CHAPTER 12

STEELWORKER TOOLS AND EQUIPMENT

In the shop and out on a jobsite, you will be using grinders, portable power drills, compressors, saws, and various other tools. As a Steelworker you need to be thoroughly familiar with the operation and maintenance of these tools as well as all applicable safety precautions.

BENCH AND PEDESTAL GRINDERS

The common bench and pedestal grinders are the simplest and most widely used grinding machines. The grinding work done with them is called OFFHAND GRINDING. Offhand grinding is used for work on pieces that can be held in the hands and controlled until ground to the desired shape or size. This work is done when the piece king ground does not require great precision or accuracy.

The bench grinder (fig. 12-1) is attached to a bench or table. The grinding wheels mount directly onto the motor shaft. One wheel is coarse for rough grinding, and the other is fine for finish grinding.

The pedestal grinder, inmost cases, is larger than the bench grinder and is equipped with a base and pedestal fastened to the floor. The DRY TYPE (fig. 12-2) has no arrangement for cooling the work while grinding other than a water container into which the piece can be dipped to cool it. The WET TYPE (fig. 12-3) is equipped with a built-in coolant system that keeps the wheels constantly drenched with fluid. The coolant washes away particles of loose abrasive material, as well as metal, and keeps the piece cool.

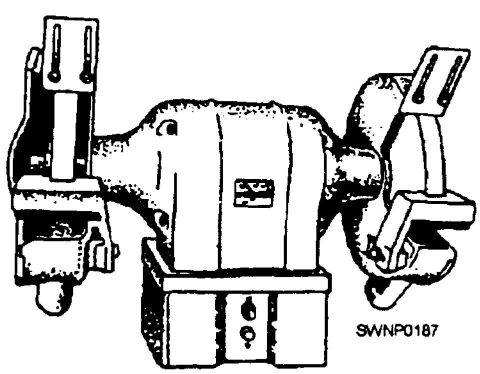

Figure 12-1.—The bencb grinder, Eye shields have not been mounted.

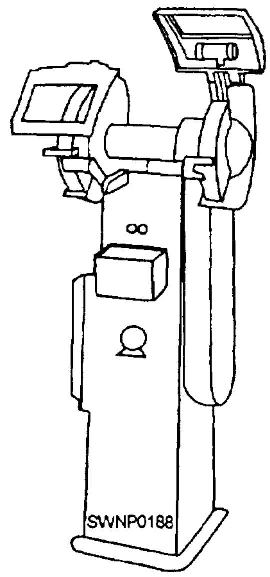

Figure 12-2.—The pedestal grinder (dry type).

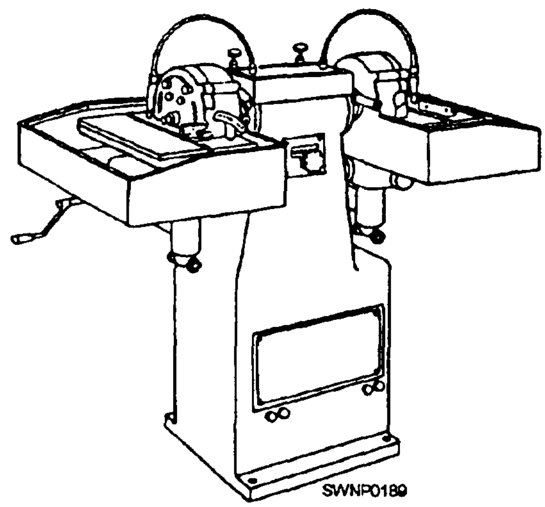

Figure 12-3.—Pedestal grinder (wet type) wttb a built-in coolant system

Bench and pedestal grinders are dangerous if they are not used correctly They must never be used unless fitted with guards and safety glass EYE SHIELDS (fig. 12-4). Even then you must wear goggles or safety glasses. A TOOL REST is furnished to support the work while grinding. It should be adjusted to come within one eighth of an inch from the wheels. This will

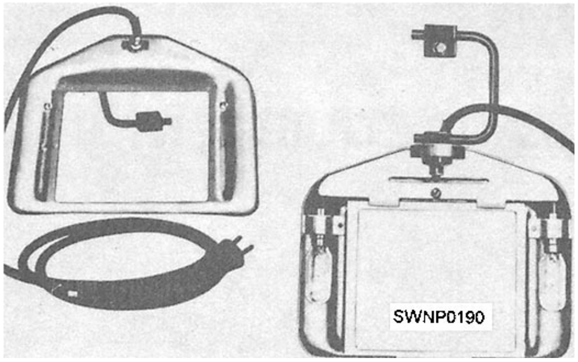

Figure 12-4.—Eye shields for bench and pedestal type of grinders.

prevent work from being wedged between the tool rest and the wheel. Turn the wheel by hand after adjusting the tool rest to ensure there is satisfactory clearance completely around the wheel (fig. 12-5).

The grinding wheels themselves can be sources of danger and should be examined frequently, based upon usage, for irregularities and soundness. You can test a new wheel by suspending it on a string or wire and tapping the side of the wheel with a light metal rod. A solid wheel will give off a distinct ringing sound, A wheel that does not give off such a sound must be assumed to be cracked and should be discarded. Under no circumstances should it be used. Since it is not practical to check the wheels by this manner every time you use the grinder, make it a habit never to stand in front of a grinder when it is first turned on. A cracked wheel can disintegrate and become projectiles quickly.

The wheel must also run true and be balanced on the shaft. A WHEEL DRESSER (fig. 12-6) should be used to bring abrasive wheels back to round and

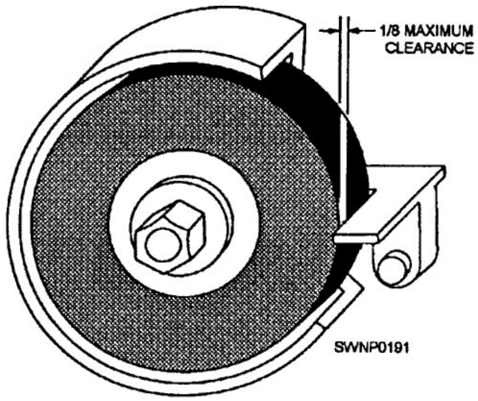

Figure 12-5.—Properly spaced tool rest.

