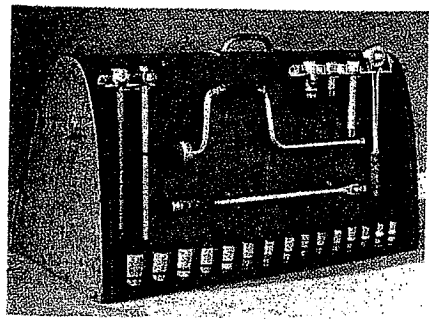

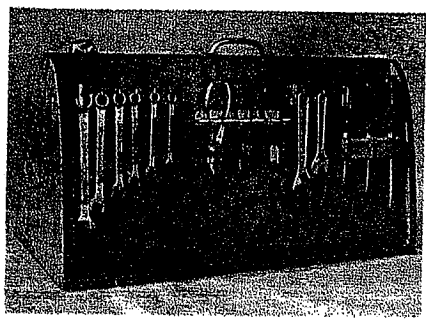

unit 2
using tools

Every small engine repair job requires the use o tools. These tools may be divided into tw groups: hand tools and power tools. Hand tool get their name from the fact that the hand supplie the power to operate them. Power tools however are operated by electricity or air hydraulic power In this unit we will study the most common smal tools you will use in repairing small engines.

LET'S FIND OUT: **When you finish reading and studying this unit you should be able to:**

1. **Identify types of wrenches used to repair small engines.**
2. **Identify the common types of screwdrivers used on small engines.**
3. **Describe the common types of hammers and pliers used in the shop.**
4. **Describe the metalworking tools used for small-engine repair.**
5. **Identify the common power tools used to repair a small engine.**

HAND TOOLS

Wrenches

Many small-engine parts are fastened together with bolts and nuts. Wrenches are tools designed to tighten or loosen bolts and nuts. Since there are many different sizes of bolts and nuts, wrenches must be made in many different sizes.

The size of a wrench is determined by the size of the nut or bolt on which it fits. The wrench shown in Figure 2-1 has 11/16 stamped on it. This

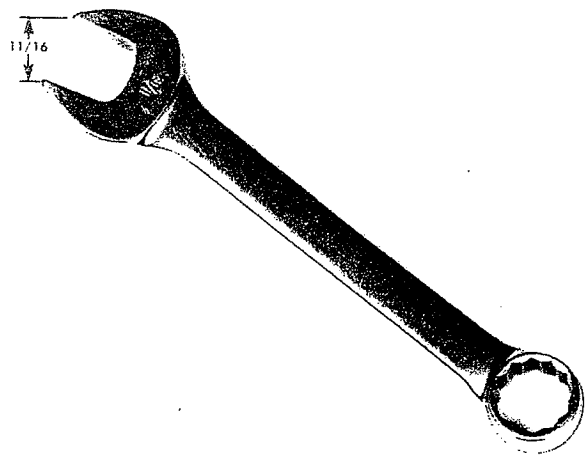

Figure 2-1. The size of a wrench is stamped on the handle or head.

means that the opening of the wrench is 11/16 inch across the flats and that it will fit on a bolt head or nut that is 11/16 inch across the flats.

Wrench sizes are given in the metric system or in the U.S. customary system. Both of these systems are explained in the chapter on measurement. Metric wrenches have sizes such as 10mm, 11mm and 12mm. Wrenches made under the U.S. customary system have fractional sizes such as 5/16", 3/8", 7/16", 1/2" and 9/16". In the past, American engines had only customary sized bolts and nuts, while foreign engines used the metric sizes. A mechanic needed two sets of wrenches to work on foreign and American motorcycles. American engine manufacturers, like other American industries, are changing slowly to the metric system. Before long only metric-sized wrenches will be necessary.

Open-End Wrench. An open-end wrench has an opening at the end to allow the wrench to be placed on a bolt or nut, Figure 2-2. Most open-end wrenches have different-sized openings on each end. An open-end wrench should not be used to loosen extremely tight bolts or nuts because it can easily slip off.

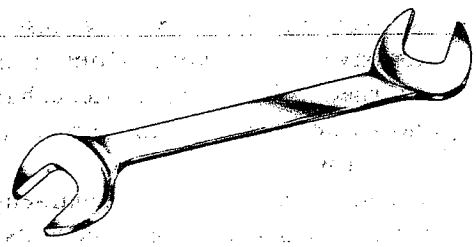

Figure 2-2. An open-end wrench has an opening to allow placement on a bolt or nut. (Snap-On Tools Corporation)

Box-End Wrench. A box-end wrench is designed to fit all the way around a bolt or nut, Figure 2-3. Box-end wrenches permit the mechanic to apply more force without the danger of the wrench slipping off the nut or bolt. Like other wrenches, box-end wrenches come in a number of sizes.

