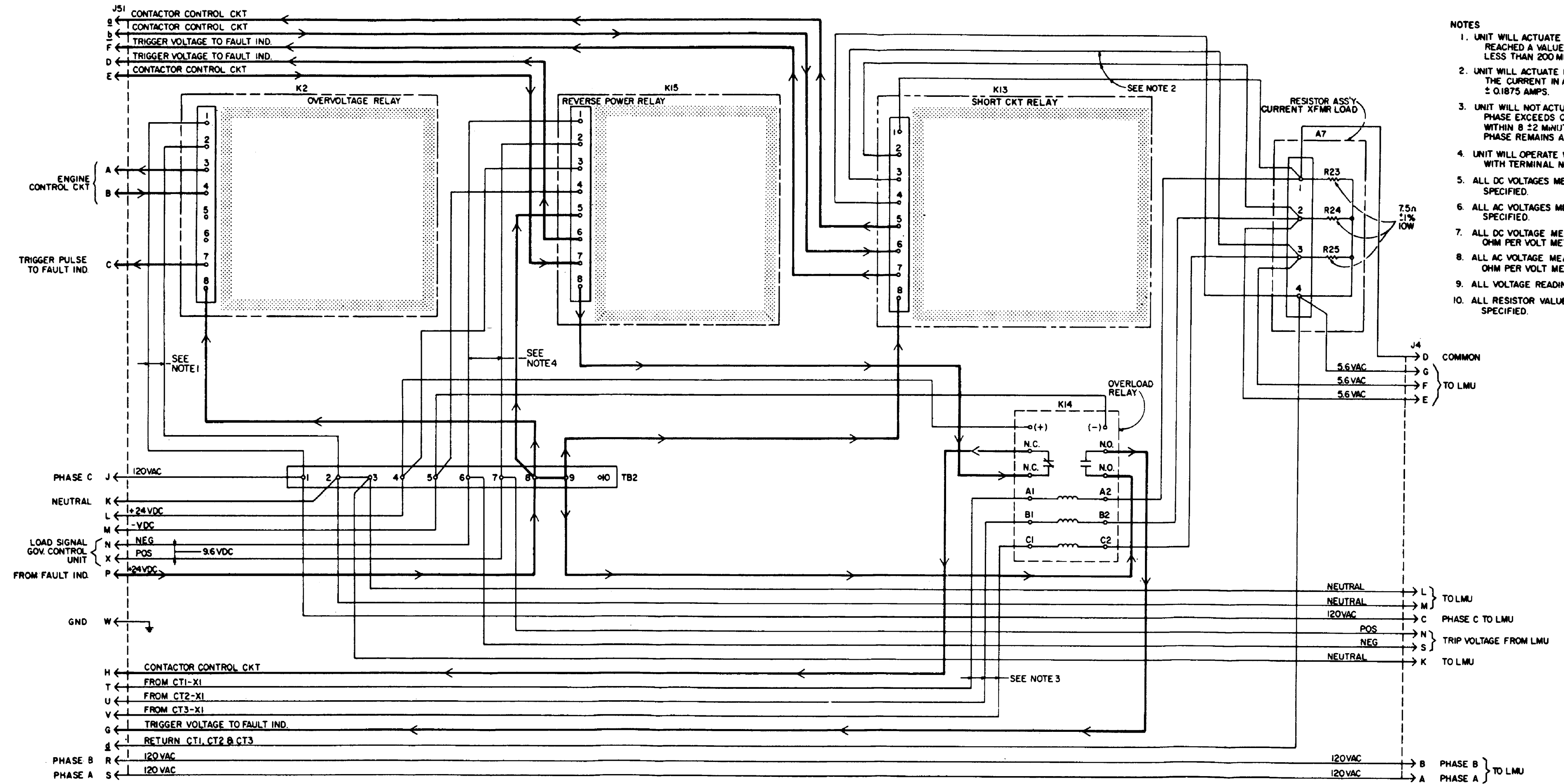