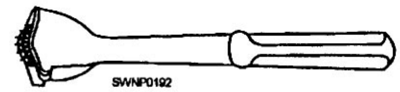

Figure 12-6.—Mechanical wheel dresser.

remove the glaze that occurs after heavy use. This is done by holding the dresser firmly against the wheel with both hands, using the tool rest for support. Then, as the wheel turns, move the dresser back and forth across the surface (fig. 12-7). For maximum efficiency and safety in operating the grinder, you should observe the following rules:

1. Use the face of the wheel, never the sides.

2. Move the work back and forth across the face of the wheel. Even wear results because this action prevents the wheel from becoming grooved.

3. Keep the wheel dressed and the tool rest properly adjusted.

Do not shape soft metals, like aluminum, brass, and copper, that tend to load (clog) the abrasive wheel. These metals should be shaped by other methods, such as tiling, sanding, and chipping.

PNEUMATIC POWER TOOLS

The portable power tools that are available for use are either powered by electric motors or by air (pneumatic) motors. Whether powered by electricity or compressed air, the tools are basically the same and the procedures for using them are the same. This section will deal with pneumatic tools since these require unique maintenance and servicing on the jobsite or in the shop.

NOTE: All low-pressure compressed air systems should have a filter, a regulator, and a lubricator assembly installed at the outlet. This assembly will ensure delivery of clean, regulated mist lubricated compressed air for the operation of pneumatic tools.

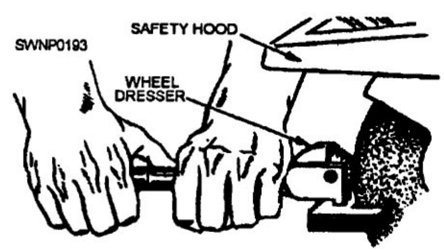

Figure 12-7.—Using a wheel dresser.

CAUTION

Before operating a pneumatic tool, inspect the air hose and check it for leaks or damage. Blow air through the air hose to free it of foreign material before connecting it to the tool. Keep the air hose clean and free from lubricants. Never point the air hose at another person.

Pneumatic tools must have complete lubrication. The moving parts of pneumatic tools are fitted very closely, and they must be lubricated correctly or they will wear quickly and fail to work.

Valves and pistons on pneumatic hammers require a light machine oil. Since the compressed air comes directly in contact with these parts, it has a tendency to drive the lubricant out through the exhaust.

When working continuously with a pneumatic tool, you should regularly check the lubricator to ensure there is ample lubricant available. Next, empty the filter assembly as needed.

On low-pressure compressed air systems that do not have the filter, the regulator, and the lubricator assembly installed, you should disconnect the air hose every hour or so and squirt a few drops of light oil into the air hose connection. Do NOT use heavy oil because the oil will cause precision parts to either fail or to have operating troubles. If this occurs, you have to clean your tool in cleaning solvent to loosen the gummy substance that results. Blow out the tool with air, lubricate it with light oil, and go back to work.

Keep your pneumatic tools clean and lubricated and you will have few operating problems.

SHOP MACHINERY

Prefabrication of steel parts and assemblies is typically accomplished in a steel shop where heavy steel working machinery is accessible. The steel shop is tasked with manufacturing and fabricating items, such as sheet-metal ducts, pipeline section fittings, plates, and angles. In the following sections, we will discuss some of the common types of machinery found in a well-equipped steel shop.

COMBINATION IRON WORKER

The combination iron worker is likely the most valuable and versatile machine in a shop. The combination punch, shear, and coper (fig. 12-8) is capable of cutting angles, plates, and steel bars, and it can also punch holes. The size of the angles and plates that can be safely handled by the machine depends upon its capacity. It is manufactured in various sizes and capacities, and each machine has a capacity plate either welded or riveted on it. This guide should be strictly adhered to. The pressure and power the machine develops demand extreme caution on the part of the operator.

VERTICAL BAND SAWS

While the vertical band saw is designed primarily for making curved cuts, it can also be used for straight cutting. Unlike the circular saw, the band saw is frequently used for freehand cutting.

The band saw has two large wheels on which a continuous narrow saw blade, or BAND, turns, just as a belt is turned on pulleys. The LOWER WHEEL, located below the WORKING TABLE, is connected to the motor directly or by means of pulleys or gears and serves as the driver pulley. The UPPER WHEEL is the driven pulley.

The saw blade is guided and kept in line by two sets of BLADE GUIDES: one fixed set below the table and one set above with a vertical sliding adjustment. The alignment of the blade is adjusted by a mechanism on the back side of the upper wheel. TENSIONING of the blade—tightening and loosening-is provided by another adjustment located just back of the upper wheel.

Cutoff gauges and ripping fences are sometimes provided for use with band saws. However, you will do most of your work freehand with the table clear because accurate cuts are difficult to make with a band saw when gauges or fences are used.

The size of a band saw is designated by the diameter of the wheels. Thus the 14-inch model (fig. 12-9) has 14-inch wheels. Common sizes are 14-, 16-, 18-, 20-, 30-, 36-, 42-, and 48-inch machines. The 14-inch size is the smallest practical band saw. With the exception of capacity, all band saws are much alike in maintenance, operation, and adjustment.

Blades, or bands, for bandsaws are designated by POINTS (tooth point per inch), THICKNESS (gauge), and WIDTH. The required length of the blade is found by adding the circumference of one wheel to twice the distance between the wheel centers. Length can vary within a limit of twice the tension adjustment range.