Combination Wrench. A combination wrench has a box-end wrench at one end and an open-end at the other, Figure 2-4. A set of combination wrenches provides the advantages of both types. The open-end side is used when space is limited; the box-end is used to finish tightening or to begin loosening. Combination wrenches usually are the same size at both ends.

Socket Wrench. A socket wrench, Figure 2-5, is similar to a box wrench in that it goes all the way around the bolt or nut. Socket wrenches are different in that they can be removed from the han-

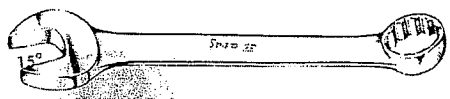

Figure 2-4. A combination wrench has a box and an open end. (Snap-On Tools Corporation)

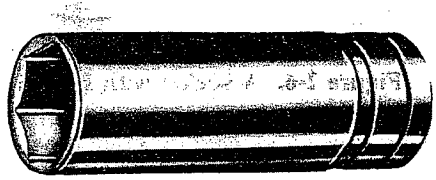

Figure 2-5. A socket wrench goes all the way around a nut or bolt. (Snap-On Tools Corporation)

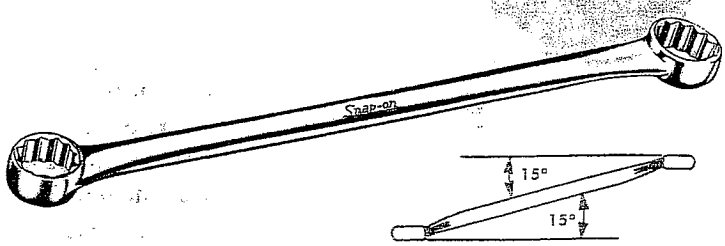

Figure 2-3. A box-end wrench fits all the way around a nut or bolt. (Snap-On Tools Corporation)

dle. Sockets are made in all the U.S. customary and the metric sizes to fit any size bolt or nut. A number of different-sized socket wrenches can be used with one handle.

Sockets are attached to their driving handles and attachments by a square hole at the end of the socket. Socket sets are made with different-sized square drive holes. For small bolts and nuts, such as engine shrouds or sheet metal, socket sets with a 1/4-inch square drive are useful. For general purpose work, a 3/8 drive set is popular. Heavier work requires a 1/2-inch drive socket set.

Besides having different opening sizes and drive sizes, sockets have different numbers of points and different lengths. The socket shown in Figure 2-6 has six points or corners that hold the nut or bolt. The socket shown in Figure 2-7 has eight points. The fewer points, the more strength the socket has, but the harder it is to slip over a bolt or nut.

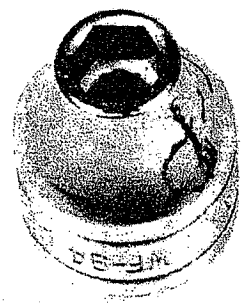

Figure 2-6. A socket with six points.

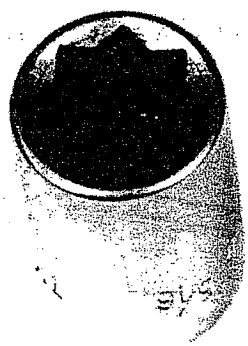

Figure 2-7. A socket with eight points.

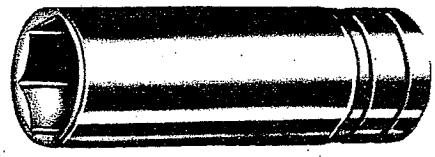

Figure 2-8. A deep socket is used for long bolts or studs. (Snap-On Tools Corporation)

The socket shown in Figure 2-8 is an example of a long or deep socket. It is useful for driving nuts on long bolts and studs or working in a deep hole.

A large number of handles and attachments is available to drive socket wrenches. A group of handles and attachments is shown in Figure 2-9. The sockets, handles and attachments must all have the same size drive.

The handle shown in Figure 2-10 is a ratchet. A socket wrench is attached to the square drive on the ratchet handle. The socket is then placed over a bolt or nut that is tightened or loosened by rotating the socket handle. The ratchet has a freewheeling or ratchet mechanism inside it that will allow it to drive the nut in one direction and then allow the handle to move freely in the other direction without driving the nut. This permits fast work in a small space because the socket does not have to be removed from the nut each time it is turned. A lever on the ratchet handle allows the mechanic to choose the direction in which the ratchet will drive.

