AUTOMOBILE ENGINEERING LABORATORY MANUAL

1.LIST OF EXPERIMENTS.

S/no	NAME OF EXPERIMENT (AUTO)	REMARK
1	Study and demonstration of Layout of an Automobile	
2	Study and Demonstration of Differential	
3	Study and Demonstration of Clutches	
4	Study and Demonstration of Brakes	
5	Study and Demonstration of Gear box	
6	Study and Demonstration of Steering Mechanism	
7	Study and Demonstration of Suspension System	
8	Study and Demonstration of Internal Combustion Engine	

2

LIST OF EXPERIMENTS:

1.Study of Automobile Components and its Functions.

2.Study of Petrol and Diesel Fuel Injection systems.
3.Dismantling and Assembly of Carburetors.
4.Dismantling and Assembly of Clutches.
5.Dismantling and Assembly of Gear Boxes.
6.Dismantling and Assembly of Differential.
7.Dismantling and Assembly of Brakes.
8.Dismantling and Assembly of Suspension.
9.Wheel alignment: measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe- out.

Working sheet.

EXP. NO.	Date	Name of the Exercise	Marks	Signature of the staff.

EX.NO: DATE:

IDENTIFICATION AND APPLICATION OF HAND TOOLS

Aim:

To identify the various hand tools and to study the applications of each tool.

Introduction:

A good work shop must have equipment to undertake all types of fault finding and servicing jobs. The following is a list of hand tools and equipment's, which are a must in the work shop.

1. Screw driver:

These are used to tighten or loose the screw in the machine element. The main parts of screwdrivers are,

1. Handle which is a smooth and shaped properly for good grip. It is usually made of wood or moulded plastics.
2. Blade made of hardened and tempered carbon steel or alloy steel for strength. Blades are usually rounded, though occasionally square or rectangular sections are also used. The length sizes various from 40 mm to 250 mm or even more. The ends of the blades are formed in to flared tips for turning screw by fitting in to their head slots.
3. Screwdrivers are specified according to the length of the blade and width of the tip. Normally blade length of 45mm and 300mm and tips 3mm to10mm wide are available.

2. Spanners:

These are also called wrenches. These are used for tightening or loosening the nuts. These are made of high tensile or alloy steel and are drop forged & heat-treated. Their size in determined by the nuts or blots is fits. In the unified system used commonly, the spanners are marked with sign A/F followed by a number representing decimal equivalent of the nominal size across the flats of the hexagonal nuts or bolts. The following types of spanner are commonly used.

3. Ring Spanners:

The ring spanners also called box spanners. The end openings completely enclosed by the nuts and the bolt heads, for which they cannot slip and cause damage. Further the end holes in some ring spanners are twelve sides, because of which they can be used in restricted spaces.

4. Open-Ended Spanners:

These are the most commonly used type of the spanners in the garage, although they may not be the best means of tightening or loosening the nuts. Therefore these are employed where ring spanners or socket wrenches cannot work.

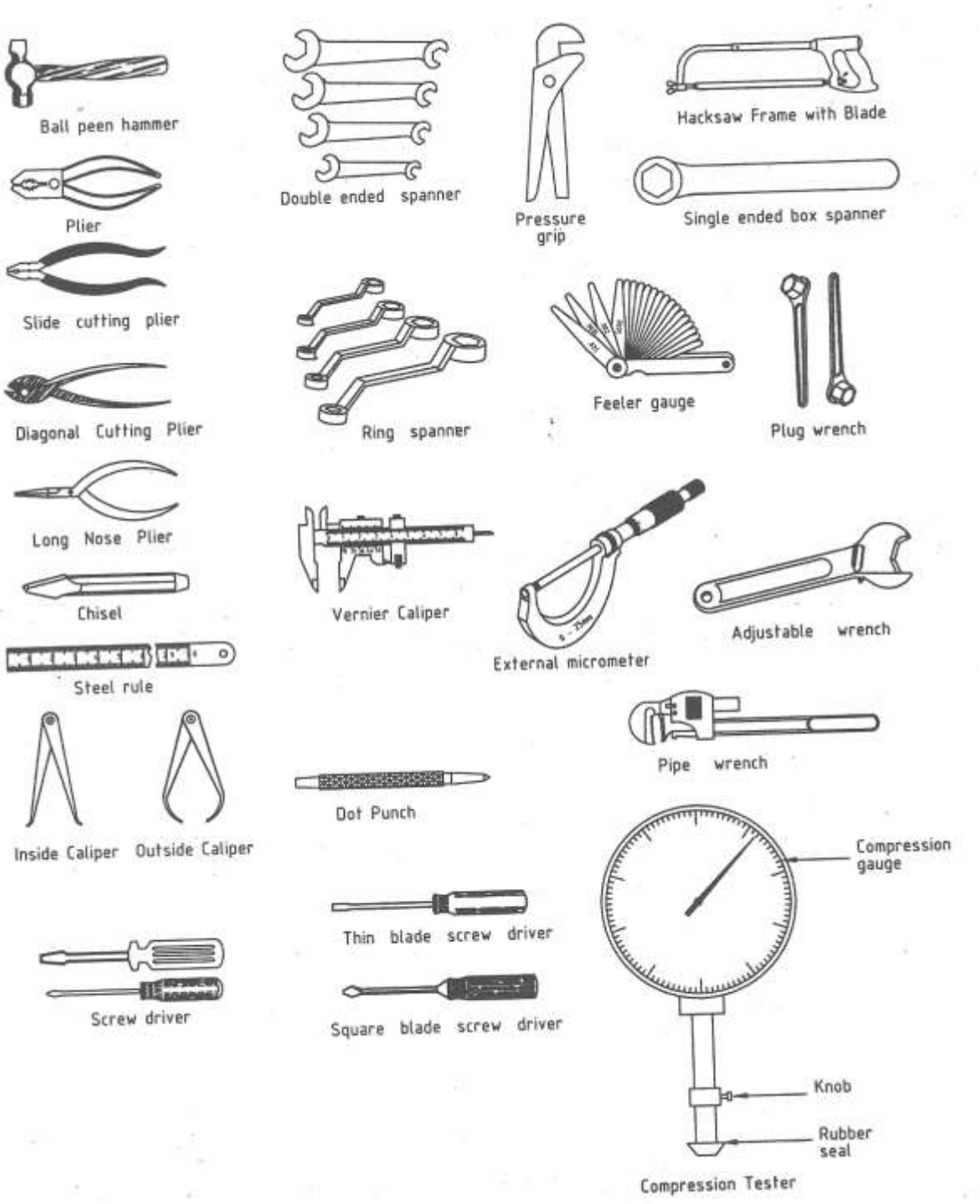
It is observed that spanner opening is kept at an angle with the body axis. This is done to facilitate the turning of the nut in restricted space.

5. Combination Spanners:

These are on one end and have hole on the other end. Thus they are combination of open-ended and the ring spanners. Initially for loosening jammed nuts more torque is required and we use ring end, which will not slip. However after the nut is already loose, it is more convenient to further continue with the open end.

6. Socket Spanner:

These types of spanners are useful in restricted spaces where common types of spanners cannot be used. Both 6&12-point socket should be included in the well-equipped tool kit. This consists of different sizes, which can be used with various types of handles. A part from handles, both electric and air operated impact wrenches are used to drive socket for speeding up the work.