Vertical band saws are comparatively simple machines to operate. Each manufacturer publishes a technical manual for their machine. Refer to the

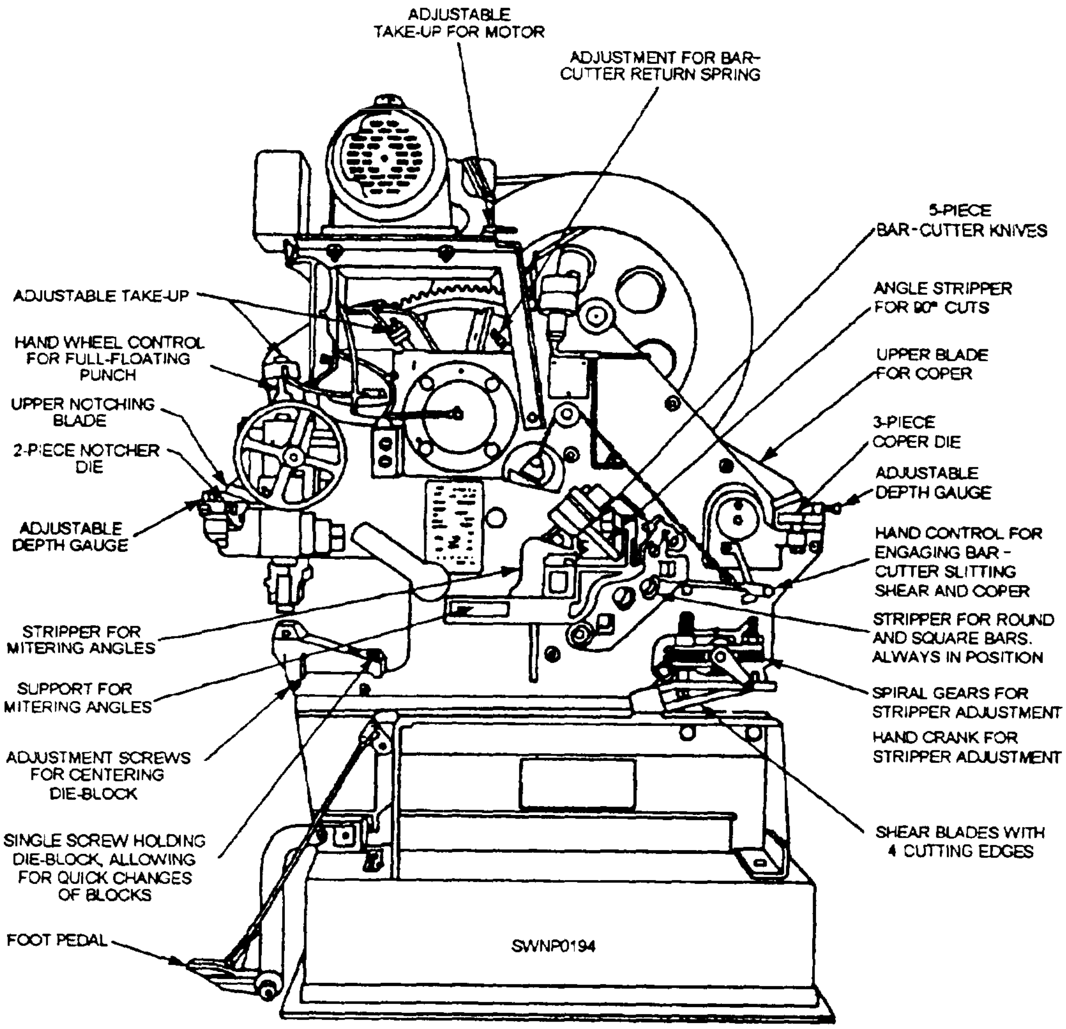

Figure 12-8.—Combination punch, shear, and coper.

manufacturer's manual for detailed information concerning the structure, operation, maintenance, and repair of the individual machine.

One of the key parts of the vertical band saw is its blade that must be sharp and accurately set to cut in a straight line. The radius of the curve, or circle, to be cut determines the size of the saw blade to be used. Use a narrow blade to cut curves of small radii. A l/8-inch blade will cut a l-inch curve; a 3/16-inch blade, a 1 l/2-inch curve; a l/4-inch blade, a 2-inch curve; and a 3/8-inch blade, a 2 l/2-inch curve; provided, in each instance, the teeth have the correct amount of set.

After turning on the power, see that the blade is operating at full speed before you start a cut. It is advisable to true up one face or edge of the stock before taking a cut with the saw. Also, start the cut in the waste stock and do not crowd or cramp the blade.

Keep the top guide down close to the work at all times. When sawing curves or straight lines (outlines), you guide the stock along the lines marked on the face of the stock. When more than one piece is to be sawed, several can be tack-welded together before sawing. Tack-weld from the side on which the outline is marked so the welds will be visible to the saw operator. Be careful not to exceed the rated capacity of the machine.

Do not force the material too hard against the blade. A light contact with the blade permits easier following of the line and prevents undue friction and overheating of the blade.

By keeping the saw blade well sharpened, you need to apply very little forward pressure for average cutting. Move stock steadily against the blade, but no faster than required to give an easy cutting movement.

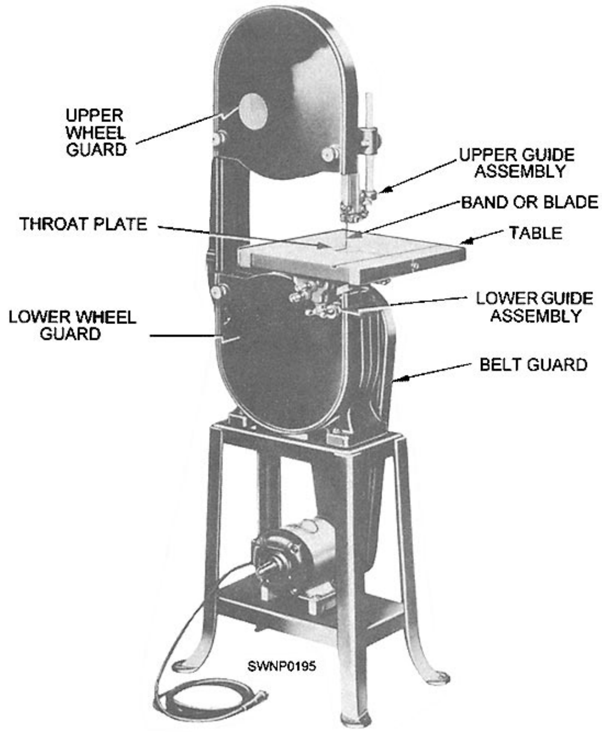

Figure 12-9.—14-inch band saw.