Torque Wrench. When small-engine parts are reassembled after repair, the bolts and nuts must be tightened to exactly the correct degree. A special type of socket handle called a torque wrench is used for this purpose. A torque wrench measures the force applied to turn a bolt or nut. This force is called torque.

There are many types of torque wrenches. One popular type shown in Figure 2-11 uses a beam and pointer assembly. During tightening, the beam on the wrench bends as the resistance to turning increases. The torque is shown on a scale near the handle. Another type of torque wrench is shown in Figure 2-12. This one has a ratchet-drive head. An adjustable handle and scale allow the

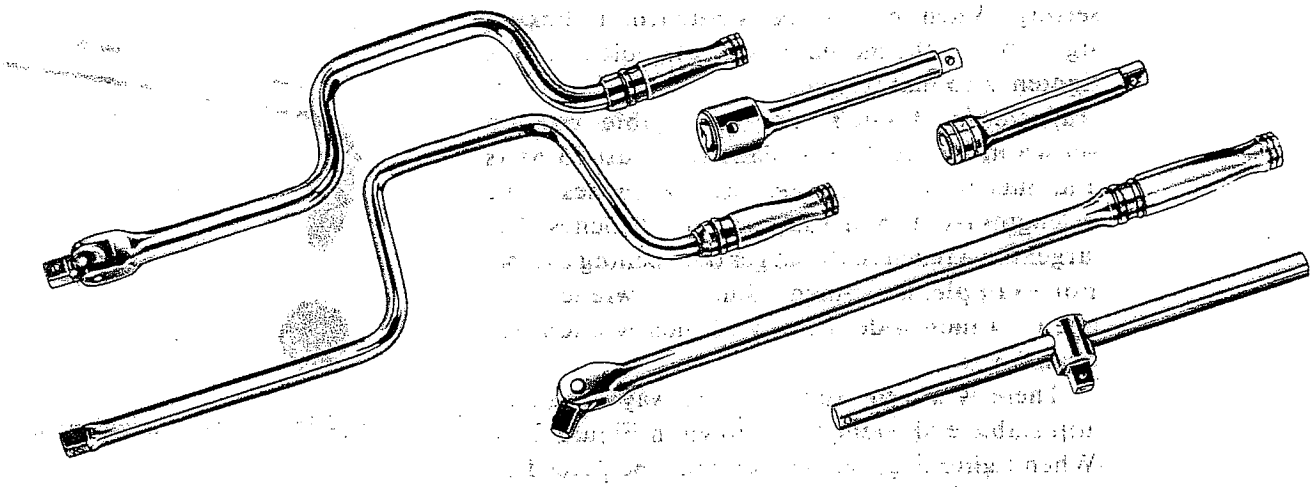

Figure 2-9. Socket wrenches are used with different handles and attachments. (Snap-On Tools Corporation)

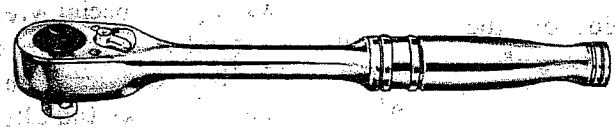

Figure 2-10. A ratchet will drive a socket wrench in either direction. (Snap-On Tools Corporation)

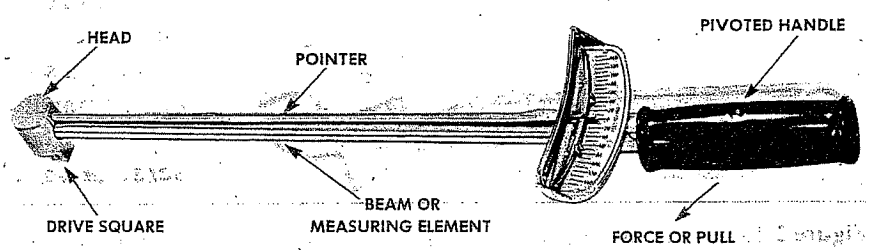

Figure 2-11. A torque wrench allows tightening to the correct degree. (Ammco Tools, Inc.)