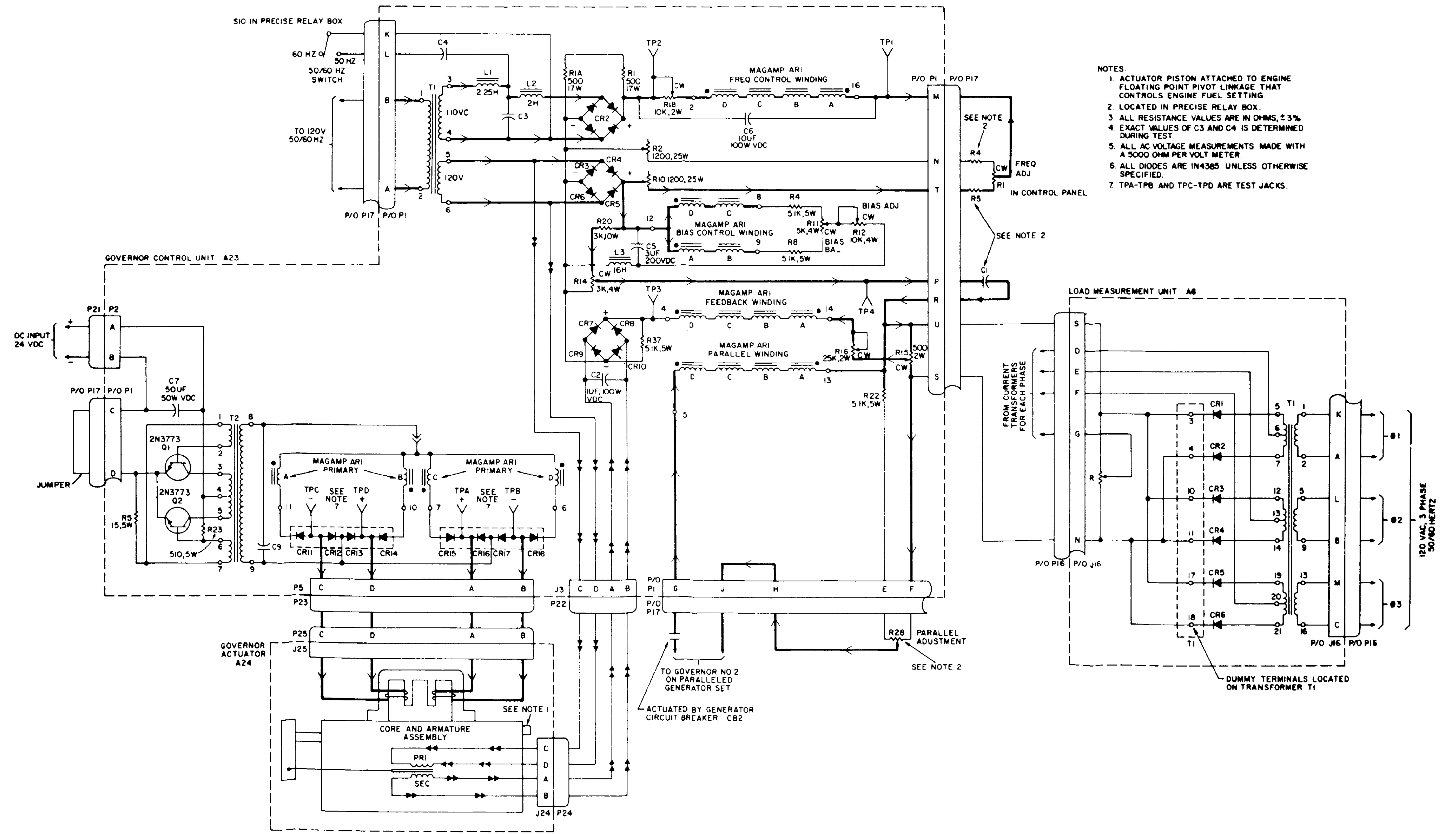