Avoid twisting the blade by trying to turn sharp corners. Remember that you must saw around comers. If you want to saw a very small radius, use a narrow blade.

If you find that a saw cut cannot be completed, it is better to saw out through the waste material to the edge of the stock than to back the blade out of the curved cut. This will prevent accidentally drawing the blade off the wheels.

BAND SAW teeth are shaped like the teeth in a hand ripsaw, which means that their fronts are filed at 90 degrees to the line of the saw. Reconditioning procedures are the same as they are for a hand ripsaw, except that very narrow band saws with very small teeth must usually be set and sharpened by special machines.

A broken band saw blade must be BRAZED when no accessory welder is available. The procedure for brazing is as follows:

1. SCARF the two ends to be joined with a file so that they may be joined in a SCARFJOINT(fig. 12-10).

2. Place the ends in a brazing clamp, or some similar device, that will permit them to be brought together in perfect alignments.

3. Coat the filed surfaces with soldering flux.

4. Cut a strip of silver solder the length of the scarf and the width of the blade. Coat it with flux and insert it between the filed surfaces.

5. Heat a pair of brazing tongs bright red and clamp the joint together. The red-hot tongs wiIl heat the blade and melt the solder. Keep the tongs clamped on the joint until they turn black.

6. Smooth the joint on both sides with a flat file, and finish it with fine emery cloth.

Figure 12-11 shows band ends being joined by using the butt welder-grinder unit. The entire procedure for joining is as follows:

1. Trim both ends of the band square; clean them thoroughly. Butt the ends together in the jaws of the welder-grinder unit; make sure that the ends are aligned and that the seam is centered between the welder jaws. First, set the resistance knob to agree with the dial for the width of band you are going to weld Then press and

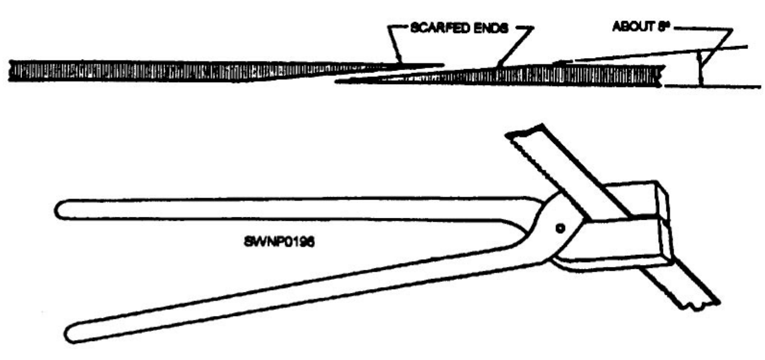

Figure 12-10.—Rejoining a broken band saw blade.

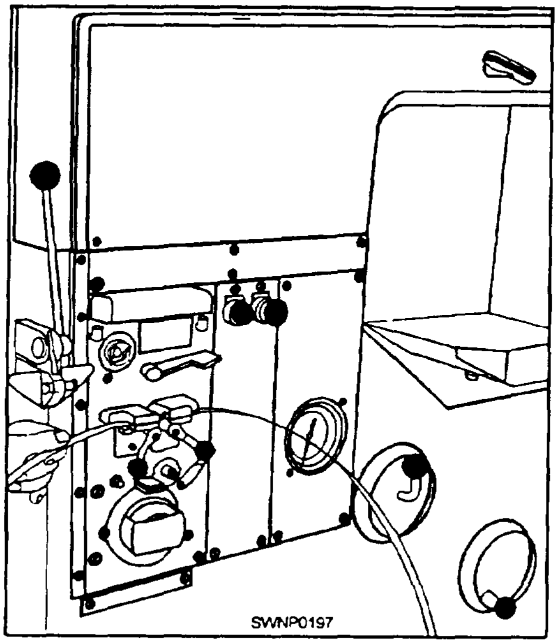

Figure 12-11.—Butt welder-grinder unit.

hold the WELD button until the blade ends fuse together. Let the weld cool for a few seconds and then press the ANNEAL button until the welded area heats to a dull cherry red. Hold the welded area at that temperature momentarily by jogging the button, and then allow the temperature to fall off slowly and gradually by increasing the time between jogs. (Allow about 10 seconds for this last phase.)

2. After the band has been annealed, take it out of the welder jaws and grind the weld bead with the small grinder. Grind the weld area to the same thickness as the rest of the band. Check the back edge of the band for burrs and misalignment; grind off irregularities. After the grinding is completed, place the band in the butt welder-grinder unit and reanneal the welded areas to destroy any hardness that may have developed. See the technical manual furnished with each machine.

Causes of Blade Breakage

A number of conditions may cause a band saw blade to break. Breakage is unavoidable when it is the result of the peculiar stresses to which such saws are subjected. The most common causes of blade breakage that may be avoided by good judgment on the part of the operator are as follows: (1) faulty alignment and adjustment of the guides, (2) forcing or twisting a wide blade around a curve of short radius, (3) feeding too fast, (4) dullness of the teeth or the absence of sufficient set, (5) excessive tension on the blade, (6) top guide set too high above the work being cut, and (7) using a blade with a lumping or improper] y finished braze or weld. When a saw blade breaks, shut off the power immediately, and then wait until the wheels stop turning before replacing the blade.

Replacing Saw Blades

To replace a bandsaw blade, open the wheel guard on each wheel. Raise the guide to the top position. Remove the throat plate from the table. Release the tension on the blade by turning the top wheel adjusting screw. Remove the blade and install the replacement.

HORIZONTAL BAND CUTOFF SAW

A relatively new metal-cutting band saw is shown in figure 12-12. This HORIZONTAL BAND CUTOFF SAW is being used in shops to replace the reciprocating type of power hacksaw. The continuous cutting action of the blade provides greater speed, accuracy, and versatility for metal-cutting jobs.