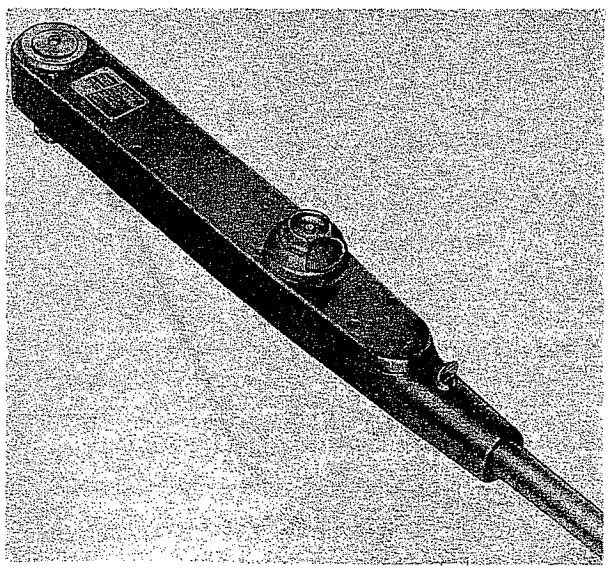

Figure 2-12. Some torque wrenches have a ratchet drive. (Ammco Tools, Inc.)

mechanic to adjust the wrench to a certain torque setting. When that torque is reached, a clicking signal warns the mechanic that the bolt or nut is tightened to that torque.

Adjustable Wrench. The adjustable wrench shown in Figure 2-13 is made to adjust to bolts and nuts of different sizes. These wrenches come in lengths from about four to about 20 inches. The larger the wrench is, the larger the opening can be. For example, a six-inch adjustable wrench will open 3/4 inch wide while a 12-inch wrench will open 1 5/16.

There is a right and a wrong way to use an adjustable end wrench, as shown in Figure 2-14. When tightening, the wrench must be placed on the bolt or nut so that the stress is placed on the stationary jaw (the jaw that does not move). If used incorrectly, the wrench can slip, hurting you and damaging the nut or bolt. In addition, the adjustable jaw of the wrench can be damaged.

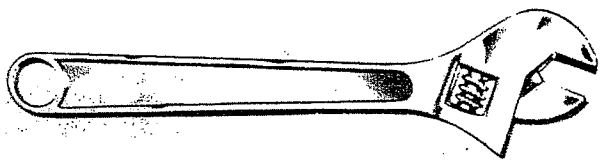

Figure 2-13. An adjustable wrench adjusts to different sizes. (Snap-On Tools Corporation)

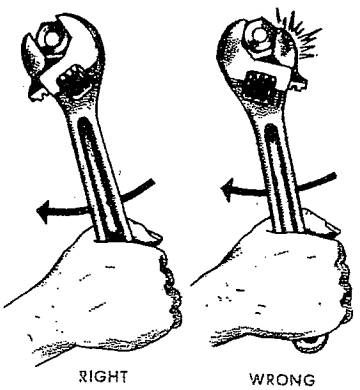

Figure 2-14. Always put the stress on the stationary jaw. (General Motors Corporation)

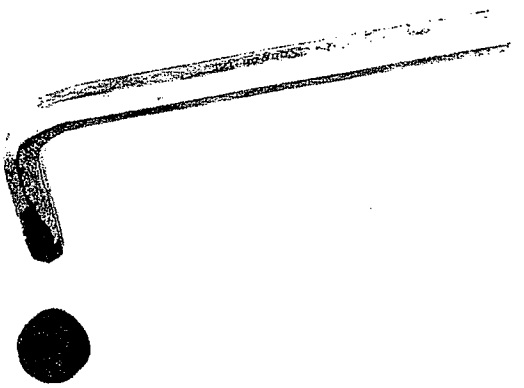

Figure 2-15. A hex-head (allen) screw and wrench.

Hex Wrench. Many drive pulleys on sma engines are held in place with hex-head screw These screws require special wrenches. An exan ple of a hex-head screw and wrench is shown i Figure 2-15. Hex-head screws and wrenches a often called allen screws and allen wrenches. He wrenches are available in sets of different size with the size determined by the size of the screw i which they fit. They are made in U.S. customar sizes such as 3/32 and 1/8, or in metric sizes such a 4mm, 5mm and 6mm.

Screwdrivers

Many engine components are held togethe with screws. A screwdriver is a tool used to turn o drive a screw. It should never be used as a pry ba

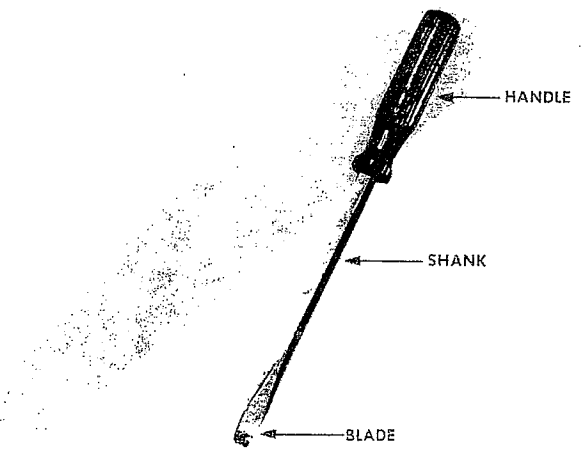

Figure 2-16. Parts of a screwdriver.

