

# Chapter 25 WRENCHES

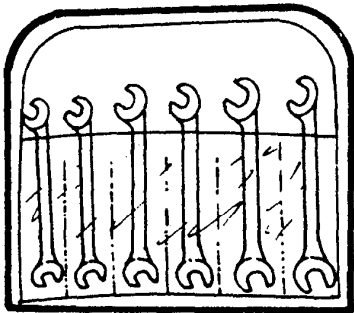
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## HOW TO CHOOSE AND USE THEM

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The "Types and Uses" section provides you with a list of some of the types of wrenches. These pages should help you select the right wrench to do the job.

The "Using" section tells you how to use the wrench to perform the desired function, The "Care" procedures tell you how to care for the items.



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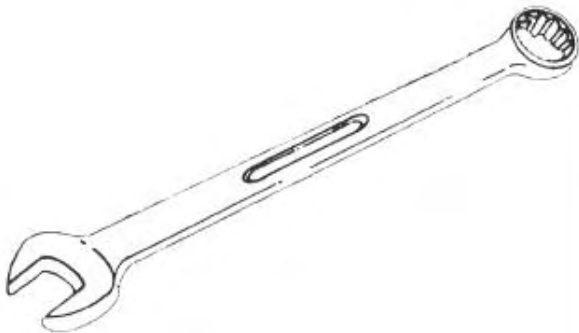
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## TYPES AND USES

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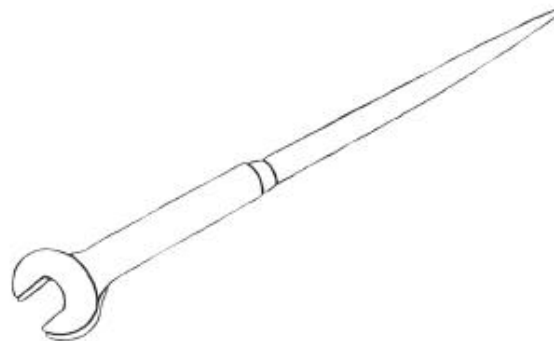
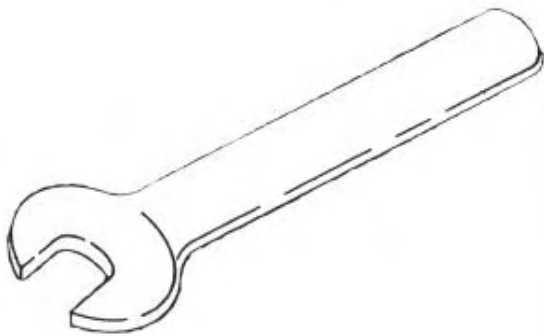
A wrench is a tool specially designed to tighten or loosen nuts, bolts, studs, and pipes. Wrenches are forged from steel alloy to prevent breakage. There are many different types of wrenches. Each type has its own use. By using the proper wrench for the task to be done, you will not break the wrench, damage the equipment, or cause personal injury. The following section is intended to give you information on the different wrench types.

### OPEN-END WRENCHES



The engineer's double open-end wrench has different size openings on each end. This type of an arrangement permits a smaller number of wrenches to complete a set. The engineer's double open-end wrench is also used to reach behind or below blind surfaces.

All open-end wrenches have open jaws on one or both ends of the wrench. Most jaw openings are offset from the shank portion of the wrench by 15 degrees. The wrench length is determined by the size of the jaw opening. Some of the more common types of open-end wrenches and their uses are listed below.



The construction wrench combines the open-end jaw with a long tapered shank providing a wrench/alignment punch combination. The construction wrench is used in the building trades and on heavy objects which require alignment before fastening.

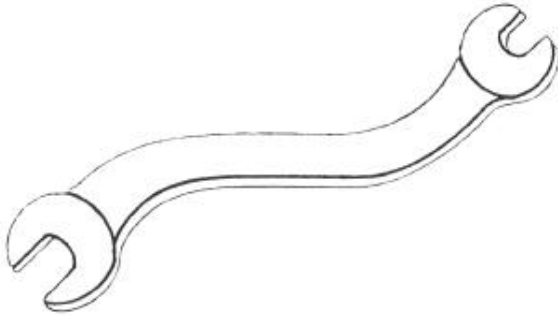
The engineer's single open-end wrench has a long smooth shank providing the user with a better gripping surface. It is used to reach behind or below blind surfaces.

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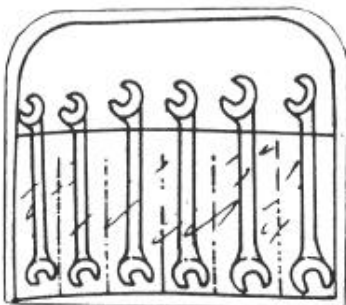
## TYPES AND USES - Continued

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### OPEN END WRENCHES (Cont)

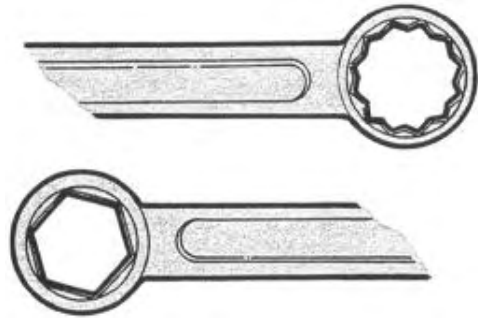


The S-Shape wrench has a 22-1/2 degree offset. It is used to reach around obstructing objects.



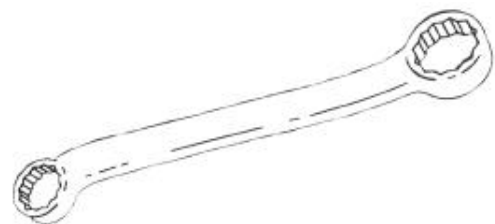
Ignition wrenches have the same size jaw opening on both ends. However, one end of this wrench is offset 15 degrees and the other end is offset 60 degrees. Ignition wrenches are smaller in size, as they are used to remove components of automotive ignition systems.

### BOX WRENCHES



A box wrench surrounds the nut, bolt head, or stud on all sides. It is available with both 6-point and 12-point openings. The 12-point opening is more common, as it may be used on both square and hexagonal bolt heads. Box wrench openings are offset from the shank by 15 degrees. A box wrench should be used whenever possible, as it provides the best protection to both the user and the equipment. The major disadvantage of the box wrench is that there must be enough clearance above and around the bolt head to place the wrench over the bolt head.

The length of the box wrench depends upon the size of the opening. Some of the more common types of box wrenches and their uses are shown below and on page 25-4.



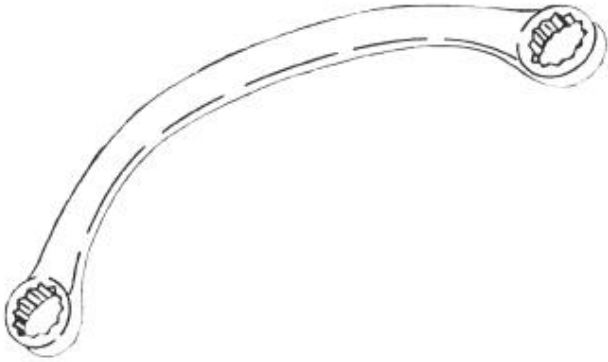
The most common box wrench is the double offset box wrench. It comes with a different size opening at each end. The double offset wrench is used to remove normal nuts and bolts.