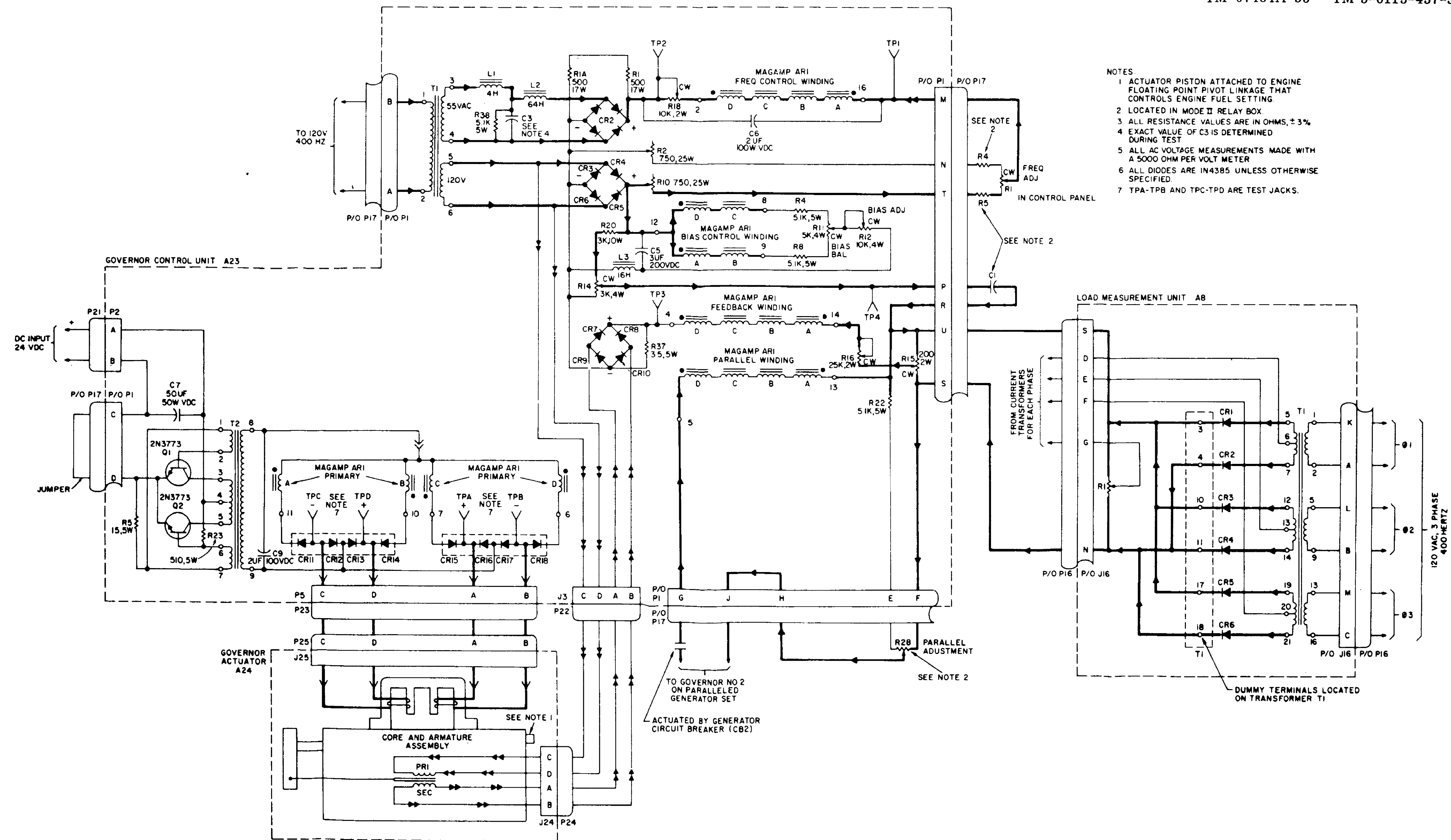