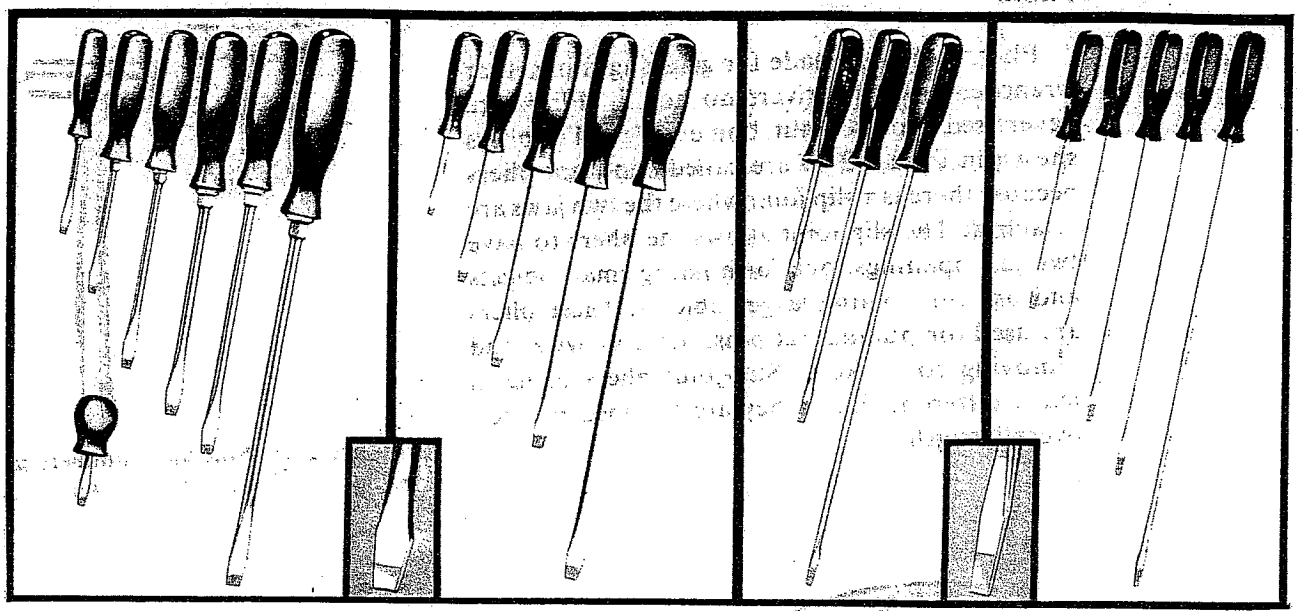

Figure 2-17. A flat-blade screwdriver is used with slotted screws. (Snap-On Tools Corporation)

The parts of a screwdriver are shown in Figure 2-16. The screw is driven by the blade on the screwdriver. The shank connects the blade to the handle. Some screwdrivers have handles made from wood, but plastic is more common. Shanks are made in different lengths and shapes. Some shanks are round; others are square. As we will see below, screwdrivers have different types of blades to drive different types of screws.

Flat-Blade Screwdriver. Screwdrivers used to drive a screw with a straight slot in the top are called flat-blade screwdrivers, Figure 2-17. The length of these screwdrivers sometimes is given by the length of the shank and sometimes by the overall length. Care must be taken to use a screwdriver that fits the slot in the screw properly. The blade should fit into the slot snugly. Otherwise the head of the screw may be damaged.

Phillips Screwdriver. A screw with crosscut slots is driven by a phillips screwdriver, Figure 2-18. A phillips screwdriver is not likely to slip out of the screw. These screwdrivers come in sets of various lengths and blade sizes. The blade sizes are based on a numbering system from 0 (smallest) to 6 (largest).

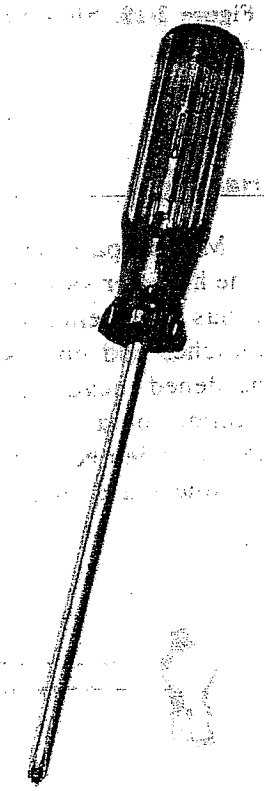

Figure 2-18. A phillips screwdriver is used with phillips screws.