7. Torque Wrench:

Important nuts and bolts in automobile work have to be tightened with the specified amount of torque because excessive torque may result in there breakage while with lesser torque they will come out loose during use. This is made possible by a torque wrench. It is a specialized form of a socket spanner.

8. Wheel Nut Spanner:

A number of different types of spanners are used for tightening or loosening wheel nuts.

9. Allen Wrenches:

Allen keys are used on Allen screws, which have hexagonal shaped grooves in their heads.

10. Pliers:

Different types of pliers have been shown in figure. A plier a device mainly used gripping only and should never be used as substitute for spanners that will damage the nut by rounding off its corner.

11. Hammers:

A hammer is a tool used for striking operations such as denting, bending, punching, straightening, riveting, etc. the head and the handle form the two parts of hammers. The head is made of drop forged carbon steel and has a hole for fitting the handle there in. A medium weight ball peen hammer is the one commonly used in automobile work.

12. Chisels:

A common application is the tearing open of corroded nuts and bolts with a flat chisels. The main parts of a chisels are the head the body and the cutting edge or point. These are made of high carbon steel or chrome vanadium steel. Chisels should be kept sharp. These should be sharpened approximately 60 degree included angle.

13. Files:

Files are used for smoothing rough surface and for removing small amount of metal. The cut in file may be classified either as single cut or double cut, depending up on whether they have cuts in one direction or in both directions. Files may be also be classified according to the shape of cross section.

14. Hacksaws:

Hacksaws are meant for cutting metals by sawing. A hacksaw consists of an adjustable frame with a handle and replaceable hacksaw blade. The construction of the hacksaw is such that different blade length can be accommodated within limits. The hacksaw blade has a thin harrow strips with teeth on one or both sides and two pin holes at the ends.

15. Drilling Machine:

Drilling machine may be hand operated or electrical ones. The tool used for drilling is called a twist drill. It is main parts are shank, body andthe point; shank is fitted in to the drill chuck of the machine, while the pointsis the conical end, which does the cutting. The cutting edges of the point are called tips.

16. Twist Drill:

The position of the drill between the shank and the point is termed body, which consist mainly of the spiral grooves called flutes. These form the cutting edges and provided passage for the chips to come out and the coolant to flow down to the point. A set of twist drills, generally from 0.5mm to 6mm is sufficient for automobile work.

17. Reamers:
After drilling the hole, the same can be finished by a reamer. It may be a straight fluted type and spiral fluted type. The initial hole is drilled by a drill 0.3mm smaller then the final finished size required, after which the reamer is turned only in the forward direction till the desired size is obtained.

18. Bench Vice:
Bench vice is used to hold the component while it is worked on. This is permanently fixed on the workbench. While holding the component some soft material is placed in the vice, it is better to place some other wooden or plastic flats between the vice jaws and the components to avoid damage to the later.

19. Steel Rule:
Most simple tool for measurements length is the ordinary steel rule, which is 300 mm long. It is quite satisfactory for measurement with accuracy up to 0.5mm. Besides straight edges of the steel rule or even otherwise unmarked straight edge may be used to measure surface irregularities.

20. Outside Micrometer:
In case of measurements where still greater accuracy is required in that place micrometer is used. External dimension of parts such as thickness, diameter are measured with the help of outside micrometer, where as internal dimensions are measured with inside micrometer.

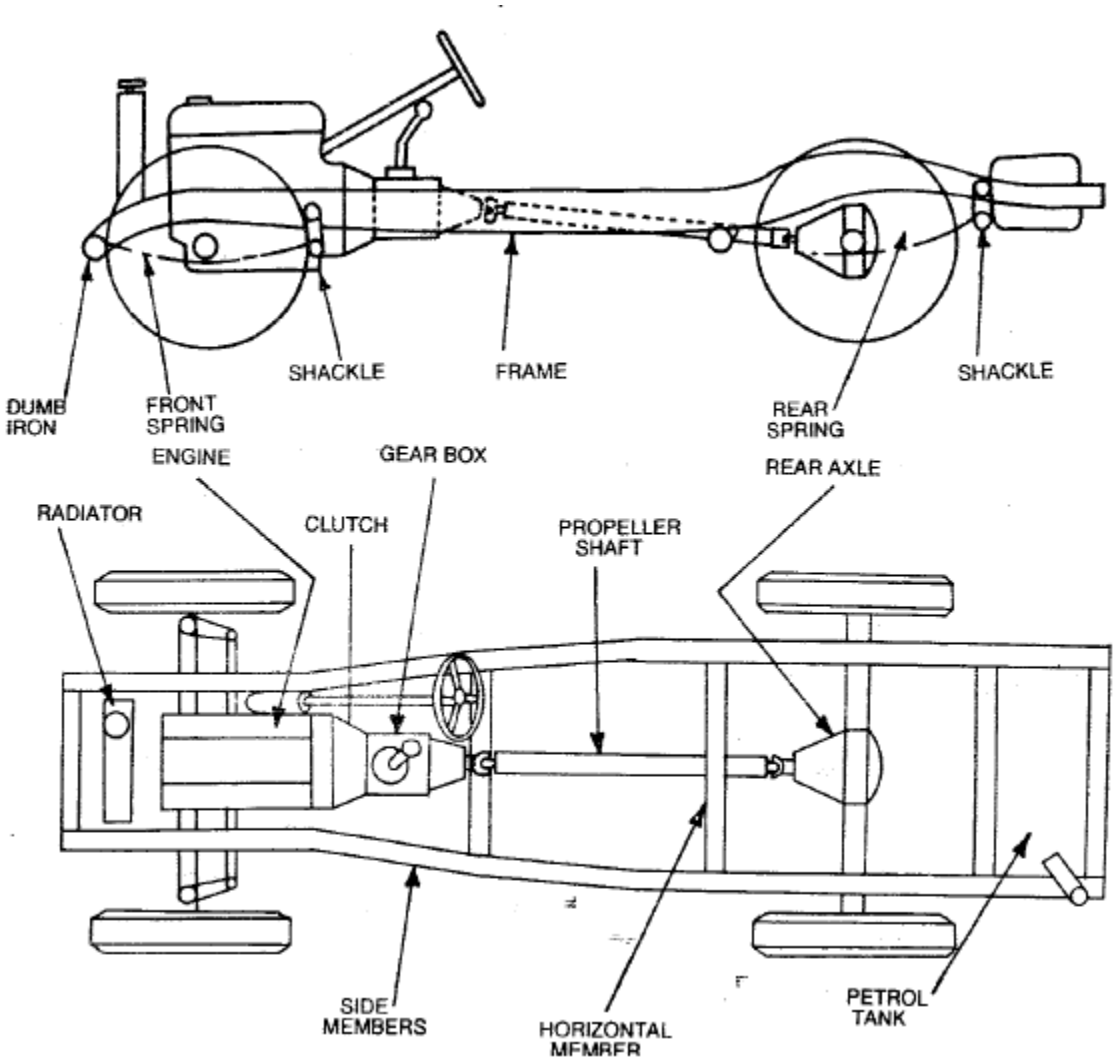
21. Lifting Jacks:
To work under the car or to change wheels, it is necessary to lift the car. For, doing this, lifting jack is use which may be mechanically or hydraulically operated. Such a jack is a standard accessory with many cars. It consists of a diamond shaped frame having a nut on one side and a sleeve on the other side.