Figure 1-18. Tactical relay box (A29) schematic diagram



- NOTES:
1. ACTUATOR PISTON ATTACHED TO ENGINE FLOATING POINT PIVOT LINKAGE THAT CONTROLS ENGINE FUEL SETTING.
  2. LOCATED IN PRECISE RELAY BOX.
  3. ALL RESISTANCE VALUES ARE IN OHMS, ±3%.
  4. EXACT VALUES OF C3 AND C4 IS DETERMINED DURING TEST.
  5. ALL AC VOLTAGE MEASUREMENTS MADE WITH A 5000 OHM PER VOLT METER.
  6. ALL DIODES ARE IN4365 UNLESS OTHERWISE SPECIFIED.
  7. TPA-TPB AND TPC-TPD ARE TEST JACKS.

Figure 1-22. 50/60 Hertz precise governor system schematic, precise generator sets



- NOTES
- 1 ACTUATOR PISTON ATTACHED TO ENGINE FLOATING POINT PIVOT LINKAGE THAT CONTROLS ENGINE FUEL SETTING
  - 2 LOCATED IN MODE II RELAY BOX
  - 3 ALL RESISTANCE VALUES ARE IN OHMS, ± 3%
  - 4 EXACT VALUE OF C3 IS DETERMINED DURING TEST
  - 5 ALL AC VOLTAGE MEASUREMENTS MADE WITH A 5000 OHM PER VOLT METER
  - 6 ALL DIODES ARE IN4385 UNLESS OTHERWISE SPECIFIED
  - 7 TPA-TPB AND TPC-TPD ARE TEST JACKS.

Figure 1-23. 400 Hertz precise governor system schematic, precise generator sets



WIRE MARKING NO	FROM		TO		WIRE FIND NO	CUT LENGTH IN	MARKING COLOR
	STATION NO	LUG FIND NO	STATION NO	LUG FIND NO			
D20B16	J1-A	-	A1-L1	8	1	21.5	BLACK
D21B16	J1-B	-	A1-L2	8	1	22	
D22B16	J1-C	-	A1-L3	8	1	22.5	
D24A16	M8-(-)	10	S8-41	8	1	6	
D24B16	J1-D	-	M8-(-)	10	1	38	
D29A18	A1-(+)	4	M7-(+)	7	2	53.5	
D30A18	A1-(-)	4	M7-(-)	7	2	52.5	
D68A16	A1-S2	8	S8-33	8	1	48.5	
D69A16	A1-S1	8	S8-32	8	1	54	
D70A16	A1-S3	8	S8-34	8	1	48.5	
D83A16	S8-31	8	M8-(+)	10	1	7	
D84A18	S8-11	4	M9-(-)	7	2	10	
D85A18	S8-21	4	M9-(+)	7	2	11	
D86A18	A2-(+)	4	M6-(+)	7	2	44.5	
D87A18	A2-(-)	4	M5-(-)	7	2	47.5	
E35A18	J1-Y	-	M4-(+)	7	2	32	RED
E36A18	J1-Z	-	M4-(-)	7	2	33	
E37A18	J1-X	-	M3-(-)	6	2	34	
E38A18	J1-0	-	M2-(-)	6	2	39	
E39A18	J1-V	-	M1-(-)	8	2	42	
K32A18	J1-M	-	R1-M	5	2	29.5	BLACK
K33A18	J1-N	-	R1-R	5	2	30	BLACK
K34A18	J1-T	-	R1-L	5	2	31	BLACK
L23A18	DS1-2	4	S4-2	4	2	22.5	RED
L23B18	DS1-2	4	DS2-2	4	2	10	RED
L23C18	DS2-2	4	DS3-2	4	2	17	RED
L25A18	J1-J	-	S6-3	4	2	34.5	BLACK
L26A18	J1-K	-	S6-6	4	2	33.5	BLACK
L34A18	S7-12	4	DS7-2	4 STRIP	2	10	RED
L92A18	S6-2	4	DS4-2	4	2	10	BLACK
L93A18	S6-5	4	DS5-2	4	2	8	BLACK
L93B18	J1-b	-	DS5-2	4	2	32.5	BLACK
P40N16	J1-y	-	T81-5	11	1	12	RED
P40P16	J1-u	-	T81-5	11	1	11	
P40R16	T81-5	11	S2-11	8	1	42.5	
P40S16	S2-2	8	S2-11	8	1	7	
P40T16	S2-5	8	S2-2	8	1	8	
P40U18	S2-5	4	S4-1	4	2	14	
P40V18	S4-1	4	DS8-3	1/4 STRIP	2	10	