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## TYPES AND USES - Continued

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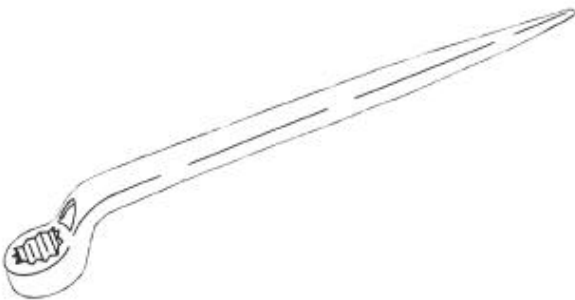
### BOX WRENCHES (Cont)



The half-moon wrench has different size openings at each end and has a curved shank. The half-moon wrench is used when it is necessary to reach around objects in tight spaces.

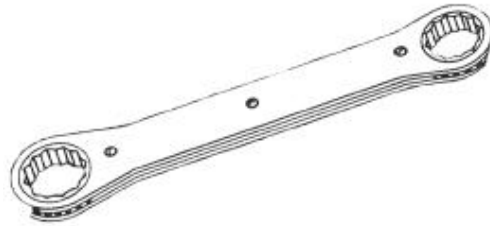


The split-box wrench is a 12-point wrench with 2 points cut away. The split-box wrench is used on pipe unions or couplings where you want the protection of a box wrench, but need to slide the wrench around a pipe.



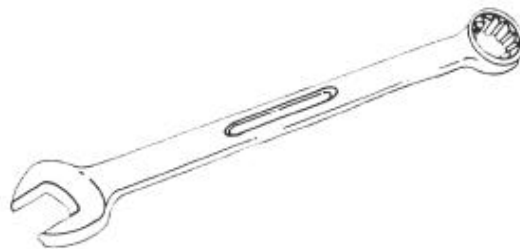
The structural-tapered handle wrench combines a box wrench opening with a tapered shank to produce a box

wrench/alignment pin combination. It is usually used on heavy structural construction (bridge girders, building beams, etc.).



Ratchet-box wrenches are either reversible or non-reversible. The ratchet-box wrench does not have to be lifted up and repositioned each time the shank has reached its maximum travel between two obstructions. The ratchet-box wrench provides an easy means of removing and/or installing nuts or bolts which are not under strain. These wrenches should not be used to torque down or to free nuts or bolts.

### COMBINATION WRENCHES



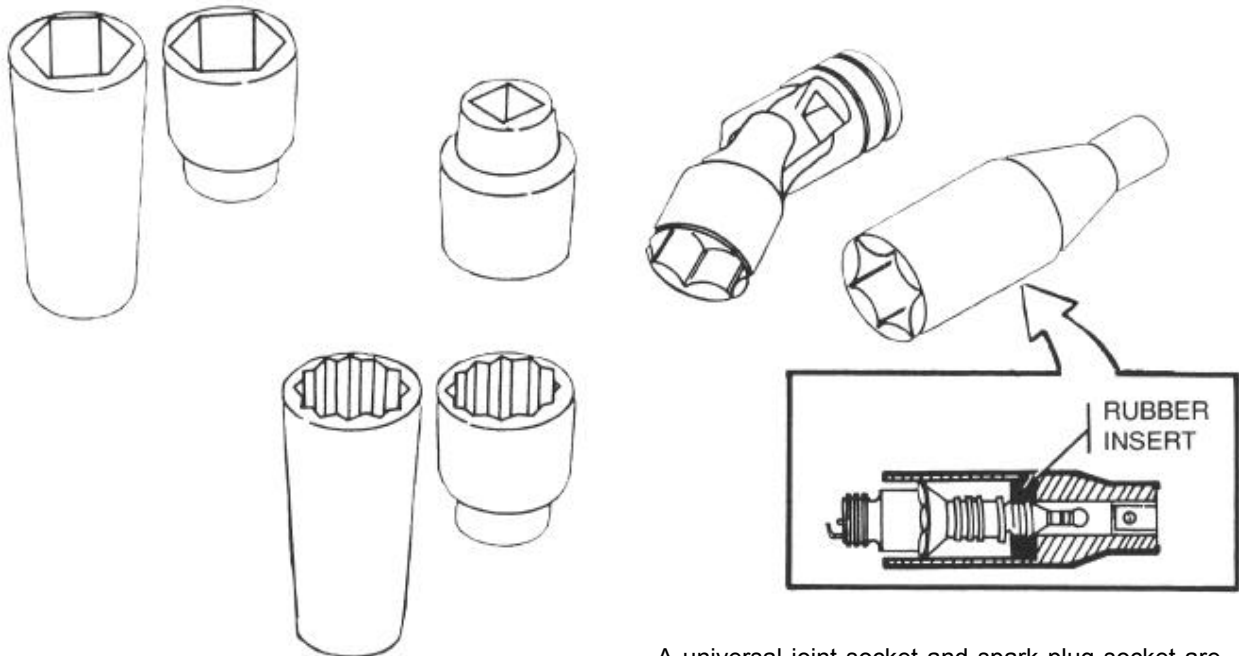
The combination wrench combines the best features of the open-end and box wrench into a single wrench. The size opening on the wrench is the same on both ends, but one end has a box head and the other end has an open-end head. The length of the wrench varies with the size of the head. The most common opening is offset from the shank by 15 degrees. They are used to remove common-size nuts and bolts.

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## TYPES AND USES - Continued

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### SOCKET WRENCHES



The socket wrench consists of a round metal sleeve with a square opening in one end for insertion of a handle, and a 6-point or 12-point wrench opening in the other. They are available in both common (short) and deep (long) lengths. The length of the socket does not determine its size. Socket wrenches usually come in sets. The square or drive end may vary in size from 1/4 to 1 inch. In socket sets, the drive end determines the size; for example, a 1/4-inch drive set may contain nine sockets ranging in size from 3/16 inch through 1/2 inch. In 3/8-inch drive, the smallest socket would be 3/8 inch. This overlap in size allows better control by the user and prevents breakage of either the socket or the equipment from using the wrong size handle.

A universal joint socket and spark plug socket are examples of specially designed sockets. The universal joint socket is used when it is necessary to reach around an object. The spark plug socket has a rubber insert. This insert protects the ceramic insulator when removing and/or installing the spark plug.

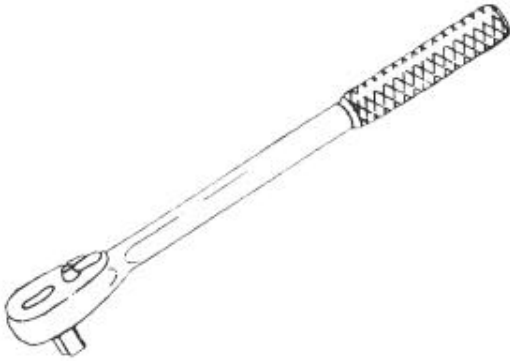
All sockets must be used with some type of handle. Sockets are used to remove and/or install common-size nuts or bolts.

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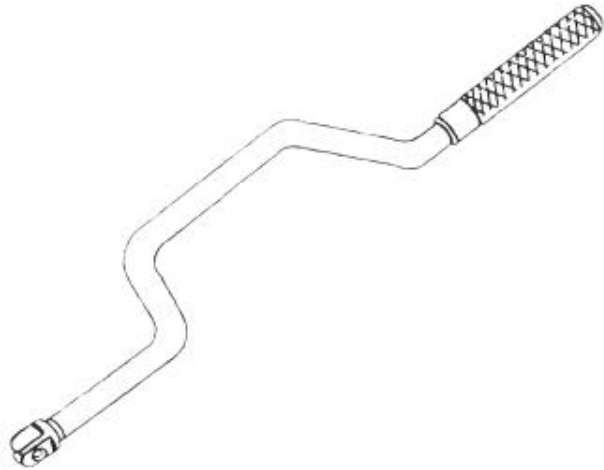
## TYPES AND USES - Continued

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### SOCKET WRENCH HANDLES, EXTENSIONS AND ADAPTERS



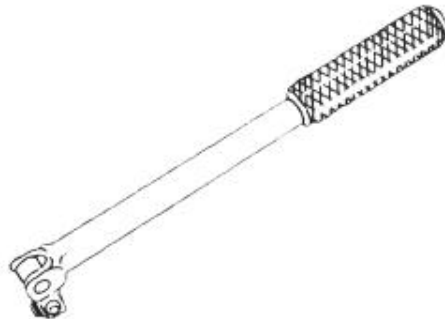
Ratchet handles may have either a straight-head or a flex-head. Both types have a selection lever on the top of the head to determine the direction of drive. The flex-head is used to go around objects. Both types are used with socket wrenches for rapid removal of nuts or bolts.