22. Axle Stand:
It is always necessary to make sure that before start working the car with axle stand. The axle is not suppurated by the jack or any other support and also it is not safe to use bricks, for supporting purpose. So axle stand is the batter way to support the weight of the vehicle.

23. VernierCaliper:
Most simple tool for measurements length is the ordinary steel rule, which is 300 mm long. It is quite satisfactory for measurement with accuracy up to 0.5mm.besides straight edges of the steel rule or even otherwise unmarked straight edge may be used to measure surface irregularities. Used in hole diameter, depth of hole , outerdiameter and inner diameters.

RESULT:
Thus the various hand tools are identified and the applications were studied.

Layout of Chassis and its main Components.



LAYOUT OF CHASSIS AND ITS MAIN COMPONENTS.

Ex. No: **Date:**

STUDY OF AUTOMOBILE COMPONENTS AND ITS FUNCTIONS

AIM:

To study the various auto components and function.

Layout of Chassis and its main Components:

The main components of the Chassis are given below

Frame:

It is the base of the vehicle. Engine, clutch, gear box, rear axial etc are mounted on the frame.

Engine:
The function of the heat engine is to convert the heat energy contained in the fuel into mechanical work.
Engines in which the combustion of fuel takes place inside the engines cylinder are known as internal combustion engines.
Ex: - Petrol, Diesel and Gas engines.
Engines, in which the combustion of fuel takes place outside the engine cylinder, are known as external combustion engines.

Ex: - Steam engines.
Fuel Feed System:
In Petrol Engine, the Petrol from the fuel tank reaches through the fuel pump, filter and carburettor to the engine cylinder. The fuel feed system consists of the following components:
1. Fuel Tank
2. Fuel Pump
3. Fuel Filter
4. Carburettor
5. In-take manifold
6. Fuel pipes or tubes
7. Gauge to indicate the fuel level in the fuel tank.

Function of Fuel feed System:
1. To store fuel in the tank.
2. To supply fuel to the engine in good condition i.e. the correct quantity.
3. To indicate the fuel level in the tank.

S. No.	**Parts Name**	**Materials used**	**Composition**
1	Cylinder block	Grey cast iron	Iron:95%, Silicon:1.2%, Manganese:0.6%, Sulphur:0.1%, Phosphorus: 0.8%, Carbon: 2.2%.
		Aluminium alloys	Aluminium:91%, Tin: 2%, Copper: 7%.
2	Cylinder head	Grey cast iron	Copper: 3%, Silicon:5%, Manganese: 0.5%.
		Aluminium alloys	Magnesium: 0.5%, Silicon:4.5%, Manganese: 0.5%.
3	Crank case	Cast Iron, Aluminium, Alloy Steel	------
4	Oil pan	Pressed sheet steel	---------
5	Piston	Cast Iron,	---------

		Aluminium alloy, Nickel iron alloy, cast steel	
6	Piston rings	Alloy cast Iron, alloy steel plated with chromium or cadmium	Iron:99%, Silicon: 0.3%, Manganese:0.5%, Carbon: 0.2%.
7	Connecting rod	Plain carbon steel, Nickel alloy steel, alluminium alloys.	-------
8	Crankshaft	Carbon steel, Nickel chrome alloys	------
9	Cam shaft	Hardened cast iron, Alloy steel	Iron: 93%, Silicon: 2%, Manganese:0.6%, Molybdenum: 0.2%, Chromium:0.6%, Carbon: 3.3%.

Cooling System:

During the combustion of air-fuel mixture enormous amount of heat is produced inside the engine cylinder. The temperature as high as 1500o to 2000o may be reached. It will break the lubricating film between the moving parts and may cause mechanical breakage C.F. the engine parts. Hence this temperature must be reduced to such a value, about 200oC to 250oC.

Clutch:

Clutch is a device used in the transmission system of vehicle to engage and disengage the engine to the transmission. When the clutch is engaged the power flows from the engine to the rear wheels through the transmission system and the vehicle moves. When the clutch is disengaged, the power is not transmitted to the rear wheels and the vehicle is stops while the engine is running.

The clutch is disengaged when starting the engine, when shifting gears, when the stopping the vehicle and when idling the engine. The clutch is engaged only when the vehicle is to move and it is kept engaged, when the vehicle is moving. The clutch also permits the gradual taking up of the load.

Types of Clutches:

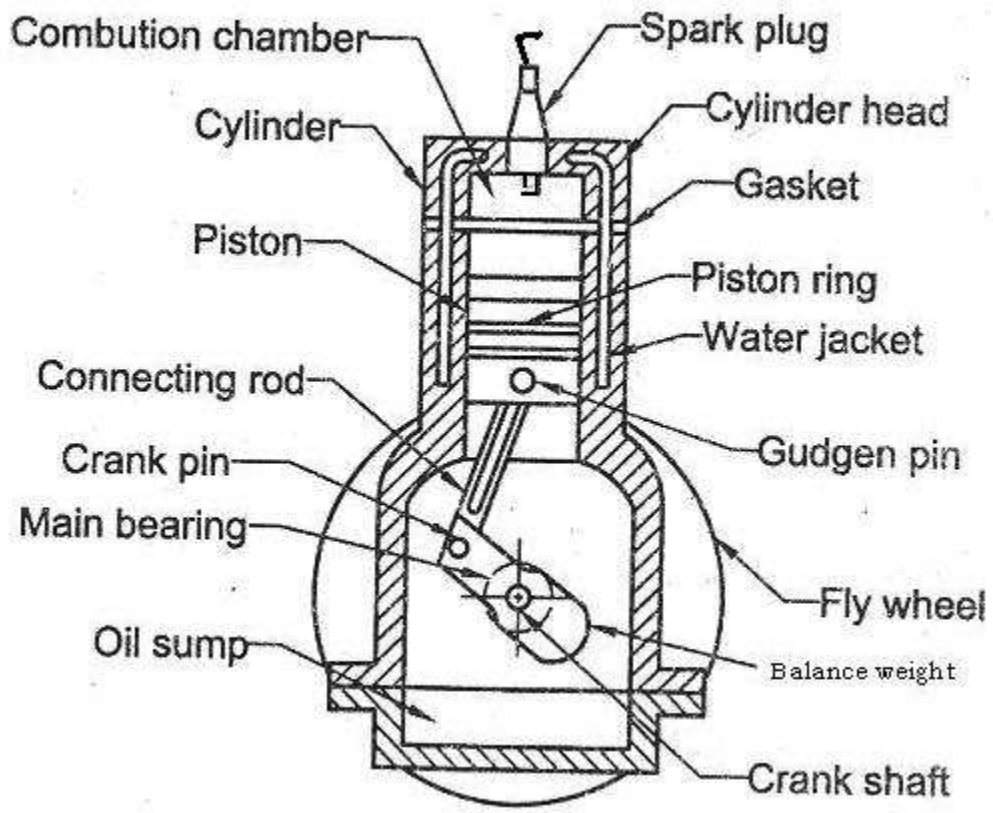
1. Frictional Clutch
a) Single Plate Clutch
b) Multi Plate Clutch - wet type, dry type
c) Cone clutch.
2. Centrifugal Clutch
3. Semi Centrifugal Clutch

4. Diaphragm Clutch
5. Hydraulic Clutch
6. Vacuum Clutch
7. Automatic Clutch (or) fluid flywheel or fluid coupling

Gear box:
The gear box is a device which is located between the clutch and the propeller shaft. It is used to transmit the power from clutch shaft to propeller shaft. When a vehicle is moving from rest it required more torque and less speed.