Good results from the use of any metal-cutting band saw depend upon careful choice of blade, speed, rate of feed, and feed pressure. The primary consideration in selecting the blade is the tooth pitch. Tooth pitch should be considered in relation to the hardness and toughness of the material being worked and the thickness of the workpiece. At lease two teeth should be in contact with the work. When cutting thick material, do not select a tooth pitch that will allow too

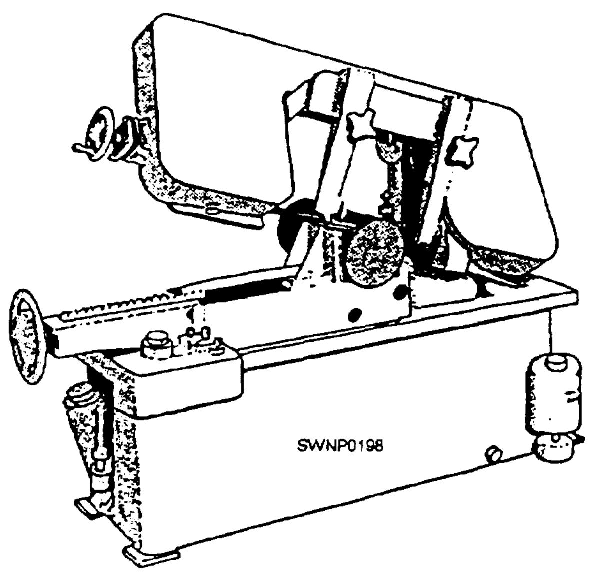

Figure 12-12.—Horizontal band Cutoff saw.

many teeth to be in contact with the material. The more teeth in contact, the greater the feed pressure required to force them into the material. Excessive feed pressure will cause off-line cutting.

POWER HACKSAWS

The POWER HACKSAW is found in all except the smallest shops. It is used for cutting bar stock, pipe, tubing, or other metal stock. The power hacksaw (fig. 12- 13) consists of a base, a mechanism for causing the saw frame to reciprocate, and a clamping vise for holding the stock while it is being sawed. Two types of power hacksaws are in use today: the direct mechanical drive and the hydraulic drive.

The capacity designation of the power hacksaw shown is 4 inches by 4 inches. This means that it can handle material up to 4 inches in width and 4 inches in height.

Three types of feed mechanisms are in use today. They are as follows:

1. Mechanical feed, which ranges from 0.001 to 0.025 inch per stroke, depending upon the class and type of material being cut.

2. Hydraulic feed, which normally exerts a constant pressure but is so designed that when hard spots are encountered, the feed is automatically stopped or shortened to decrease the pressure on the saw until the hard spot has been cut through.

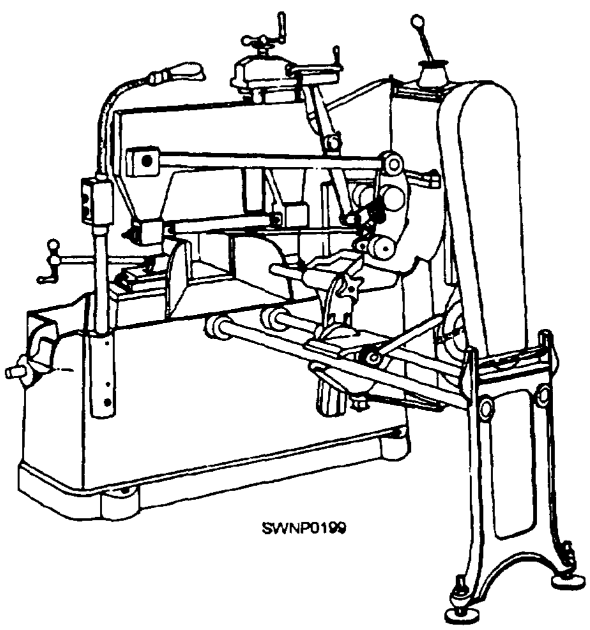

Figure 12-13.—Power hacksaw.

3. Gravity feed, which provides for weights on the saw frame. These weights can be shifted to increase or decrease the pressure of the saw blade on the material being cut.

All three types of feed mechanisms lift the blade clear of the work during the return stroke.

Hacksaw Blades

The blade shown in figure 12-14 is especially designed for use with the power hacksaw. It is made with a tough alloy steel back and high-speed steel teeth-a combination which gives both a strong blade and a cutting edge suitable for high-speed sawing.

These blades vary as to the pitch of the teeth (number of teeth per inch). The correct pitch of teeth for a particular job is determined by the size of the section and the material to be cut. Use coarse pitch teeth for wide, heavy sections to provide ample chip clearance. For thinner sections, use a blade with a pitch that will keep two or more teeth in contact with the work so that the teeth will not straddle the work. Such straddling will strip the teeth. In general, you select blades according to the following information:

1. Coarse (4 teeth per inch—for soft steel, cast iron, and bronze.

2. Regular (6 to 8 teeth per inch)—for annealed high carbon steel and high-speed steel.

3. Medium (10 teeth per inch)—for solid brass stock, iron pipe, and heavy tubing.

4. Fine (14 teeth per inch)—for thin tubing and sheet metals.

Speeds and Coolants

Speeds on hacksaws are stated in strokes per minute—counting, of cm-use, only those strokes that cause the blade to come in contact with the stcck. Speed changing is usually accomplished by means of a gearshift lever. There maybe a card attached to your equipment or near it, stating recommended speeds for

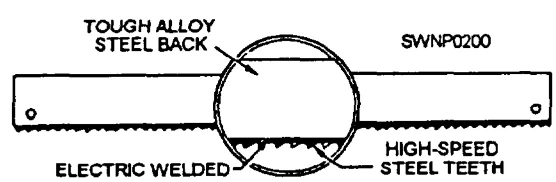

Figure 12-14.—Power hacksaw blade.

cutting various metals. The following speeds, however, can usually be used:

1. Cold rolled or machine steel, brass, and soft metals—136 strokes per minute.

2. Alloy steel, annealed tool steel, and cast iron-90 strokes per minute.

3. High-speed steel, unannealed tool steel, and stainless steel—60 strokes per minute.

Cast iron should be cut entirely dry, but a coolant should be used for cutting all other materials. A suitable coolant for cutting most metals is a solution of water and enough soluble oil to make the solution white. The coolant not only prevents overheating of the blade and stock but also serves to increase the cutting rate.