The speed handle has a brace-type shaft with a revolving grip on the top. It is used for rapid removal and/or installation of nuts or bolts, which are out in the open and have little or no torque.



The sliding T-Bar handle has a single head which may be adjusted along a bar handle. It has two spring-loaded balls, one for keeping the bar in the head and the other for keeping the socket on the head. The sliding T-Bar is used for increased leverage or for working around other objects.



A hinged handle has a hinged adapter on one end which may be rotated in 90 degree steps. The hinged handle is used when additional leverage or torque is needed to loosen nuts or bolts.

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## TYPES AND USES - Continued

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### SOCKET WRENCH HANDLES, EXTENSIONS AND ADAPTERS (Cont)



The spin-type screwdriver grip handle has a plastic or wood handle. It is used to remove and/or install small nuts and bolts.



Extensions are either rigid or flexible. They range from 2 to 17 inches in length. Extensions may be used with any socket handle combination to gain clearance above nut or bolt.

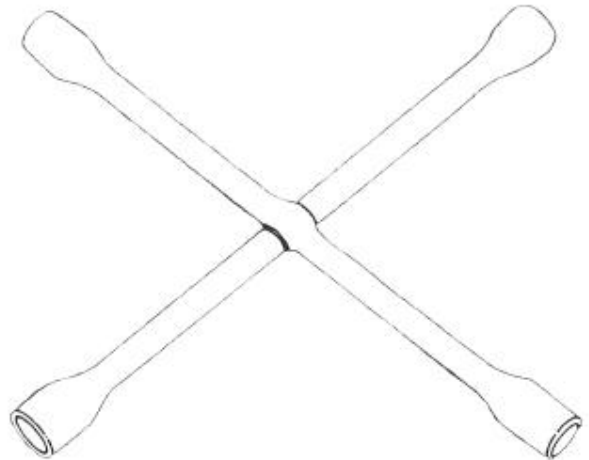


The ratcheting adapter converts a non-ratcheting handle into a ratchet drive. It is used for quick removal of nuts or bolts.



The socket wrench adapter is used to change the drive size between the socket and the handle. It usually increases or decreases the fractional size by one (1/4 inch to 3/8 inch). The socket wrench adapter is used to increase or decrease the drive end of a particular handle allowing it to be used with two different socket sets.

### SPECIAL PURPOSE SOCKET WRENCHES



The four-way socket wrench has four nonremovable sockets attached to four arms. Each of the sockets is a different size. The four-way socket wrench is usually used to remove or install the wheel stud nuts of a vehicle. The handle construction provides extra leverage when loosening and tightening the stud nuts.

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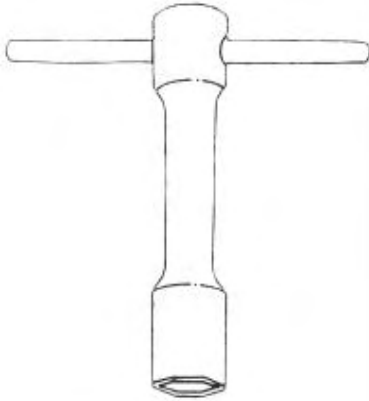
## TYPES AND USES - Continued

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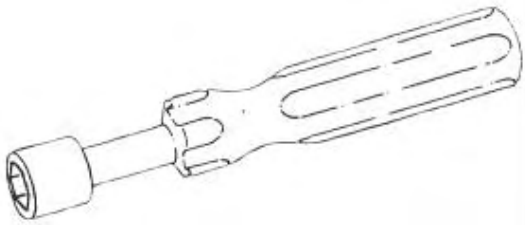
### SPECIAL PURPOSE SOCKET WRENCHES (Cont)



The 90-degree offset handle socket wrench has a fixed socket at the end of a bent handle. It is used for removing and/or installing a nut or bolt which may not be reached with a box or combination wrench.



The T-handle socket wrench has a fixed T-handle above a fixed socket wrench. The T-handle socket wrench has many uses. One of the more common uses is for shutting off or turning on water or gas lines. The T-handle permits the operator to apply the turning force required to operate the valve.

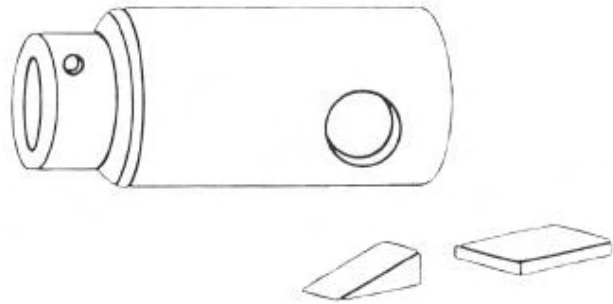


The screwdriver-type socket wrench has a socket fixed on the bottom of a screwdriver handle. They are used to remove and/or install small nuts and bolts.

Stud removers may be either the cam-operated type or the wedge type. They are used to remove studs from their seats for replacement. A single stud remover can be adjusted to remove different size studs.



The cam-operated type uses a concentric cam to get a grip on the stud. The cam is tightened on the stud through mechanical linkage between the drive shank and the cam.



Wedge-type stud removers are made of a socket housing and two metal wedges. The socket is placed over the stud to be removed and the wedges are driven into the socket to hold the stud. The socket housing is now turned with a handle to remove the stud.

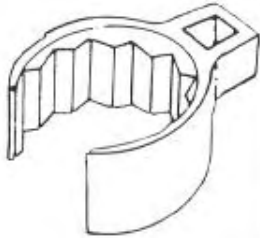


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## TYPES AND USES - Continued

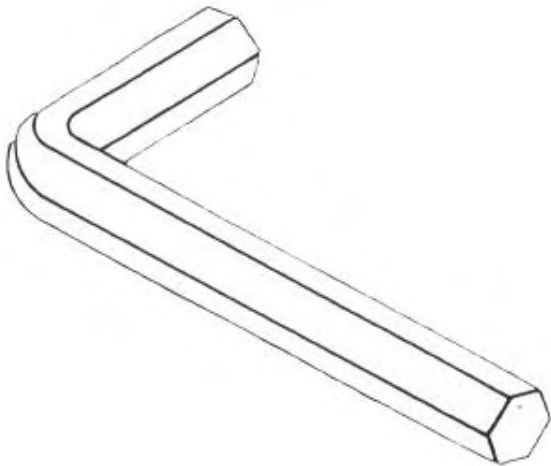
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### CROWFOOT WRENCH



The crowfoot wrench is an open-end wrench head which is turned with a socket handle. It is used to remove and/or install nuts or bolts. It is also used where an obstruction would prevent the use of a regular socket.