S. No.	**Parts Name**	**Materials used**	**Composition**
10	Inlet Valve	Silicon chrome steel	Carbon: 0.4%. Nickel :0.5%, Manganese:0.5%, Silicon:3.5%, Chromium: 8%.
11	Exhaust valve	Austenitic steel	Carbon: 0.5%. Nickel : 4%, Manganese:9%, Silicon:0.2%,Nitrogen: 0.4%, Chromium: 8%.
12	Timing gears	Cast Iron,Steel Aluminium alloy, Laminated fibre.	-------
13	Cylinder liners	Cast Iron, Aluminium alloy	-------
14	Main Bearing	Babbit, copper-lead, Aluminium (or) tin based.	Tin: 89%, copper:3%, Antimony: 7.5%, Lead:0.3%, Arsenic:0.2%.

INTERNAL COMBUSTION ENGINE.



Similarly more torque is required at the time of hill climbing and accelerating the purpose of gear box is:

1. To provide high torque at the time of starting, accelerating, hill climbing and pulling the load.
2. To give more speed at the time of normal running. (Less torque)
3. To provide a natural position, so that engine transmits the power to clutch shaft, but propeller shaft remain idle.
4. To reverse the vehicle.

The above are obtained by a set gears enclosed in a gear box and gear changing Mechanism.

Types of gear boxes:

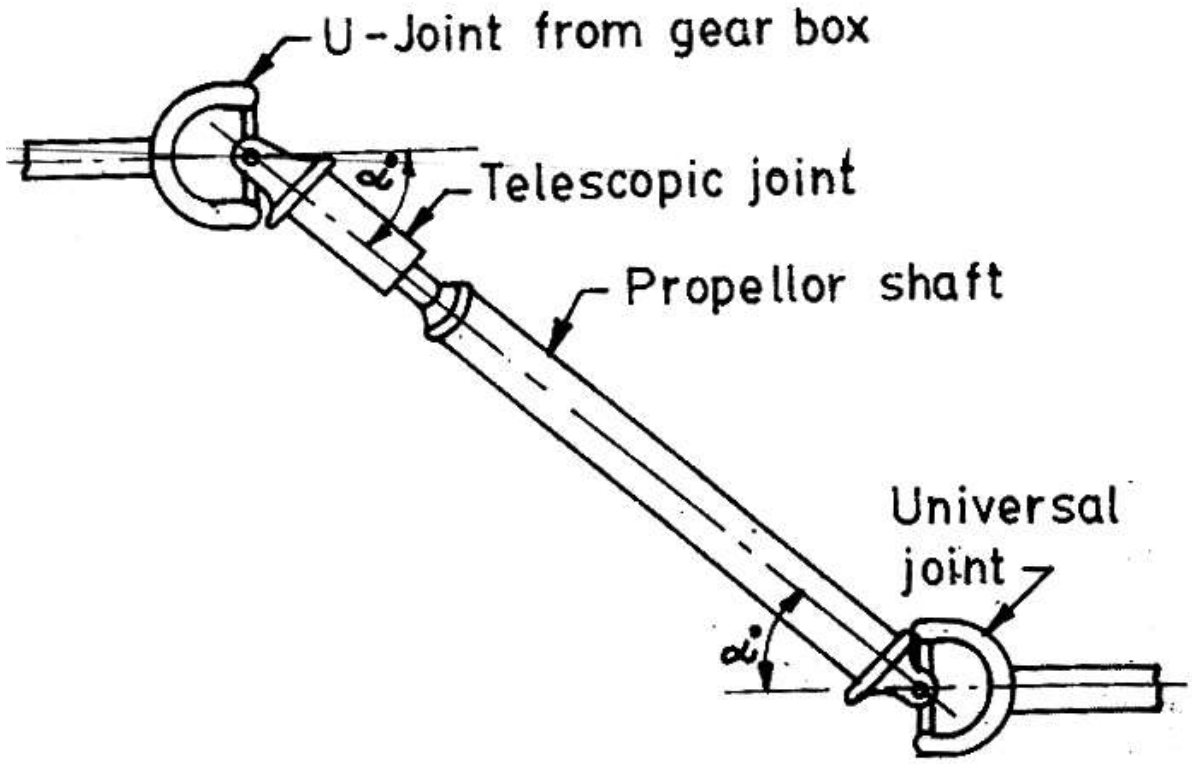
1. Sliding mesh gear box 2. Constant mesh gear box
3. Synchro-mesh gear box 4. Epicyelic gear box

Universal Joint:

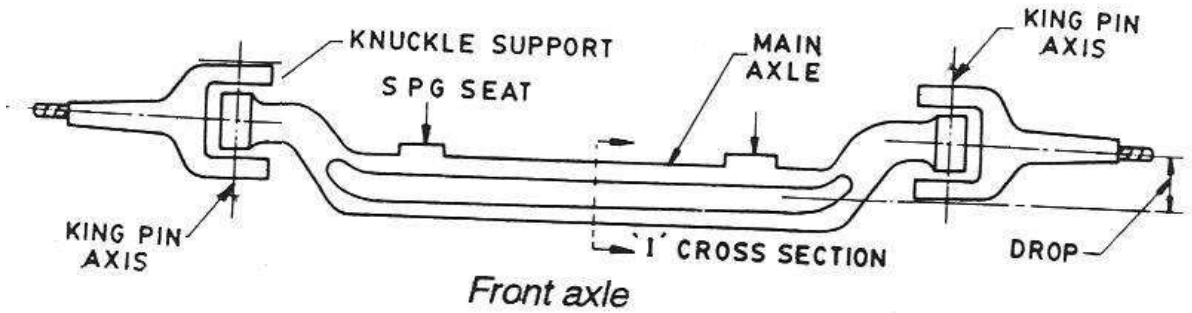
A universal joint is used where two shafts are connected at angle to transmit torque. The output of the gar box or main shaft, propeller shaft and final drive are not in one line and hence the connectionbetween them is made by the universal joint. One universal joint is used to connect the main shaft and propeller shaft at required angle, other universal joint is used to connect the other end of the propeller and final drive with some angle. Thus the connection between the three shafts are flexible and at an angle with one another.

Types of universal joint:

1) Non constant (or) variable velocity joint:
a) Cross type (or) spider and yoke type (or) Hook's joint
b) Pot type
c) Flexible ring type
d) Ball and turning type.
2) Constant velocity type:
a) Tracta type
b) Bendix type
c) Rzeppa type



PROPELLER SHAFT



FRONT AXLE

Propeller Shaft:
The propeller shaft transmits power from the gearbox to the rear axle, accommodates change in length, and transmits motion at varying angles. It is connected between the gear box side universal joint and differential unit side universal joint.

Material of propeller shaft:
The propeller shaft has to withstand the torsion stresses of the transmitting torque. But it should be light and well balanced so that vibrations will not occur at high speeds. So it should be made of a strong steel tube. Solid propeller shaft is also used. The propeller shaft may be in two section supported by a center bearings and coupled together by universal joint. This is for lengthy vehicle.