WIRE MARKING NO	FROM		TO		WIRE FIND NO	CUT LENGTH IN	MARKING COLOR
	STATION NO	LUG FIND NO	STATION NO	LUG FIND NO			
P40W16	DS7-3	4 STRIP	DS6-3	1/4 STRIP	2	18.5	RED
P40X18	T81-5	11	DS8-3	1/4 STRIP	2	52	
P43A16	S7-5	8	S2-12	8	1	22	
P44A16	S1-1	8	S7-4	8	1	23	
P44B16	J1-g	-	S7-4	8	1	37	
P45A16	T81-10	11	S2-3	8	1	45	
P45B16	S2-3	8	S7-8	8	1	22	
P45C16	S7-8	8	S7-11	8	1	7	
P45D16	J1-R	-	T81-10	11	1	14.5	
P45E16	T81-10	11	A4-7	11	1	11	
P46A16	J1-x	-	S1-2	8	1	34	
P47A16	S2-6	8	S7-9	8	1	22.5	
P47B16	J1-e	-	S7-9	8	1	38	
P50A16	T81-8	11	A4-9	11	1	12	
P50B16	J1-w	-	T81-8	11	1	13	
P50C16	T81-8	11	S3-2	8	1	38	
P50D16	M1-(+)	9	S3-2	8	1	23	
P50E18	M1-(+)	6	M2-(+)	6	2	7	
P50F18	M3-(+)	6	M2-(+)	6	2	25	
P50G18	M5-(+)	4	M3-(+)	8	2	8.5	
P55AA16	J1-r	-	T81-3	11	1	18	
P55CC18	T81-3	5	DS1-1	4	2	47	
P55DD18	DS1-1	4	DS2-1	4	2	9.5	
P55EE18	DS2-1	4	DS3-1	4	2	17	
P55FF18	M5-(-)	4	DS3-1	4	2	38	
P55GG18	M5-(-)	4	DS6-1	1/4 STRIP	2	14	
P55HH18	DS6-1	4 STRIP	DS7-1	1/4 STRIP	2	16.5	
P55KK16	J1-p	-	M1-CASE	9	1	42	
P55MM16	A4-2	11	T81-4	11	1	18.5	
P55XX18	T81-4	5	DS8-1	1/4 STRIP	2	50	
P56A16	S3-3	8	S3-6	8	1	7	
P56B16	J1-k	-	S3-3	8	1	31	
P57A16	S7-2	8	S3-5	8	1	19	
P57C16	J1-e	-	S7-2	8	1	38	
P82D16	J1-h	-	S7-3	8	1	38.5	
P88E16	J1-m	-	A4-8	11	1	25	
P199A18	J1-a	-	DS6-2	1/4 STRIP	2	32	
P199B18	J1-c	-	DS8-2	1/4 STRIP	2	40	

Figure 6-8. Control cubicle wire harness (Sheet 3 of 4)