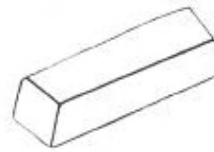
### HEX KEY WRENCH (SHORTER SECTION)



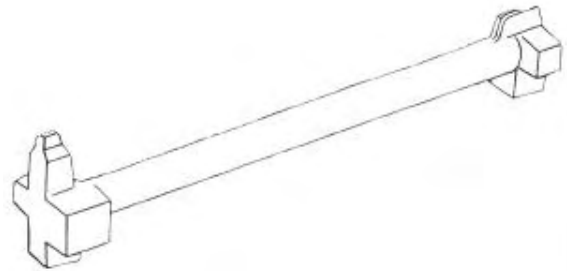
The hex key wrench is an L-shaped, six-sided wrench. Both ends of the "L" are the same size so you can turn the wrench either to gain access to the screw head or to obtain a leverage advantage. The hex key wrench is used to remove and/or install hex head screws.

### PLUG WRENCHES

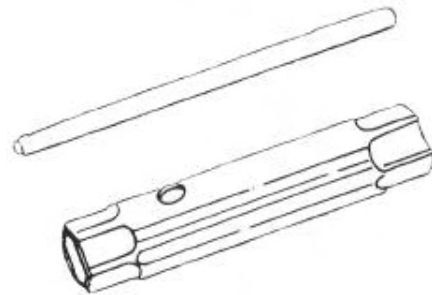
There are three basic types of plug wrenches, the bar-type, the multiple plug wrench, and the socket-type. Plug wrenches are used to remove and/or install drain plugs.



Bar-type plug wrenches may be either square or hexagonal and are about two inches long. A combination wrench or socket must be used to turn the plug.



The multiple plug wrench combines several plug ends on a common handle.



Socket-type plug wrenches are usually combined in sets with an assortment of handles. The set will contain several sizes.

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## TYPES AND USES - Continued

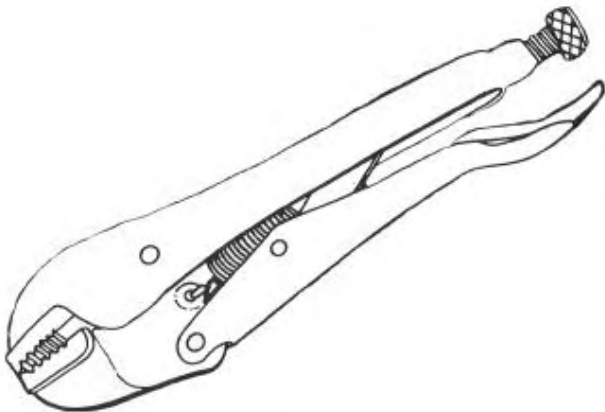
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### ADJUSTABLE OPEN-END WRENCH



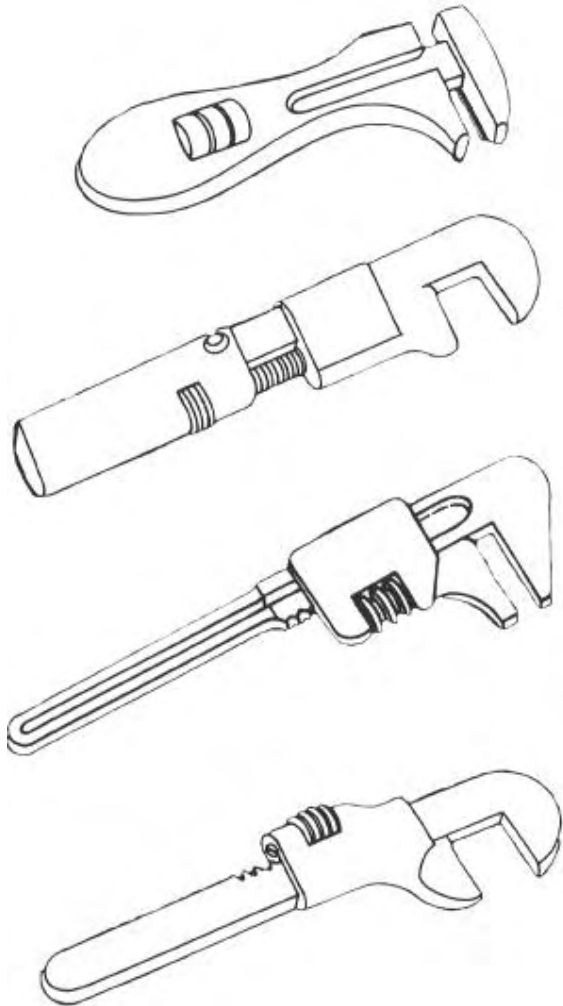
The adjustable open-end wrench has one fixed jaw and a movable or adjustable jaw. The adjustable jaw is set against the face of the nut by turning a knurled worm gear. Care must be exercised when using an adjustable wrench. Always use the fixed jaw for applying pressure to tighten or loosen nuts or bolts. Adjustable wrenches are used to remove and/or install nuts, bolts, and studs when the correct size wrench or socket is not available.

### CLAMP PLIERS



The clamp pliers are generally used more as a wrench than as a pair of pliers. It has a fixed jaw and handle which contains an adjustment screw for the movable jaw. The other handle is in two sections, one section to apply pressure and to lock the pliers, and the other section, when pulled, to release the grip. Clamp pliers are used to hold or clamp nuts and bolts which have been rounded off by using the wrong size wrench.

### MONKEY AND AUTO WRENCHES



The monkey and auto wrenches are similar and have one fixed jaw and an adjustable jaw which moves along the handle by turning a knurled worm gear. Monkey and auto wrenches are used to install or remove odd size nuts and bolts. An adjustable wrench must be used with care. Always apply pressure against the fixed jaw.

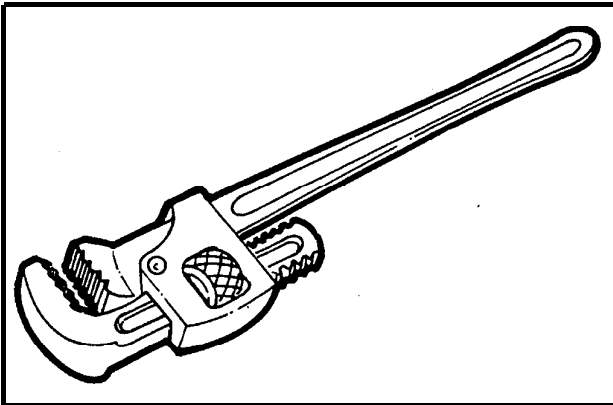
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## TYPES AND USES - Continued

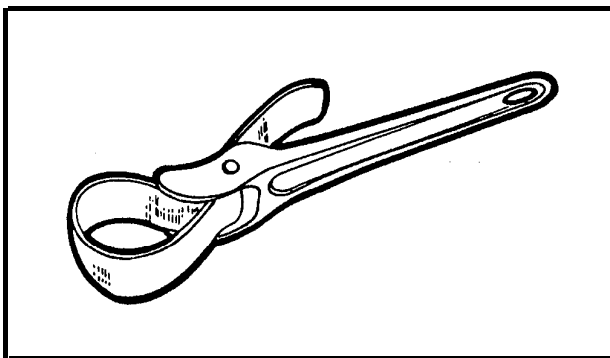
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### PIPE WRENCHES

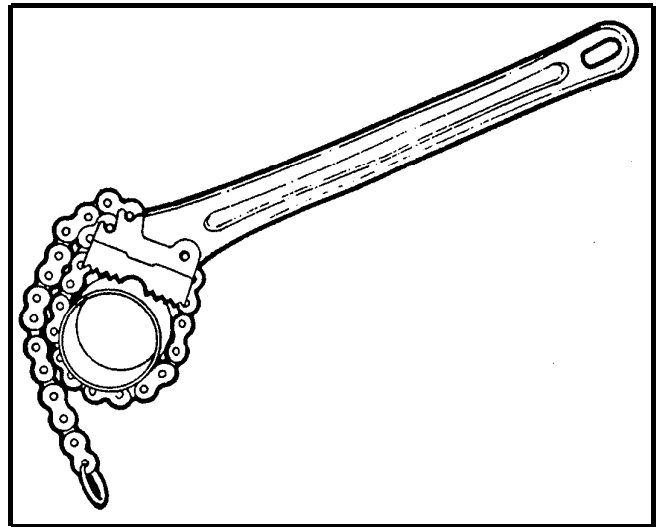
There are three basic types of pipe wrenches, the stillson wrench, the strap wrench, and the chain wrench. They are all used to connect or break pipe joints or to turn cylindrical parts.