Differential:
The function of the differential is to allow each rear wheel to rotate at different speeds during turning but at the sometime transmit equal torque to each wheel when both wheels have equal traction.

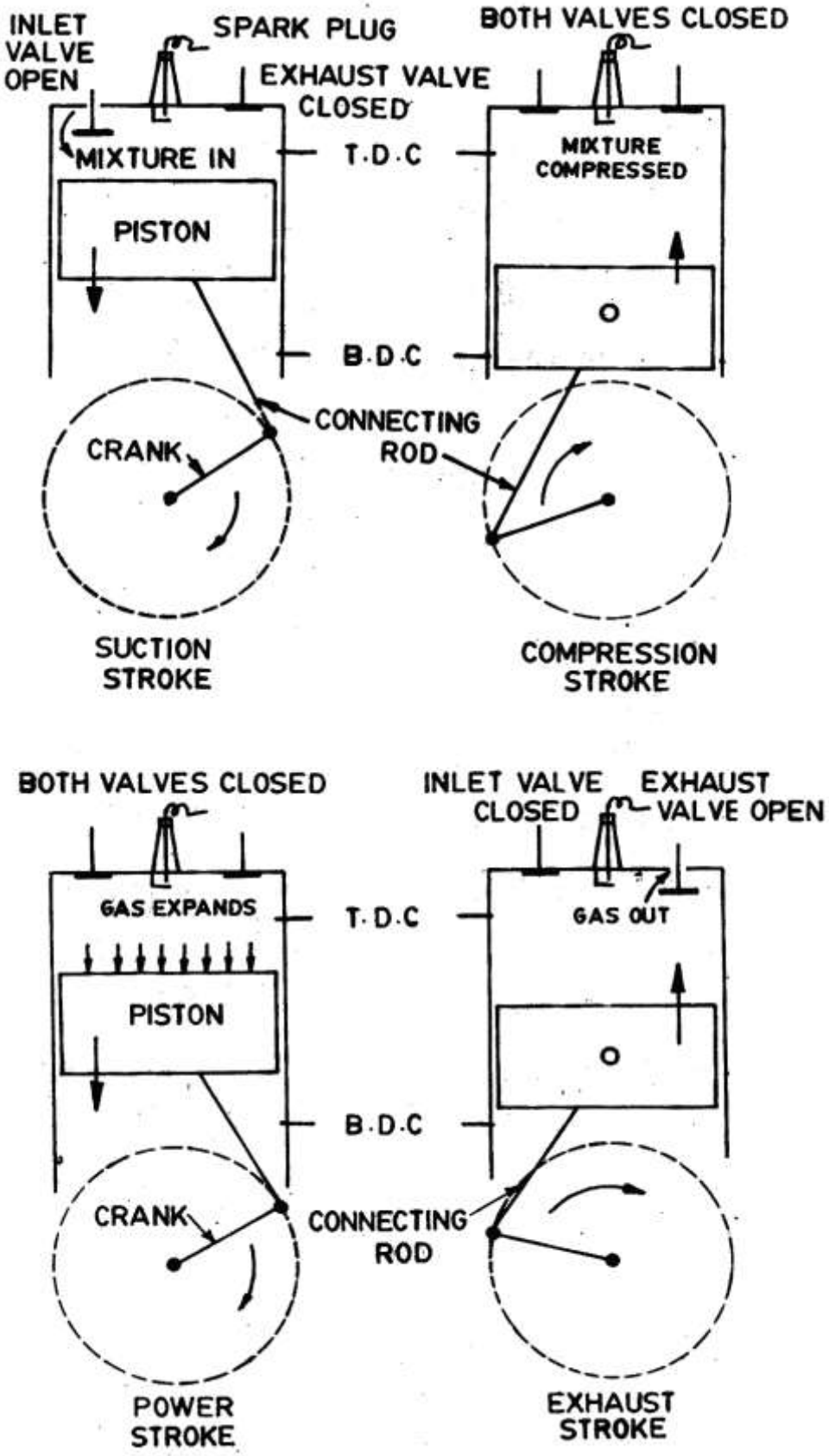
Front axle:
The front axle is used to carry the weight of the front part of the vehicle as well as to facilitate steering and absorb shocks due to road surface variation. It must be rigid and robust in construction. It is usually steel drop forging having 0.4% carbon steel or 1 to 3% Nickel steel.

Functions:
1. It carries the hubs and the wheels.
2. It carries the weight of the front part of the vehicle.
3. It works as cushion through the spring which facilitates a comfortable ride.
4. It controls the ride through shocks absorber fitted on H. It carries the brake system.
5. It carries stub axle, king pin, Steering arm by which the vehicle steers.
6. In case of four wheel drive it also transmits power to road wheels.
7. It includes steering mechanism, braking mechanism and suspension etc..

Rear axle:
The power from differential is transmitted to rear wheel by rear axle. Depending upon the methods of supporting the rear axle and mounting the rear wheels, the rear axles are classified into three types are:
1) Semi floating type
2) Three-quarter floating type
3) Full floating type

Functions of Rear Axle:
As the rear axle is suspended from the body of the vehicle by leaf springs attached to the axle housing. The rear axle performs several functions which are as under;-
1. Changing the direction of driveshaft rotation by 90 degrees to rotate the axle shafts.
2. Providing a final speed reduction between the drive shaft and the axle shafts through the final – drive gears or differential gears.
3. Providing differential action , so that one wheel can turn at a different speed as compared to the both wheel, when required,
4. Providing axle shafts or half shafts to drive the rear wheels.
5. Acting as a thrust and torque reaction member during acceleration and breaking.

RESULT: Thus the various auto components and function were studied.



FOUR STROKE PETROL ENGINE

EX.NO: **DATE:**

DISMANTLING AND ASSEMBLING OF FOUR STROKE PETROL ENGINE AND IDENTIFICATION OF PARTS

AIM:

To dismantle and assemble the given four stoke petrol engine and to identify the parts.

TOOLS REQUIRED:

1. Double end spanner set.
2. Ring end spanner set.
3. Box spanner set.
4. Hammer
5. Cutting plier.
6. Torque wrench
7. Feeler gauge
8. Screw driver
9. Emery paper