Pliers

Pliers are tools made for gripping things that wrenches or screwdrivers do not fit. Pliers are never used to drive a nut, bolt or screw. The pliers shown in Figure 2-19 are called slip-joint pliers because there is a slip joint where the two jaws are attached. The slip joint allows the pliers to have two jaw openings: one for holding small objects and one for holding larger objects. These pliers are used for pulling out pins, bending wire, and removing cotter keys. Slip-joint pliers come in many different sizes. They are grouped by their overall length.

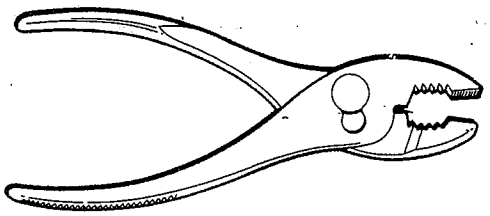

Figure 2-19. Slip-joint pliers are used to hold small objects.

Hammers

Many repair jobs require the use of a hammer. The hammer shown in Figure 2-20 is a ball peen. It has a hardened steel head and is used to drive punches and chisels. Since the ball peen has a hardened head, it should never be used to hammer on a small-engine part. The part could easily be dented or otherwise damaged. Ball peen hammers are made in different sizes and are grouped by the weight of the head. Small ones weigh as little as four ounces and big ones weigh more than two pounds.

Figure 2-20. A ball peen hammer is used to drive punches and chisels. (Snap-On Tools Corporation)

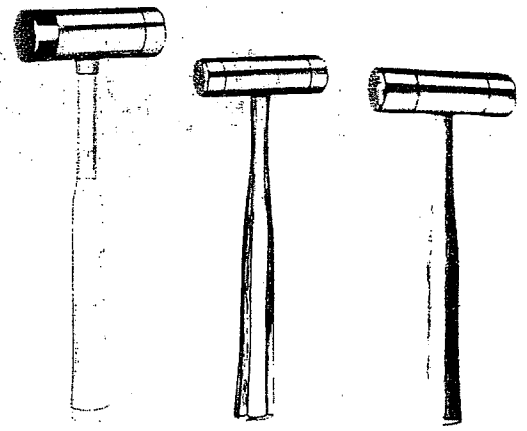

Figure 2-21. Soft-face hammers protect engine parts. (Snap-On Tools Corporation)

When a small-engine part must be hammered, care must be taken not to damage it. A number of hammers, Figure 2-21, are made with heads softer than small-engine parts. The common soft-face hammer heads are brass, rubber, plastic and rubber-covered steel. The mechanic must choose the correct soft-face hammer for a particular job.

Metalworking Tools

Many small-engine repair jobs require the use of metalworking tools to cut or shape metal. Files, hacksaws, chisels, twist drills, taps, and dies are metalworking tools.

File. A file, Figure 2-22, is a hardened-steel tool used to polish, smooth or shape by removing bits of metal from the object. The face of the file has

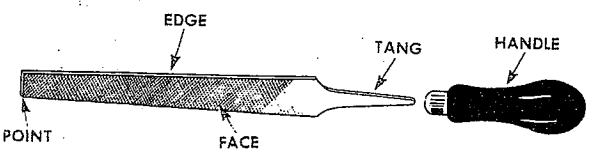

Figure 2-22. A file is used for forming and smoothing surfaces.

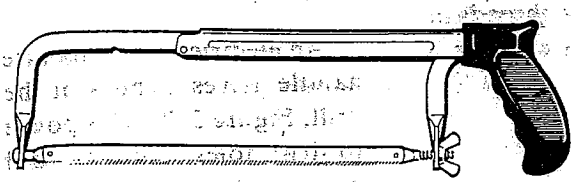

Figure 2-23. A hacksaw is used to cut metal.

Figure 2-24. A chisel is used to cut or shape metal.

Figure 2-25. Twist drills are used to cut holes.

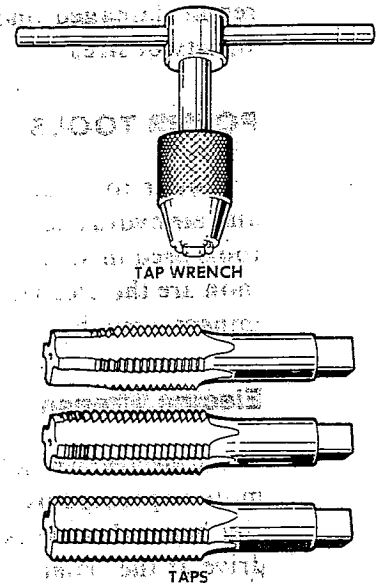

Figure 2-26. A tap is used with a tap wrench to make or repair inside threads.

rows of cutting teeth. Files are made in different lengths, measured from the tip to the heel. A pointed end, the tang, is shaped to fit into the handle. A handle must always be attached when filing to protect the mechanic from the sharp tang.