The stillson pipe wrench has a fixed jaw which is on the end of the handle and an adjustable jaw at the top of the wrench. Adjustment is made by turning a knurled adjusting screw which moves the jaw. Always pull the pipe fitting towards the fixed jaw. The serrated (grooved) jaws of the stillson wrench will mar soft pipe.



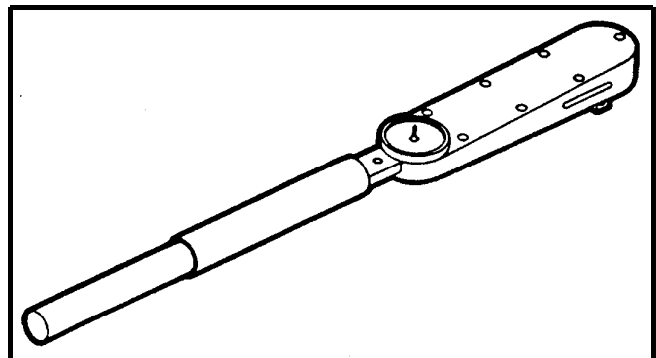
Strap pipe wrenches have a leather or canvas strap which is attached to the handle. The strap is looped around the pipe and back through the handle to grip the pipe. The strap pipe wrench will not scratch the surface of the pipe.



Chain pipe wrenches have a section of bicycle-type chain permanently attached to the handle. The upper section of the head has teeth which mate with the links of the chain. The chain is wrapped around the pipe and pulled over the head section of the wrench to grip the pipe. Chain pipe wrenches will scratch the surface of the pipe.

### TORQUE WRENCHES

Torque wrenches are designed to measure the specific degree of tightness of nuts or bolts. Torque wrenches are considered precision instruments and therefore must be calibrated at regular intervals. Torque wrenches are used for final tightening of nuts or bolts. Torque wrenches are normally calibrated in a right-hand direction only. If a unit is required to perform torquing operations in a left-hand direction, they must request that the supporting calibration facility calibrate the torque wrench in both directions.



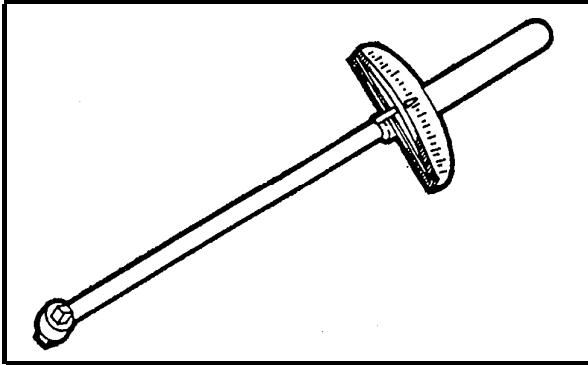
A dial torque wrench has a head which contains the drive element and a dial for reading the exact amount of torque.

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## TYPES AND USES - Continued

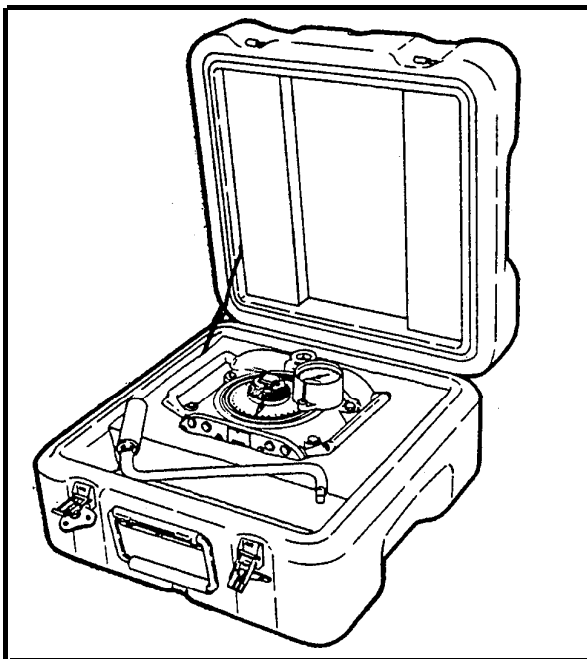
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### TORQUE WRENCHES (Cont)



A scale torque wrench has a rod which runs parallel to the handle and the drive element. This rod moves across the scale to the right or left as torque is applied.

### POWER TORQUE WRENCH



Using a powerful gear train, the power torque wrench is completely mechanical in operation. The power torque wrench is operated by a hand crank. The torque is calibrated in foot pounds, which is shown by a dial indicator on the top face of the power

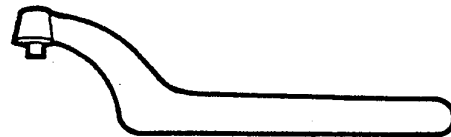
torque wrench. This type of torque wrench is used for tightening nuts and bolts requiring 200 or more foot pounds of torque.

#### NOTE

A special feature of this type of torque wrench is that it is possible to loosen as well as tighten nuts and bolts.

### SPANNER WRENCHES

Two basic types of spanner wrenches are the hook-type and the pin-type. Hook-type spanner wrenches are either fixed or adjustable and are normally used to tighten fire hoses or similar couplings which have a protruding lip. Pin-type spanner wrenches have pins protruding from the handle which fit into holes in the coupling or plate to be tightened or loosened. Spanner wrenches are special purpose wrenches and are to be used only for their intended purpose.



HOSE COUPLING PIN



FIXED HOOK



ADJUSTABLE HOOK

Three kinds of hook-type wrenches include the hose coupling pin, for tightening and loosening hose couplings, the fixed hook, for tightening or loosening couplings with protruding rims or edges, and the adjustable hook-type.

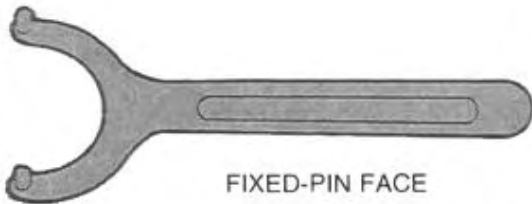
The adjustable hook-type is similar to the fixed hook-type. However, it may be adjusted around objects and fastened before use.

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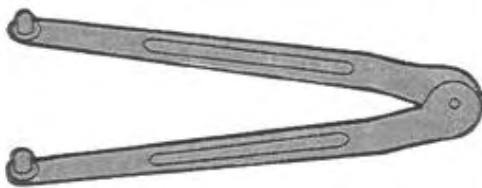
## TYPES AND USES - Continued

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### SPANNER WRENCHES (Cont)



FIXED-PIN FACE



ADJUSTABLE PIN FACE

There are two basic pin-type wrenches. The fixed-pin face has been designed to fit a particular pattern and is nonadjustable. The fixed-pin face is used to remove protective cover plates. The adjustable pin face has two arms joined at a common point. The other end of the arms contain pins which may be engaged in the holes of a cover plate for removal.