Using the Power Hacksaw

Place the workpiece in the clamping device, adjusting it so the cutting-off mark is in line with the blade. Turn the vise lever to clamp on the material in place, being sure that the material is held tightly, and then set the stroke adjustment.

Ensure the blade is not touching the workpiece when you start the machine. Blades are often broken when this rule is not followed. Feed the b] blade slowly into the work, and adjust the coolant nozzle so it directs the fluid over the saw blade.

NOTE: Safety precautions to be observed while operating this tool are posted in the shop. READ and OBSERVE them!

DRILL PRESSES

Many sizes and styles of drilling machines or DRILL PRESSES are in use today-each designed for a particular type of work. Only the drill presses not covered in *Tools and Their Uses*, NAVEDTRA 10085-B2, are discussed here.

One type of upright drill press is the SENSITIVE DRILL PRESS (fig. 12-15). This drill is used for drilling small holes in work under conditions where the operator must "feel" what the cutting tool is doing. The drill bit is fed into the work by a very simple device—a lever. These drill presses are nearly always belt driven because the vibration caused by gearing would be undesirable.

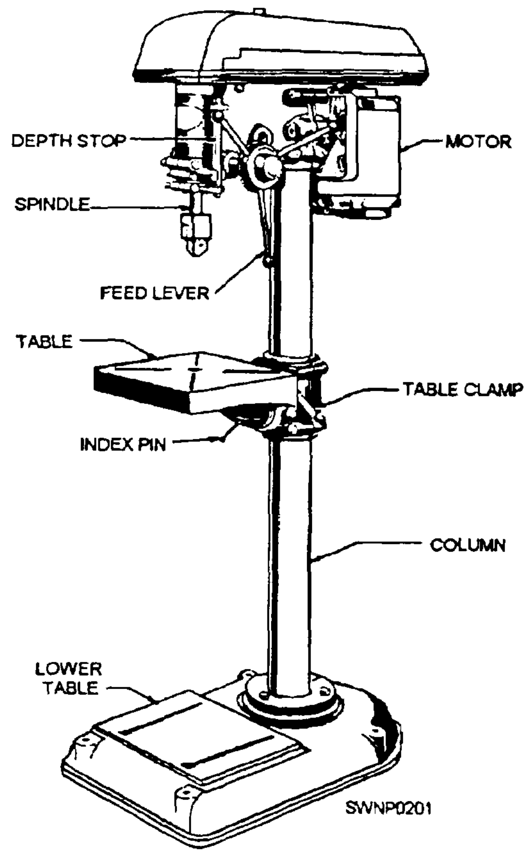

Figure 12-15.—Sensitive drill press.

The RADIAL DRILL PRESS (fig. 12-16) has a movable spindle that can be adjusted to the work. This type of machine is convenient to use on large and heavy work or where many holes are to be drilled since the work does not have to be readjusted for each hole.

Check occasionally to make sure that all locking handles are tight and that the V-belt is not slipping.

Before operating any drill press, visually inspect the drill press to determine if all parts are in the proper place, secure, and in good operating condition. Check all assemblies, such as the motor, the head, the pulleys, and the bench, for loose mountings. Check the adjustment of the V-belt and adjust as necessary according to the manufacturer's manual. Make sure that the electric cord is securely connected and that the insulation is not damaged, chafed, or cracked.

While the drill press is operating, be alert for any sounds that may be signs of trouble, such as squeaks or unusual noises. Report any unusual or unsatisfactory performance to the petty officer in charge of the shop.

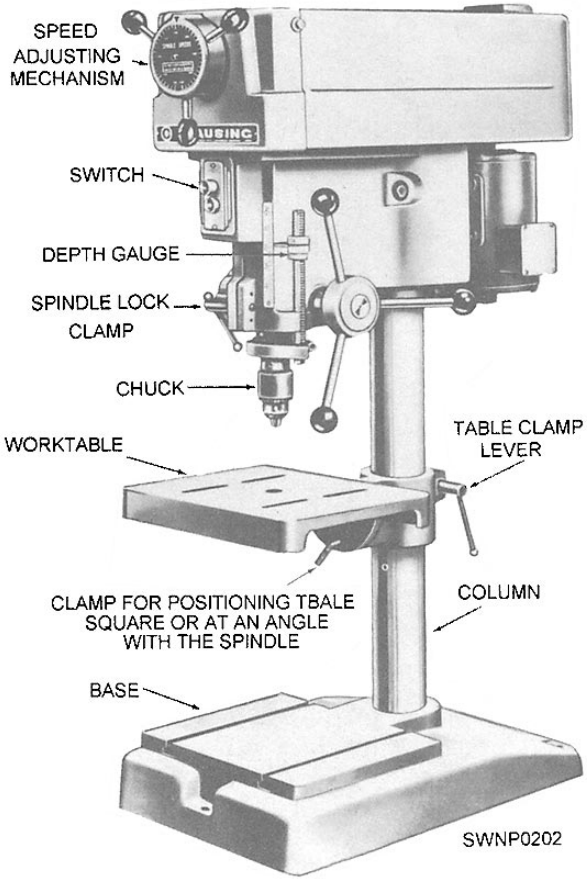

Figure 12-16.—Radial drill press.

After operating a drill press, wipe off all dirt, oil, and metal particles. Inspect the V-belt to make sure no metal chips are embedded in the driving surfaces.

DRILL BITS

Common drill bits are known as TWIST DRILLS because most of them are made by forging or milling rough flutes and then twisting them to a spiral configuration. After twisting, the drill bits are milled to the desired size and heat-treated.

The general-purpose twist drill is made of high-speed steel. Figure 12-17 shows a typical plastic-cutting drill bit and a typical metal-cutting drill bit. Notice the smaller angle on the drill bit used for drilling plastics.

Drill bit sizes are indicated in three ways: by inches, by letter, and by number. The nominal inch sizes run from 1/16 inch to 4 inches or larger. The letter sizes run from “A” to “Z” (0.234 inch to 0.413 inch).