Hacksaw. A hacksaw, Figure 2-23, is a saw designed to cut metal. Mechanics use a hacksaw to cut exhaust pipes and other metal parts that are made during a repair job. The hacksaw may have a rigid frame or an adjustable frame which can take hacksaw blades of different lengths. Hacksaw blades are made in different lengths and with different numbers of teeth.

Chisel. A chisel is a bar of hardened steel with a cutting edge ground on one end. It is used with a hammer to cut or shape metal. The chisel shown in Figure 2-24 is the most common. It is called a cold chisel.

Twist Drills. Twist drills, Figure 2-25, mounted or chucked in an electric drill, are used to drill holes. There are three parts to a twist drill. The end of the drill is called a point, the spiral portion the body, and the part that fits in the electric drill motor is the shank. The tapered-shank drill fits in a special tapered chuck in a drill press or lathe. The straight-shank drill commonly is used in portable drill motors.

Tap. A tap, Figure 2-26, is a metalworking tool designed to make or repair inside threads. A tap of the correct size is installed in a holding tool called a tap wrench. The tap is then driven into a hole either to make new threads or to repair damaged ones. Taps come in a variety of sizes.

Die. A die, Figure 2-27, is a metalworking tool used to repair or make outside threads. A die is

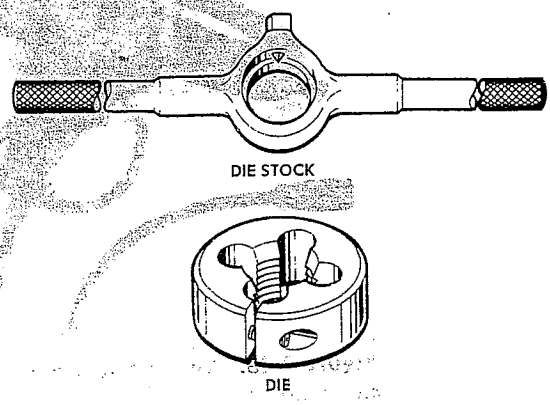

Figure 2-27. A die is used with a die stock to make or repair outside threads.

used in a tool called a die stock. The die is then driven down over the part to make new threads or repair damaged ones. Like taps, dies come in a variety of sizes.

POWER TOOLS

Power tools are tools operated by electricity and air hydraulic power. There are several power tools used in small-engine repair. The most common are the electric wrench, electric drill and air impact wrench.

Electric Wrench

An electric wrench, Figure 2-28, has an electric motor operated by a trigger on the handle. Special heavy-duty sockets are attached to a socket drive at the front of the wrench. Holding down the trigger spins the drive and socket. A reversing switch allows the mechanic to loosen as well as tighten bolts and nuts. The main advantage of the electric wrench is speed. Its motor drives a socket much faster than it can be driven by hand. Electric wrenches are especially useful for disassembling parts held together with many bolts and nuts, such as engines and transmissions.

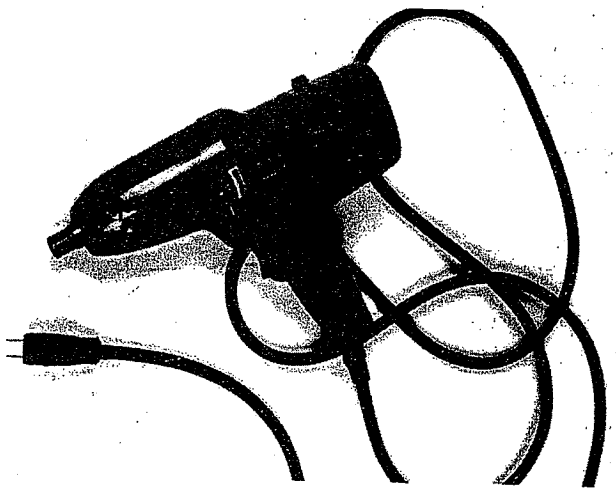

Figure 2-28. An electric wrench drives bolts or nuts electrically.

Electric Drill

An electric motor operated by a trigger on t handle drives a chuck at the front of the electr drill, Figure 2-29. This power tool is used not on to drill holes, but also to drive engine cylind hones and deglazers.