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## SAFETY

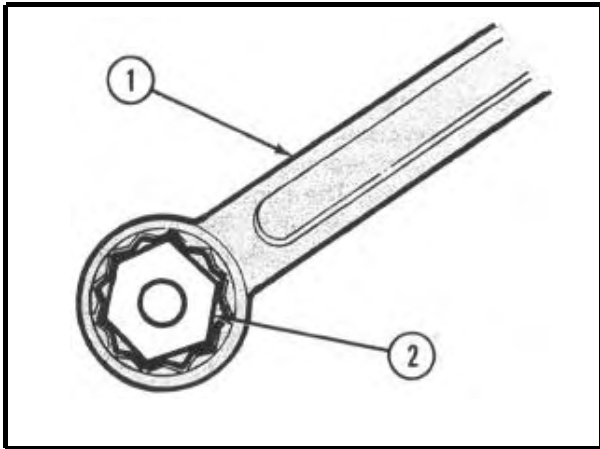
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1. Wrenches should fit the nuts or bolts they are to loosen or tighten.
2. Never turn adjustable wrenches so that the pulling force is applied to the adjustable jaw.
3. Do not attempt to extend the handle in any way to increase the leverage on a wrench. Increased leverage may damage the wrench or the work.
4. Apply penetrating oil to rusted nuts and/or bolts that resist turning. Allow time for oil to penetrate before attempting to turn.
5. Do not strike wrenches with hammers to tighten or loosen nuts or bolts.
6. Do not exert a hard pull on a pipe wrench until it has gripped the work firmly.
7. Remember to pull on the wrench, when possible, in order to protect your knuckles in case the wrench slips.
8. Return all wrenches to their proper places upon completion of each job. This eliminates the possibility of leaving them where they can injure someone.
9. Always keep the wrench in good condition, clean and free from oil or grease. Otherwise it may slip, resulting in possible serious injury to you or damage to the work.

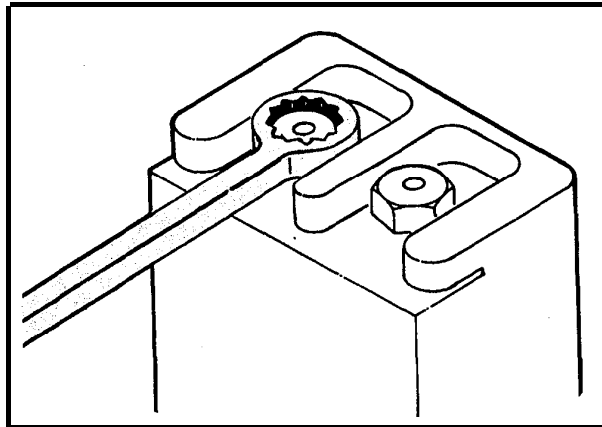
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## HOW TO USE A BOX WRENCH

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- 1 Select the size of wrench that fits the nut or bolt.
- 2 Place the wrench (1) on the nut or bolt (2). Swing the wrench clockwise to tighten and counterclockwise to loosen for a right hand threaded nut or bolt. Reverse the above for a left hand threaded nut or bolt.

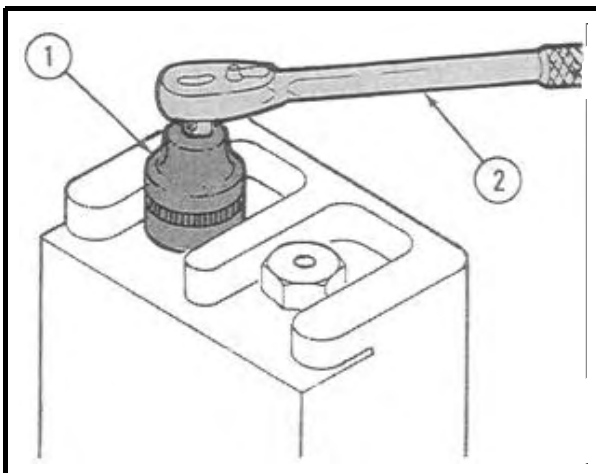


- 3 If there is insufficient room to swing the wrench in a full circle, lift it completely off the nut when it comes to the limit of the swing, and place it in a new position, permitting another swing. A swing through of a 15 degree arc is usually sufficient to continuously loosen or tighten a nut or bolt.
- 4 After the nut is tight, give it a final tightening.

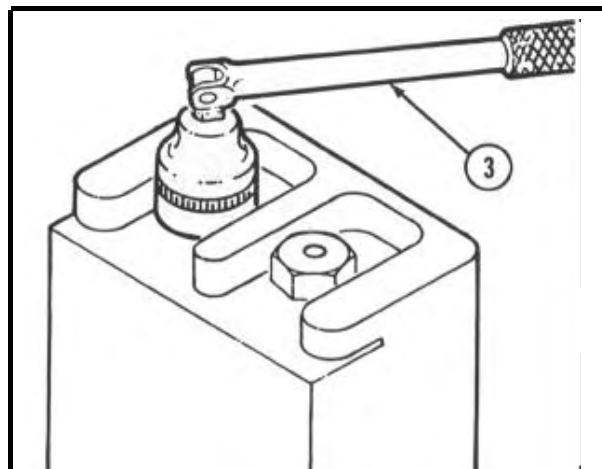
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## USING A SOCKET WRENCH

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- 1 Select the size of socket (1) that fits the nut or bolt to be turned and push it onto the handle (2) which is best suited to the job.
- 2 If there is room to swing, use the ratchet handle. (The handle may be made to ratchet in one direction for tightening work and in the other direction for loosening work.)
- 3 Swing the handle back and forth to turn the nut in the



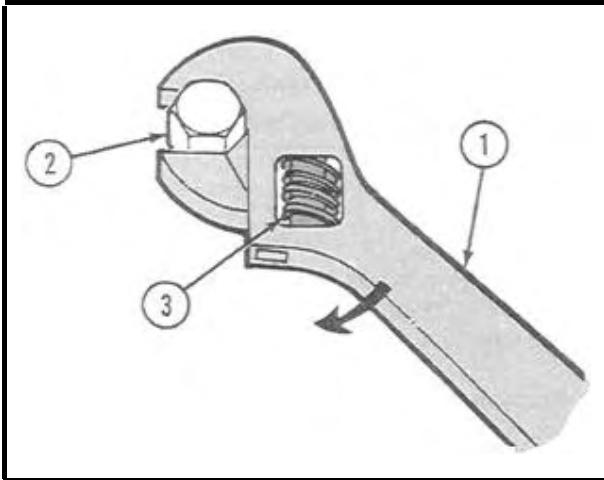
desired direction. (The socket need not be raised from the nut at the end of each swing.)

- 4 When a tight nut is to be loosened or a nut is to be set up, the nut hinged handle (3) can be swung at right angles to the socket to provide the most leverage. At the point where the nut turns easily, the handle can be swung to a vertical position and twisted rapidly between the fingers in the same manner as a screwdriver.

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## USING AN ADJUSTABLE OPEN-END WRENCH

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- 1 Place the wrench (1) on the nut (2) so that the force used to turn it is applied to the stationary jaw side of the wrench.
- 2 Tighten the knurled adjusting nut (3) until the wrench fits the nut as tightly as possible.

### CAUTION

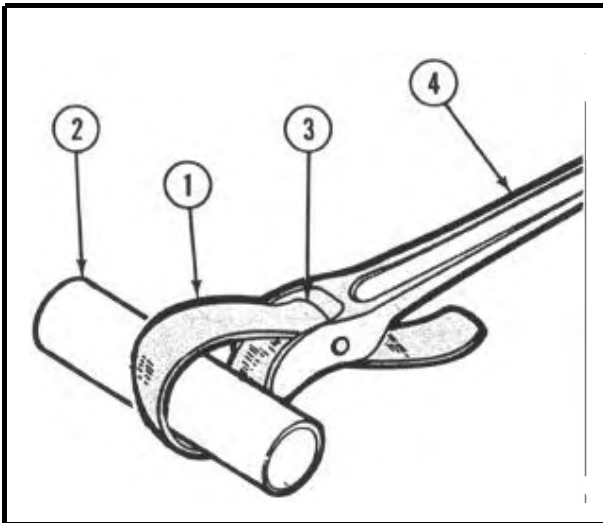
If the wrench does not fit tightly, it will slip and round the corner of the nut.