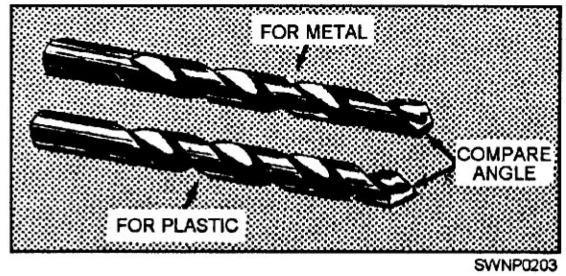

Figure 12-17.—Comparison of a twist drill for plastic and a twist drill for metal.

The number sizes run from No. 80 to No. 1 (0.0135 inch to 0.228 inch).

Before putting a drill bit away, wipe it clean and then give it a light coating of oil. Do not leave drill bits in a place where they maybe dropped or where heavy objects may fall on them. Do not place drill bits where they will rub against each other.

A drill bit should be reground at the first sign of dullness. The increased load that dullness imposes on the cutting edges may cause a drill bit to break.

Cutting Fluids

When drilling steel and wrought iron, use a cutting oil. Cast iron, aluminum brass, and other metals may be drilled dry; therefore, at high-drilling speeds it is advisable to use some medium for cooling these metals to lessen the chances of overheating the drill bit with the resultant loss of the cutting edge. Compressed air may be used for cast iron; kerosene for aluminum; oleic acid for cooper; sulphurized mineral oil for Monel metal; and water, lard, or soluble oil and soda water for ferrous metals. (Soda water reduces heat, overcomes rust, and improves the finish.)

Sharpening Drill Bits

A drill bit becomes dull with use and must be resharpened. Continued use of a dull drill bit may cause it to break or bum up as it is forced into the metal. Improper sharpening will cause the same difficulties.

Remove the entire point if it is badly worn or if the margins are burned or worn off near the point. If, by accident, the drill bit becomes overheated during grinding, do NOT plunge it into the water to cool. Allow it to cool in still air. The shock of sudden cooling may cause it to crack.

Three factors must be considered when repainting a drill bit:

1. LIP CLEARANCE (fig. 12-18). The two cutting edges or lips are comparable to chisels. To cut effectively, you must relieve the heel or that part of the point back to the cutting edge. Wh.bout this clearance, it would be impossible for the lips to cut. If there is too much clearance, the cutting edges are weakened. Too little clearance results in the drill point merely rubbing without penetration. Gradually increase lip clearance toward the center until the line across dead center stands at an angle of 120 to 135 degrees with the cutting edge (fig. 12-19).

2. LENGTH AND ANGLE OF LIPS. The material to be drilled determines the proper point angle. The angles, in relation to the axis, must be the same. Fifty-nine degrees has been found satisfactory for most metals. If the angles are unequal, only one lip will cut and the hole will be oversize (fig. 12-20).

3. THE PROPER LOCATION OF THE DEAD CENTER (fig. 12-21). Equal angles but lips of different lengths results in oversize holes and the resulting "wobble" places tremendous pressures on the drill press spindle and bearings.

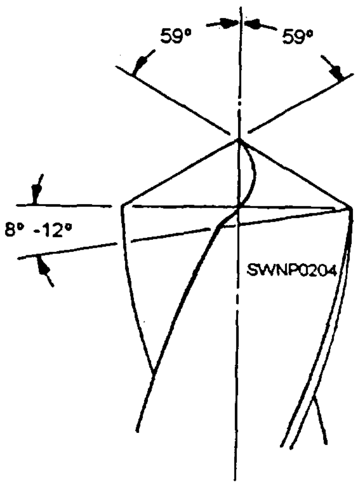

Figure 12-18.—Lip clearance.

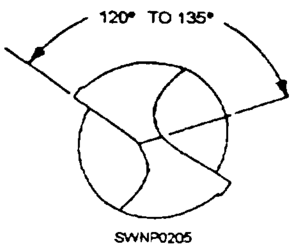

Figure 12-19.—Angle of the dead center.

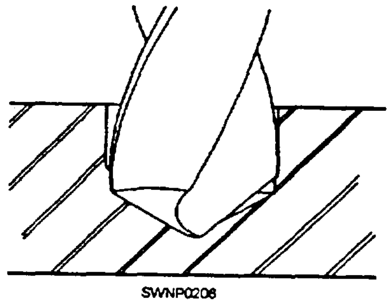

Figure 12-20.—Unequal drill point angles.

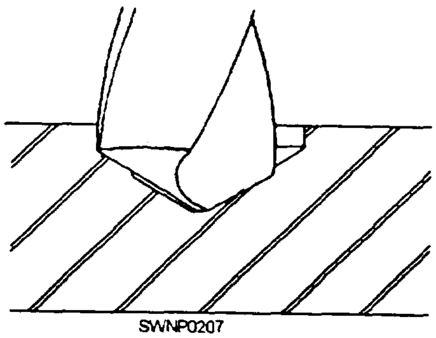

Figure 12-21.—Drill point off center.

A combination of both faults can result in a broken drill bit, and if the drill bit is very large, permanent damage to the drilling machine. The hole produced (fig. 12-22) will be oversize and often out-of-round.

The web of the drill bit increases in thickness toward the shank (fig. 12-23). When the drill bit has been shortened by repeated grindings, the web must

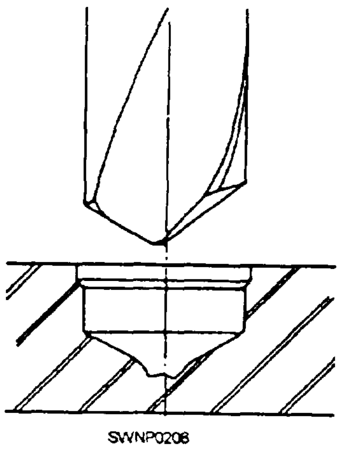

Figure 12-22.—Drill point with unequal point angles and with the drill point sharpened off center.

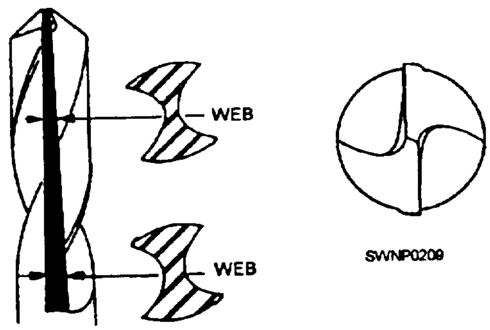

Figure 12-23.—The web of the drill bit and how the drill point is relieved by grinding.

be thinned to minimize the pressures required to make the drill bit penetrate the material. The thinning must be done equally to both sides of the web, and care must be taken to ensure that the web is centered.