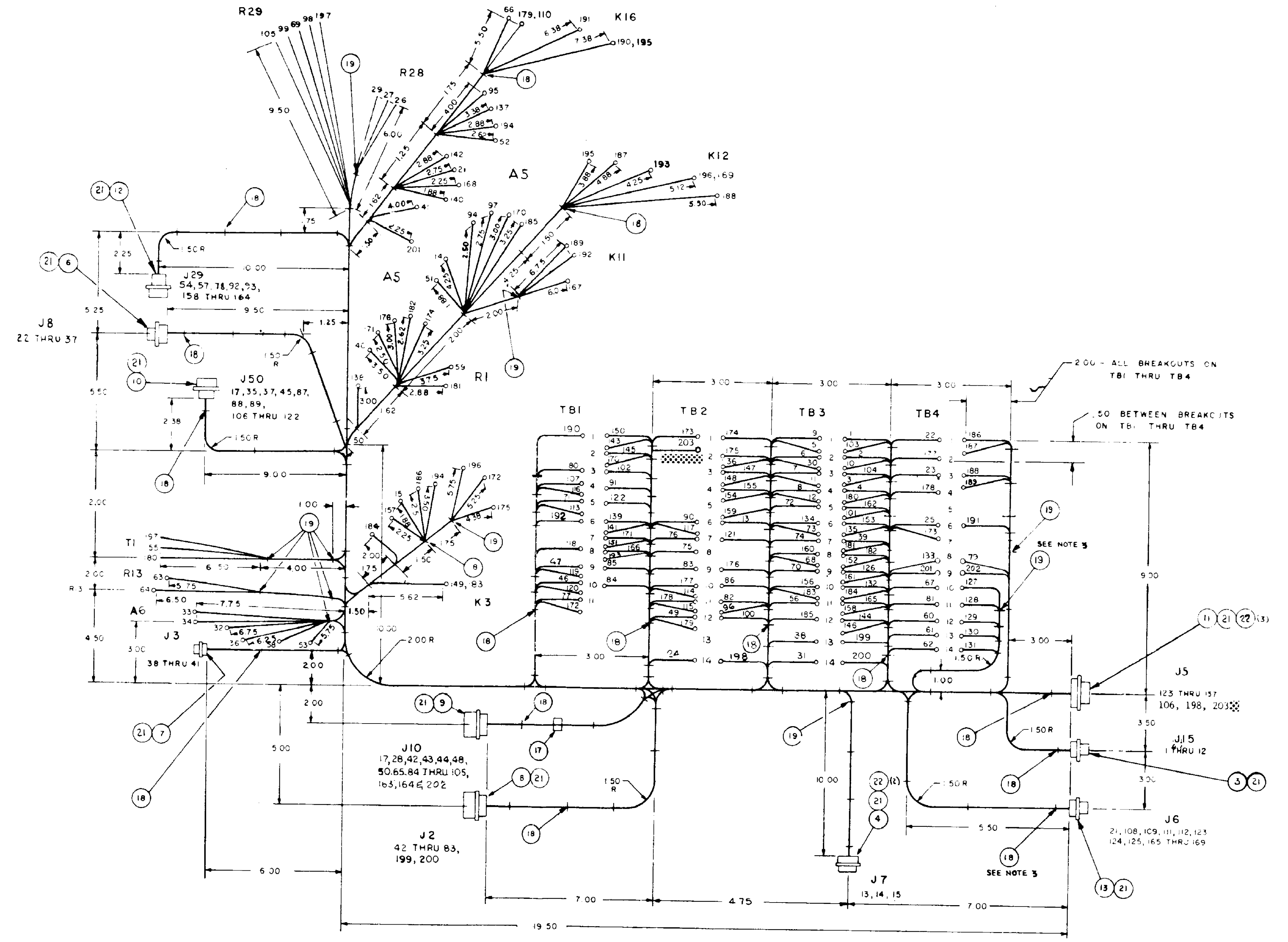


Figure 6-35. Mode II relay box assembly (A27) wiring diagram (Sheet 1 of 4)