- 3 Swing the wrench clockwise to tighten the nut.
- 4 After the nut is tight, set it up (final tightening).

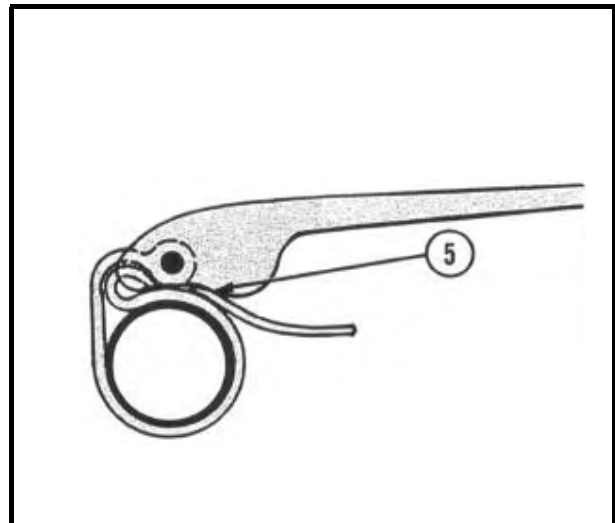
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## USING AN ADJUSTABLE STRAP PIPE WRENCH

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- 1 Loop the strap (1) around the pipe (2) in the opposite direction to that in which the pipe is to be rotated.
- 2 Slip the end of the strap through the shackle (3) and draw it up tightly.
- 3 Pull the handle (4) to turn the pipe in the desired direction until the desired tightness is obtained.



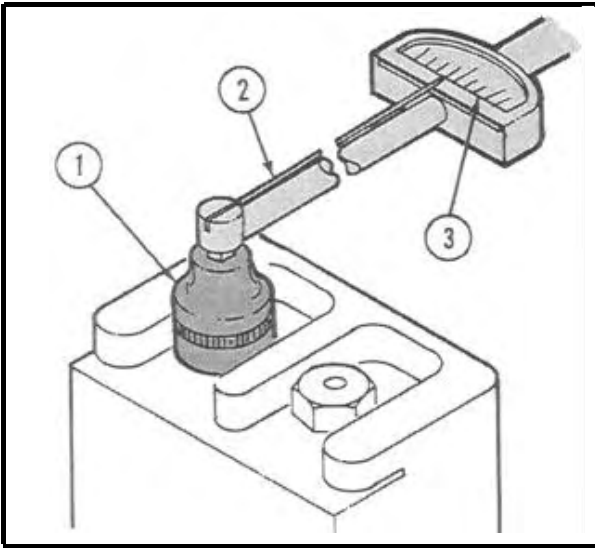
### NOTE

The jaw (5) at the end of the shackle will seat against the strap and, as the handle is pulled, the strap will tighten and turn the pipe.

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## USING THE TORQUE WRENCH

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- 1 Select proper size socket wrench (1) and attach to torque wrench square drive (2).
- 2 Place socket wrench on work and pull the torque wrench handle in the desired direction to tighten the work.

### NOTE

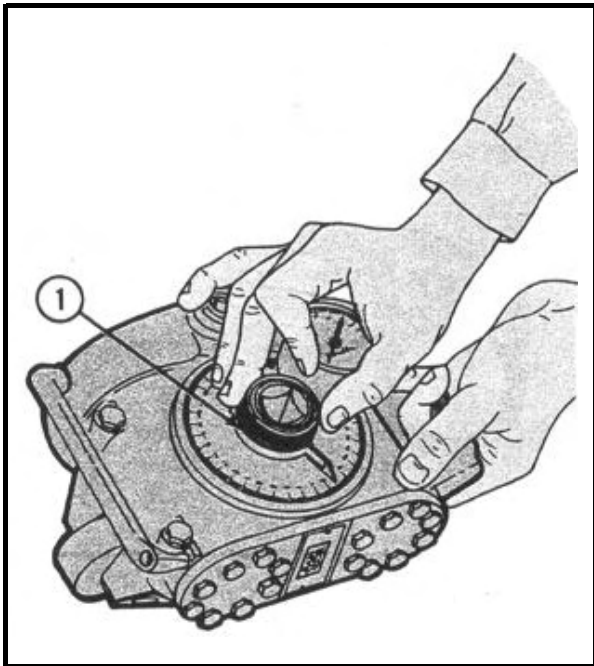
The tightening torque will be indicated on the dial or scale (3), depending on the type of the torque wrench used.

- 3 Remove the wrench when the torque on the dial or scale is reached.

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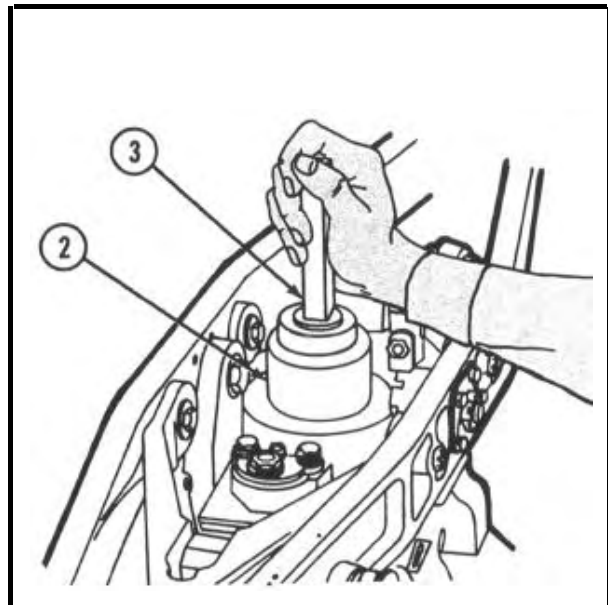
## USING THE POWER TORQUE WRENCH

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### NOTE

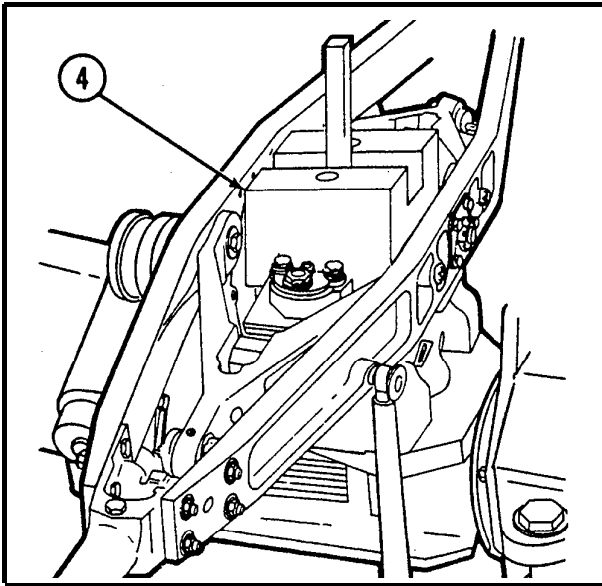
The following procedure is not the only application for the power torque wrench. However, use of this tool is basically the same regardless of model or application.



- 1 To tighten a nut, set the knurled ratchet indexer (1) (located on the front of the wrench) in the same direction the handle will be turned.
- 2 Install applicable socket (2) onto the nut to be tightened.
- 3 Install square drive bar (3) into the socket.