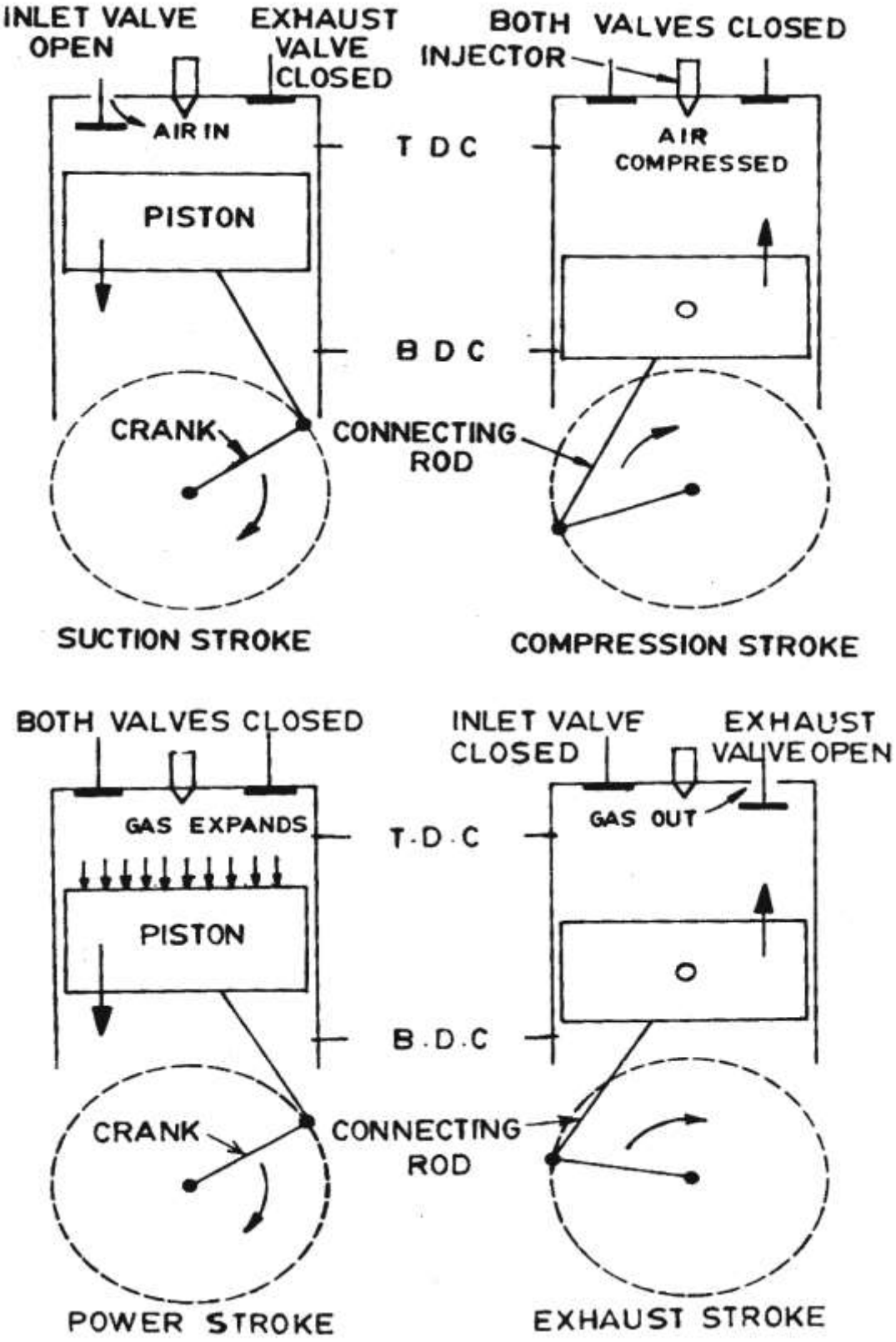
PROCEDURE:

1. Remove the connection from the battery
2. Remove the drain cock from the radiator and drain the water.
3. Remove the drain plug from the oil sump and drain the oil.
4. Remove the air cleaner, valve, carburettor, rock arm assembly, push rod, and rocker arm lubrication tube.
5. Then loose the engine head bolts and remove the gaskets carefully. Then remove the engine head and place it on a workbench.
6. Punch the valves and with the help of lock washer valve spring compressor remove the valve spring, valve lock cup and remove the valves from the head.
7. Clean the valves, rocker arm, pushrod, tappet, valve guide, valve spring, valve lock cup etc. if any parts are damaged replace it with new one.
8. After removing the carburettor from the engine body, dismantle all the parts from the carburettor and clean it using petrol and compressed air.
9. Remove the inlet manifold and exhaust manifold from the engine block and remove the gaskets carefully.
10. Clean the inlet manifold using petrol and remove the carbon from the exhaust manifold with the help of wire brush and finally clean the manifold by kerosene.
11. Then assemble all the parts by reverse of dismantling procedure. And check timing and adjust the distributor for correct advance.
12. Then start the engine and correct the low speed screw, needle screw and fit the air filter.

RESULT:

Thus the given four-stroke petrol engine was dismantled, parts are identified and assembled.

FOUR STROKE DIESEL ENGINE.



FOUR STROKE DIESEL ENGINE.

EX.NO: **DATE:**

DISMANTLING AND ASSEMBLING OF FOUR STROKE DIESEL ENGINE AND IDENTIFICATION OF PARTS

AIM:

To dismantle and assemble the given four stoke diesel engine and to identify the parts.

TOOLS REQUIRED:

1. Double end spanner set.
2. Ring end spanner set.
3. Box spanner set.
4. Hammer
5. Cutting plier.
6. Torque wrench
7. Feeler gauge
8. Screw driver
9. Emery paper

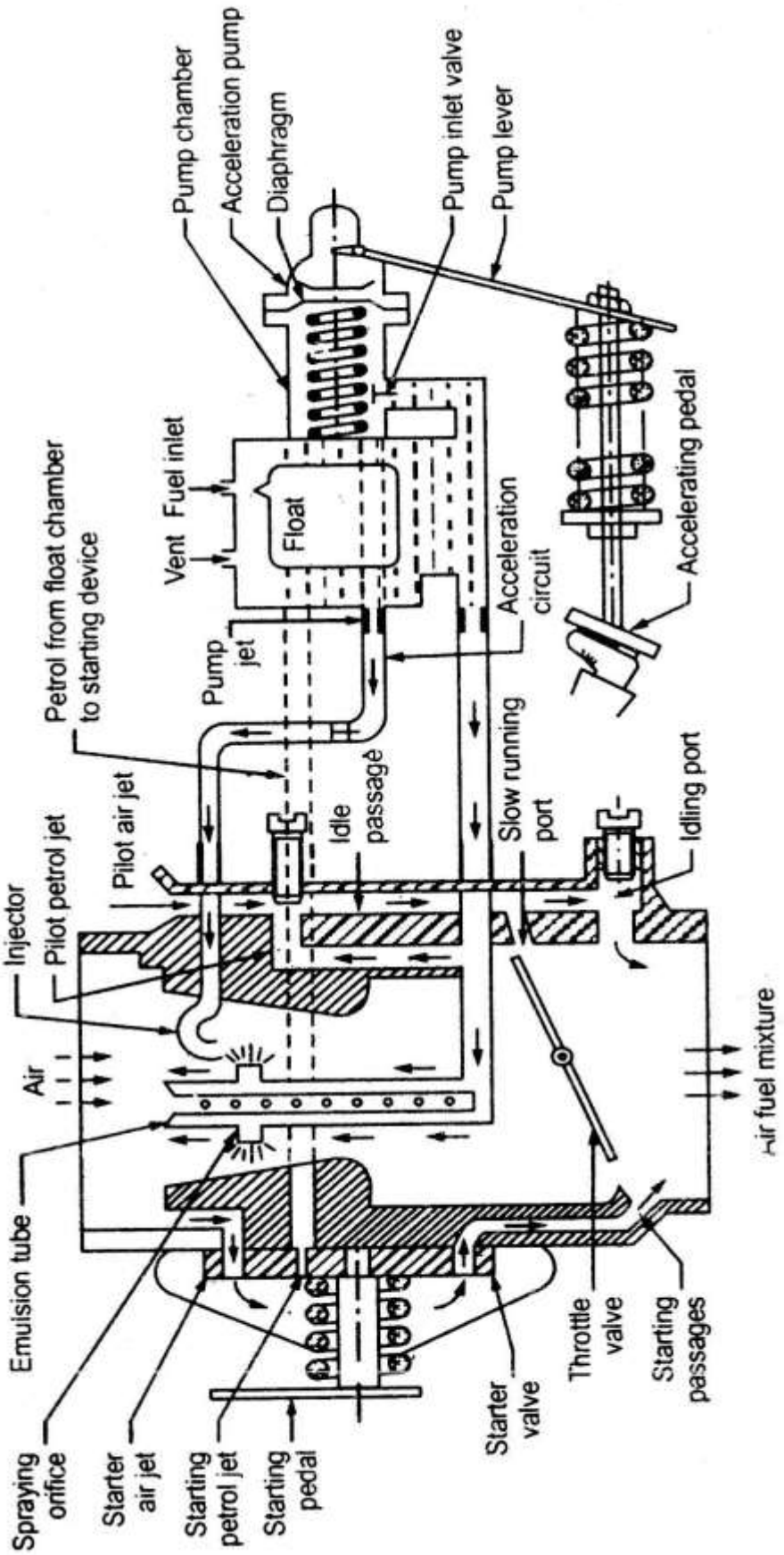
PROCEDURE:

1. Remove the connection from the battery
2. Remove the drain cock from the radiator and drain the water.
3. Remove the drain plug from the oil sump and drain the oil.
4. Remove the air cleaner, valve, fuel pump, injection pump, rocker arm assembly, and Push rod.
5. Then loose the engine head bolts and remove the gaskets carefully. Then remove the engine head and place it on a workbench.
6. Punch the valves and with the help of lock washer valve spring compressor and remove the valve spring, valve lock cup and remove the valves from the head.
7. Then clean the valves, rocker arm, push rod, tappet, value guide, value spring, value lock cup etc. if any parts are damaged replace with new one.
8. Remove the injector from the engine body and dismantle all the parts from the injector and injection pump.
9. Clean the components using compressed air.
10. Remove the inlet manifold and exhaust manifold from the engine block, and remove the gaskets carefully.
11. Clean the inlet manifold using petrol and remove the carbon from the exhaust manifold with the help of wire brush and finally clean the manifold by kerosene.

12. Then assemble all the parts by reverse of dismantling procedure. And check timing and adjust the distributor for correct advance.
13. Then start the engine and correct the low speed screw, Needle screw and fit the air filter.

RESULT:

Thus the given four-stroke diesel engine was dismantled, parts are identified and assembled.



SOLEX CARBURETTOR

EX. NO: **DATE:**

DISMANTLING, INSPECTING, OVERHAULING AND ASSEMBLING OF SOLEX CARBURETTOR

AIM:

To learn how to dismantle, clean, inspect, overhaul, and assemble the given Solex carburettor

TOOLS AND EQUIPMENTS:

1. Double end spanner set.
2. Ring spanner set.
3. Box spanner set.
4. Hammer.
5. Screw driver.
6. Emery sheet.
7. Solex carburettor
8. carburettor tool kit

PROCEDURE:

1. Disconnect the fuel lines and remove the air cleaner.

2. Remove the carburettor and cover the manifold holes with proper covering.

3. Remove the accelerator jet.

4. Remove the float chamber cover and then remove the pilot jet.

5. Clean the needle valve, acceleration pump and the non return valve by petrol and test for,
   - ❖ Fuel leakage
   - ❖ Broken gasket
   - ❖ Proper vent in float chamber
   - ❖ Leakage in needle valve
   - ❖ Broken pump leather washer

6. Make sure the condition of the gasket while replacing.

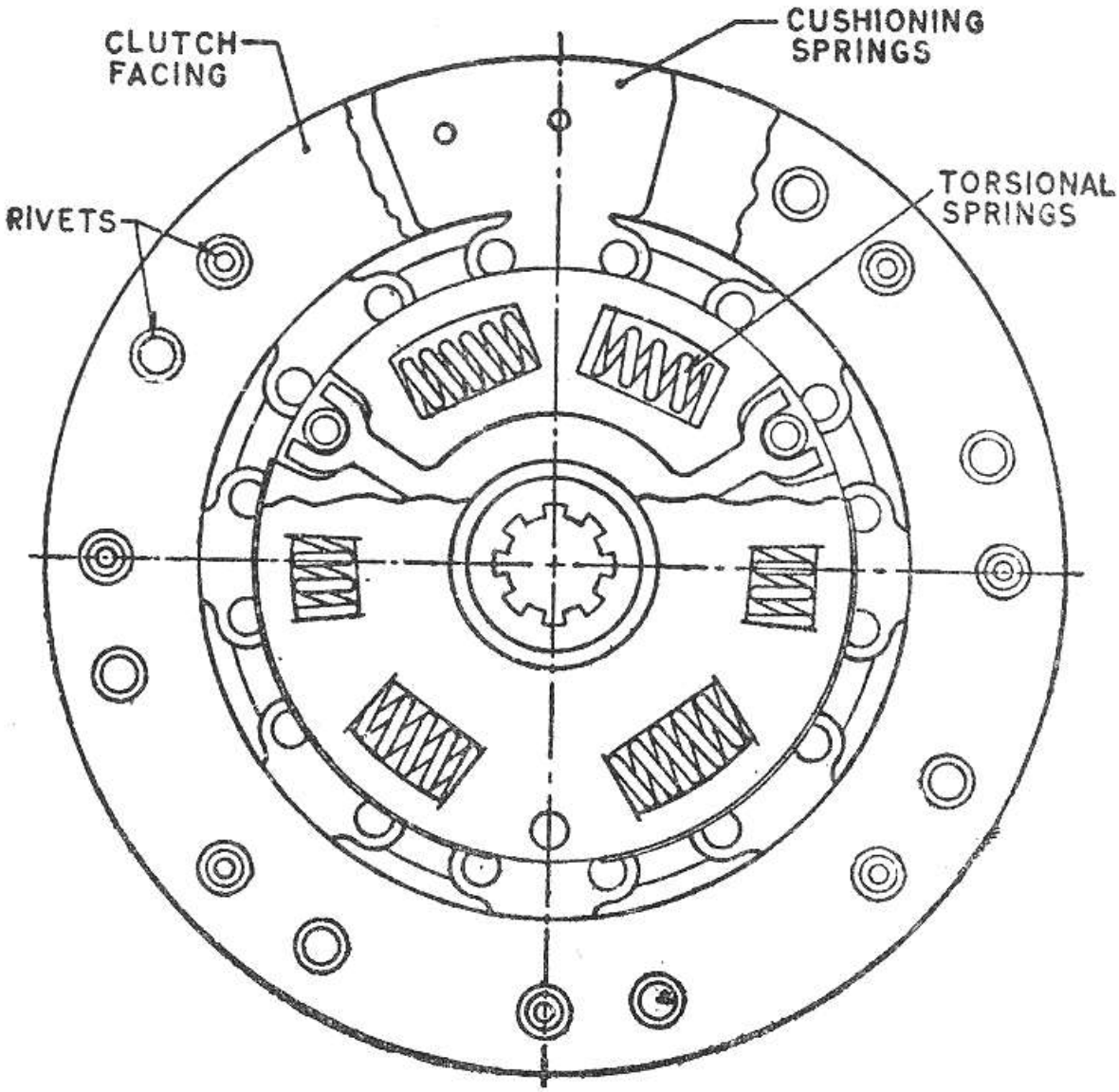
7. Mount the carburettor in its place and re-connect the fuel lines and the air cleaner