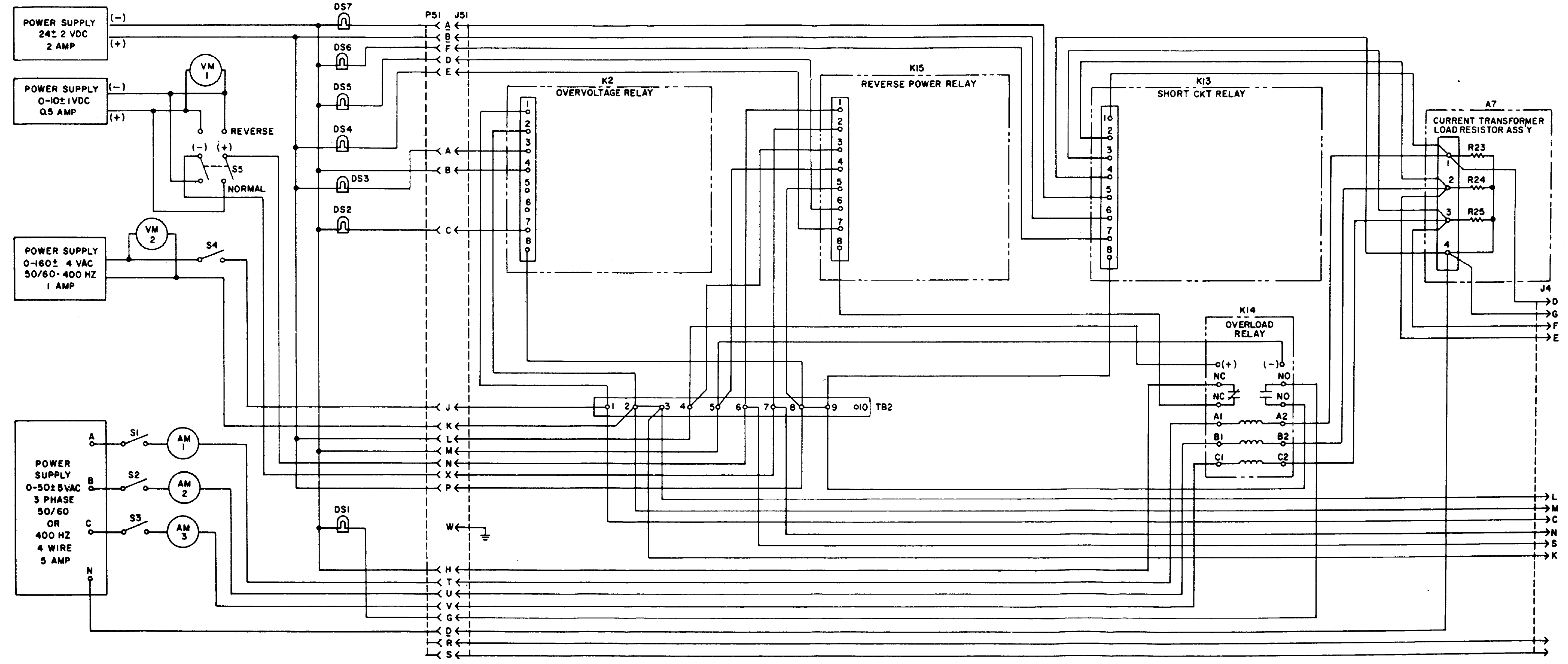
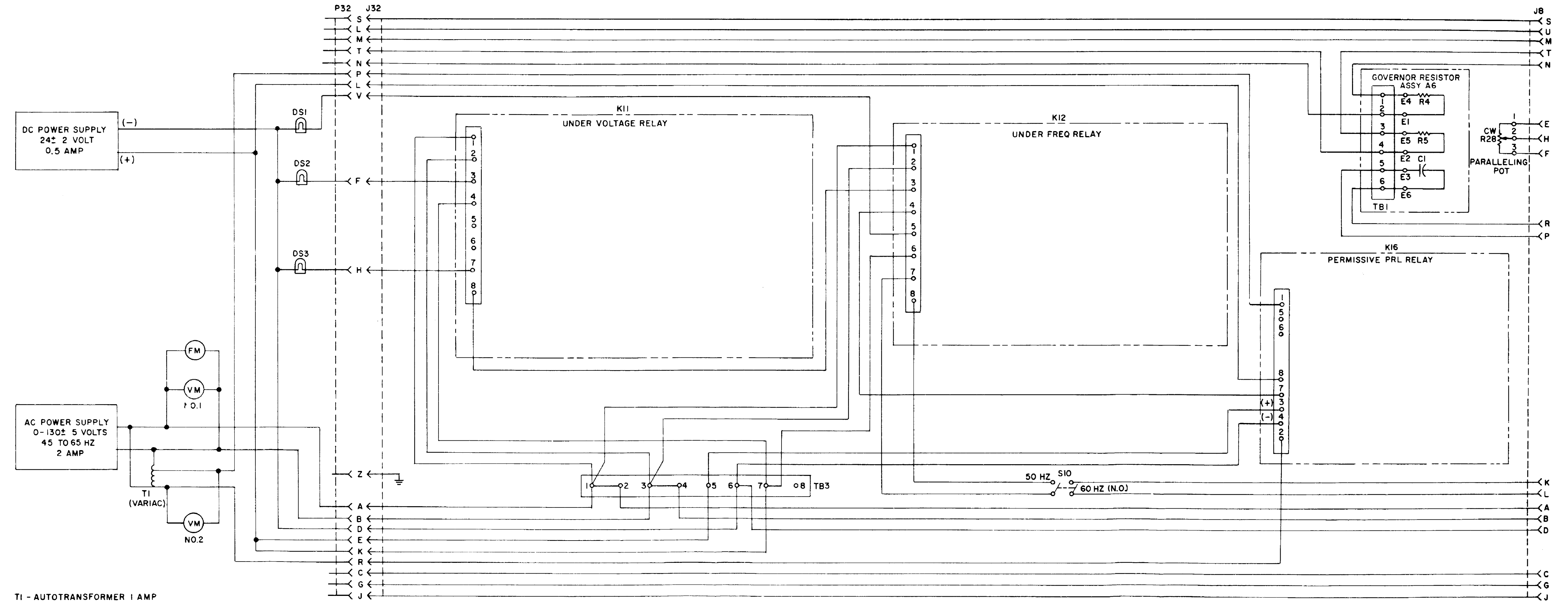


Figure 6-46. Tactical Relay Box (A29) test setup



T1 - AUTOTRANSFORMER 1 AMP

Figure 6-51. Precise relay box (A25), test setup







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