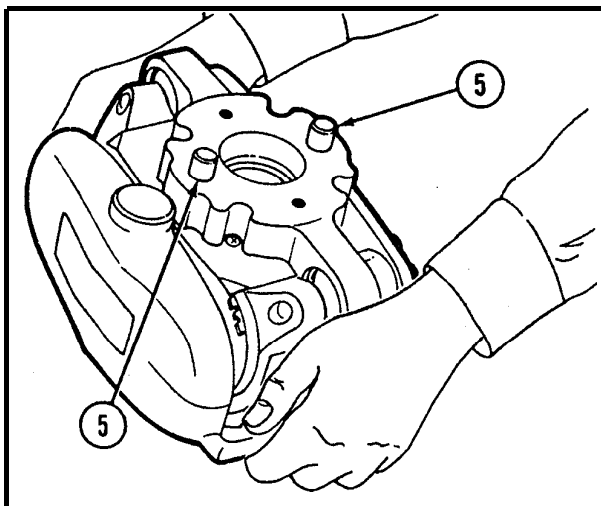
## USING THE POWER TORQUE WRENCH - Continued



### CAUTION

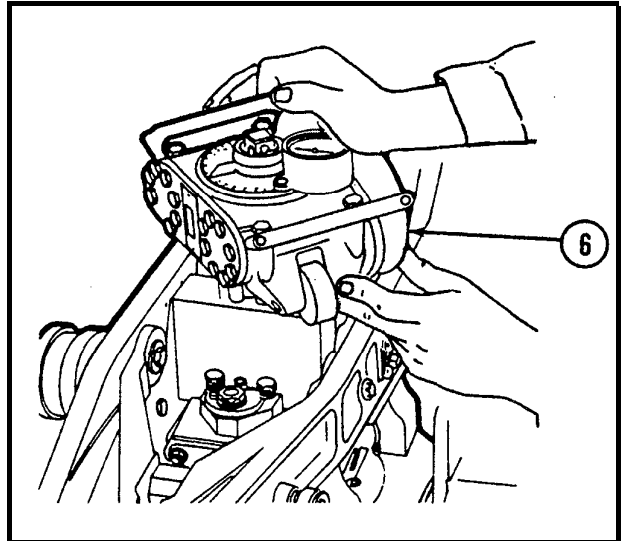
Different reaction adapters are required for various operations. Be careful to use the correct reaction torque adapter. Failure to do so will render torque wrench useless and can damage the equipment.

- 4 Install reaction torque adapter (4) over drive bar and socket as shown.

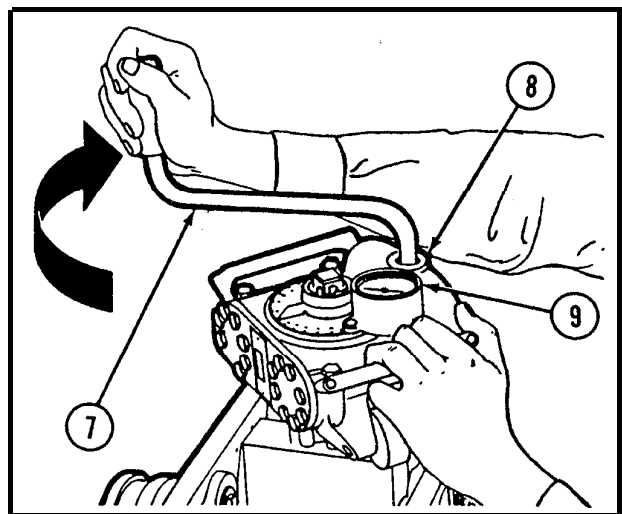


### NOTE

When installing power torque wrench, make sure the two locking pins (5) underneath the wrench are firmly engaged to the reaction torque adapter.



- 5 Install power wrench (6) onto square drive bar and reaction torque adapter. Rotate power wrench until the reaction torque adapter engages a fixed point.



### CAUTION

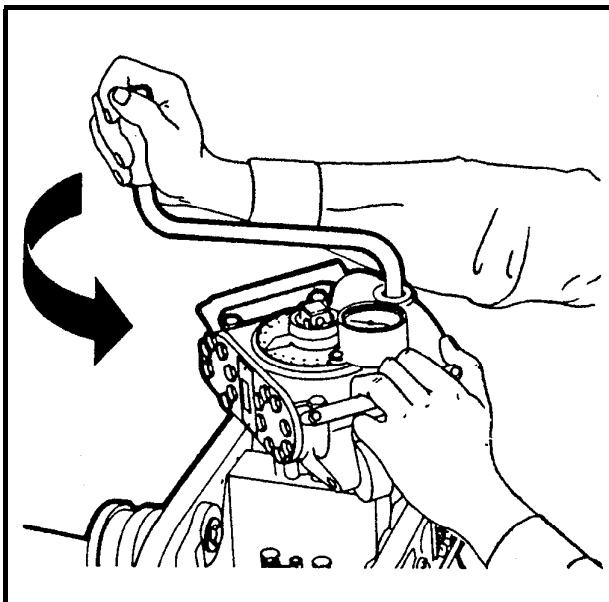
Do not use impact wrench of any kind to operate this wrench.

- 6 Install the crank handle (7) into the square input (8) and turn in the same direction as the output must turn.
- 7 Continue to turn crank until torque indicator (9) shows the desired torque reading.

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## USING THE POWER TORQUE WRENCH - Continued

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- 8 After obtaining the desired torque, turn the crank in the opposite direction until the torque indicator returns to zero (green band). This will remove the holding pressure on the wrench.
- 9 Remove the wrench, adapter, and socket.
- 10 To loosen a nut, repeat steps 1 through 6.

### NOTE

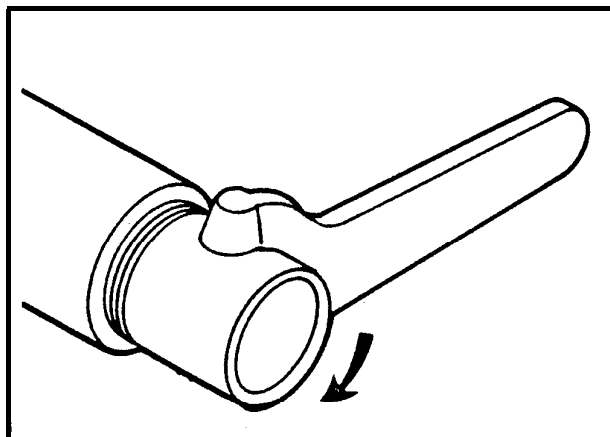
Normally, torque will build up in the wrench until break-away torque is reached. As the torque load is released, the indicator will reverse direction.

- 11 Continue to turn crank until indicator returns to "O."
- 12 Remove the wrench, adapter, drive bar and socket.

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## USING A SPANNER WRENCH

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- 1 Insert the pins or lugs into the pin holes of the part.
- 2 Keep the pin face of the wrench flush against the surface and turn the wrench.
- 3 Exert enough force against the wrench so that the pins do not pop out of the holes.
- 4 Make certain that the pins fit the holes and the force is applied with the handle perpendicular to the work.
- 5 Remove the wrench when desired tightness is obtained.

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## CARE

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- 1 Clean all wrenches after each use.
- 2 Wrenches that come in sets should be returned to their cases after use.
- 2.1 Store torque wrenches as follows:
  - a. When storing the micrometer-type torque wrenches or beam-type torque wrenches, check to make sure they are returned to zero before storing.
  - b. For the rest of the torque wrenches (unless your local SOP states differently) zero them before you store them. This takes the pressure off the spring, and the wrenches will last longer and give better service.
- 3 Apply a thin film of oil to the metal parts of all wrenches before storing them. Remove oil before use to prevent injury or damage.
- 4 For long-term storage, the wrenches should be covered with a rust-preventive compound and carefully stored in a dry place.