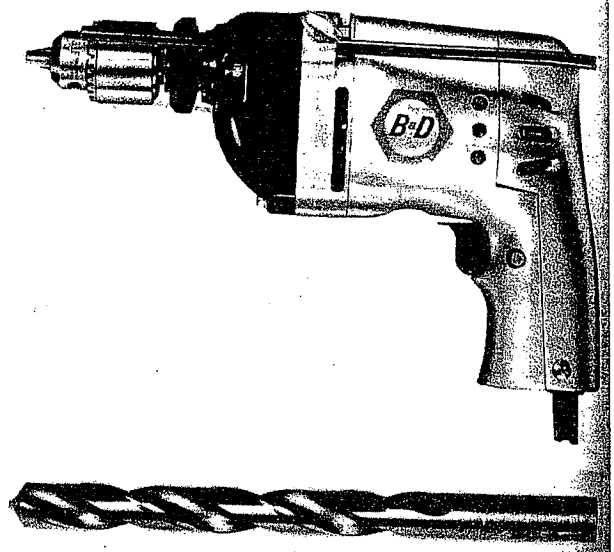

Figure 2-29. Twist drills are driven by an electric dril (Black & Decker Co.)

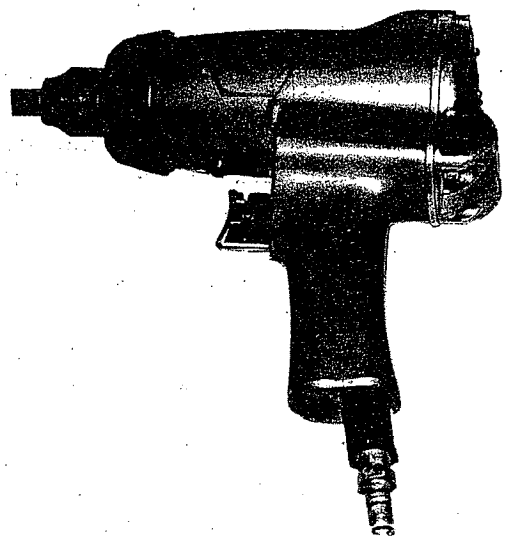

Figure 2-30. A bolt or nut which is difficult to loose may be removed with an impact wrench. (K-D Tools)

Air-Impact Wrench

An air-operated wrench, Figure 2-30, is connected to an air line. Pulling the trigger causes the air to rotate a socket attached to the drive on the wrench. A reversing switch allows the mechanic to loosen as well as tighten. Many air wrenches are designed with an impact feature. An impact wrench not only drives the socket but also vibrates or impacts it in and out. The force of the impact helps to loosen a bolt or nut that is difficult to remove.

NEW TERMS

adjustable wrench: A wrench designed to adjust to different sizes of bolts and nuts.
air-impact wrench: A wrench powered by compressed air.
chisel: A bar of hardened steel with a cutting edge ground on one end. It is driven with a hammer to cut metal.
combination wrench: A wrench with a box end at one end and an open end at the other.
die: A tool used to cut external threads.
electric drill: A drill powered by electricity.
electric wrench: A wrench powered by electricity.
file: A hardened steel tool with rows of cutting edges used to polish, smooth or shape by removing metal.
flat blade screwdriver: A screwdriver with a blade or tip made to drive common slotted screws.
hacksaw: A saw for cutting metal.
hex-head wrench: A wrench used to tighten or loosen allen, hex-head or hollow-head screws.
open-end wrench: A wrench with an opening at the end to allow it to be positioned on the bolt or nut.
phillips screwdriver: A screwdriver with a point on the blade or tip, used for driving phillips-head screws.
pliers: A tool designed for gripping objects that wrenches or screwdrivers will not fit.
power tool: Any tool powered by electricity and compressed air.
screw: A threaded fastener that fits into a threaded hole in an automotive component.
socket handles and attachments: Tools used to drive socket wrenches.
socket wrench: A wrench that fits all the way around a bolt or nut and is made to be detached from a handle.
tap: A tool used to cut internal threads.
torque wrench: A wrench designed to tighten bolts or nuts to the correct tightness or torque.
twist drill: A hardened cutting tool made to cut or drill a hole.

SELF CHECK

1. What are wrenches used for?
2. In what two ways are wrench sizes specified?
3. What does *10mm* mean when stamped on a wrench?
4. Describe an open-end wrench.
5. Describe a box-end wrench.
6. Describe a combination wrench.
7. Explain how a socket wrench differs from other types of wrenches.
8. Describe what a torque wrench is and why it is used.
9. Describe a flat blade screwdriver.
10. When are soft-face hammers used?
11. For what are pliers used on small engines?
12. List four metalworking tools.
13. List three power tools used in the shop.

DISCUSSION TOPICS AND ACTIVITIES

1. Study the tools in your school small-engine shop. How many can you name?
2. Make a list of the hand tools in your home garage.