8. Start the vehicle and check its performance.

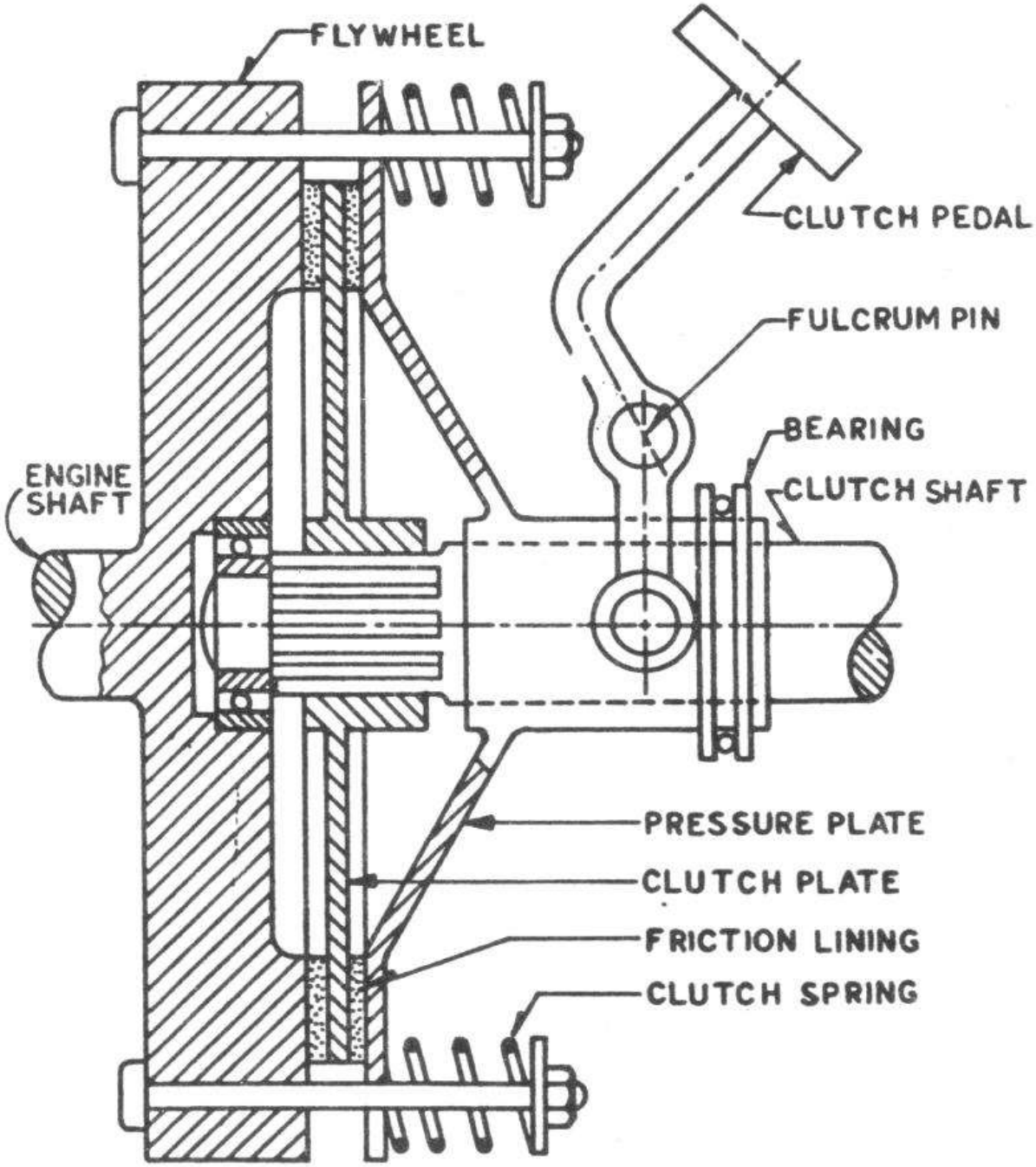
RESULT:

Thus the Solex carburettor is dismantled, inspected, overhauled and assembled.

CLUTCH PLATE



CLUTCH PLATE



SINGLE PLATE CLUTCH

Ex. No: **Date:**

Removing and Replacing of Pressure Plate and Clutch Plate, Fingers Adjustment and Clutch Plate Relining

AIM:

To dismantle, inspect, adjust and assemble the clutch assembly.

TOOLS & EQUIPMENT:

A clutch assembly, Spanner set, screw driver, clutch fixture, etc.,

PROCEDURE:

DISMANTLING OF CLUTCH:

1. To mount clutch assembly on clutch fixture.
2. Mark driving and pressure plate, so that they may be replaced in the same relative position on reassembly
3. Remove the set screw holding the with spring plate to the withdrawal plate and remove the withdrawal plate.
4. Compress the clutch assembly using fixture.
5. Loosen the bolts on the adjuster pads and remove the trust pads.
6. Slowly relieve the pressure on the springs by unscrewing the clutch fixture.
7. Separate the pressure plate, springs and the drive plate
8. Remove the bolts holding the lever brackets on the driving plate, and dismantle the withdrawal lever.

INSPECTION:

1. Examine the contact faces of pressure plate and face plate for cracks and wear.
2. Inspect the clutch linear of wear. If necessary reline the clutch using rivet and hammer.

ASSEMBLING OF THE CLUTCH:

1. Place the pressure plate under the clutch fixture.
2. Place the spring on the pressure plate.
3. Assemble the lever brackets along with the lever pivot pin, bush etc., on the driving plate Apply grease on the pivot pin and bush while fitting.
4. Lay the driving plate complete with springs cups and lever bracket assemblies on the top springs, making sure the identification marks line up.
5. Compress the assembly slowly, making sure the springs are seated properly then fit the trust pads with stepped portions upwards and tighter the bolts.
6. Release the pressure on the clutch and remove the clutch assembly.
7. Locate the clutch withdrawal plate on the levers and tighten the bolts securing the spring plate.

RESULT:

Thus the given single plate dry type clutch is dismantled, overhauled, reassembled and adjusted.

APPARATUS USED: = **TORSIOMETER**
MATERIAL: ..... DIAMETER:..... GAUGE LENGTH: = **50mm**

ANGLE TURNED BY HEAD (degs)	**TORSIOMETER READINGS (rads x10^{-3}**	**TORQUE (Nm)**	**ANGLE TURNED BY HEAD (degs)**	**TORQUE (Nm)**

MODULUS OF RIGIDITY (G): =
MAX. SHEAR STRESS: =
SHEAR STRESS AT YIELD: =

BEAM DEFLECTION.

OBJECT:

APPARATUS:

METHOD:

Calculations:

Graphs:

Conclusions:

TENSILE TEST

OBJECT

INTRODUCTION

GUIDANCE ON PROCEDURE:

COMPUTATION OF GRAPHS:

DISCUSSION