The DRILL POINT GAUGE (fig. 12-24) is the tool most frequently used to check the drill point during the sharpening operation.

Use a coarse wheel for roughing out the drill point if much metal must be ground away. Complete the operation on a fine wheel.

Many hand sharpening techniques have been developed. The following are recommended:

1. Grasp the drill shank with the right hand and the rest of the drill bit with the left hand.

2. Place the fingers of the left hand that are supporting the drill bit on the grinder tool rest. The tool rest should be slightly below center (about 1 inch on a 7-inch wheel).

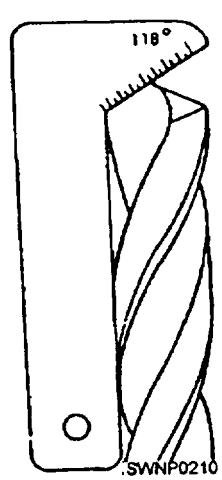

Figure 12-24.—Using a drill point gauge.

3. Stand so the centerline of the drill bit will be at a 59-degree angle with relation to the centerline of the wheel (fig. 12-25), and lightly touch the drill lip to the wheel in approximately a horizontal position.

4. Use the left hand as a pivot point and slowly lower the shank with the right hand. Increase the pressure as the heel is reached to ensure proper clearance.

5. Repeat the operation on each lip until the drill bit is sharpened. DO NOT QUENCH HIGH-SPEED STEEL DRILLS IN WATER TO COOL. LET THEM COOL IN CALM AIR.

6. Check the drill tip frequently with the drill point gauge to assue a correctly sharpened drill bit.

Secure a drill bit that is properly sharpened and run through the motions of sharpening it. When you have acquired sufficient skill, sharpen a dull drill bit. To test, drill a hole in soft metal and observe the chip formation. When proper] y sharpened, the chips will come out of the flutes in curled spirals of equal length. The tightness of the chip spiral is governed by the RAKE ANGLE (fig. 12-26).

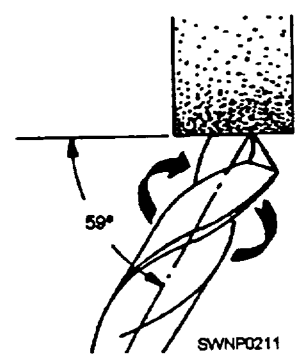

Figure 12-25.—The correct position of the drill bit at the start of the grinding operation. View is looking down on the grinder.

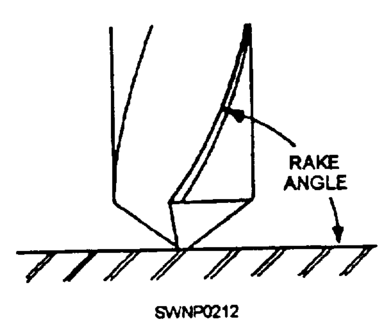

Figure 12-26.—Rake angle of drill bit for ordinary work.

An attachment for conventional tool grinders is shown in figure 12-27. In a shop where a high degree of hole accuracy is required and a large amount of sharpening is to be done, a machine or attachment is a must.

AIR COMPRESSORS

A compressor is a machine for compressing air from an initial intake pressure to a higher exhaust pressure through reduction in volume. A compressor consists of a driving unit, a compressor unit, and accessory equipment. The driving unit provides power to operate the compressor and may be a gasoline or diesel engine. Compressors are governed by a pressure control system adjusted to compress air to a maximum pressure of 100 psi.

Compressed Air System

A compressed air system consists of one or more compressors, each with the necessary power source, control of regulation, intake air filter, aftercooler, air receiver, and connecting piping, together with a distribution system to carry the air to points of use.

The object of installing a compressed air system is to provide sufficient air at the work area at pressures adequate for efficient operation of pneumatic tools being used.

Many construction projects require more cubic feet of air per minute than any one compressor will produce. Terrain conditions often create problems of distance from the compressor to the operating tool. Since the air line hose issued with the compressor causes considerable line loss at distances farther than 200 feet, a system has been devised for efficient transmission of compressed air over longer distances. This system is called air manifolding (fig. 12-28). An air manifold is a pipe having a large diameter used to transport compressed air from one or more compressors over a distance without detrimental friction line loss. In construction work, air manifolds are usually constructed of 6-inch diameter pipe. A pipe of this size can carry 1,200 cubic feet per minute (cfm) of air (output from two 600 cfm air compressors) at 100 psi with less than .035 pound pressure loss per 100 linear feet. One or more compressors pump air into the manifold and eventually "pressurize" it at 100 psi; then air may be used at any point along the manifold by installing outlet valves and connecting air lines and pneumatic tools.

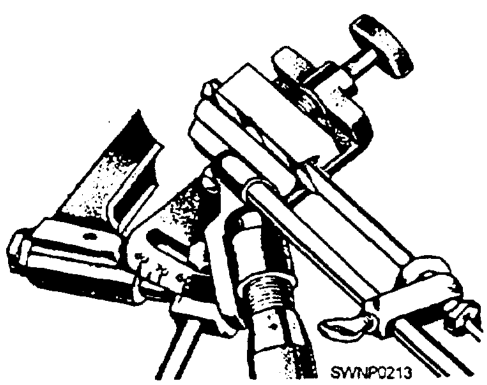

Figure 12-27.—A drill bit sharpening attachment mounted on a conventional bench grinder.

Compressor Operation and Maintenance

The following paragraphs will give general instructions on operating and maintaining air compressor units.

A compressor must be located on a reasonably level area. Most compressors permit a 15-degree lengthwise and a 15-degree sidewise limit on out-of-level operation. The limits are placed on the engine, not the actual compressor. When the unit is to be operated out-of-level, it is important to do the following: (1) keep the engine crankcase oil level near the high-level mark (with the unit level) and (2) have the compressor oil gauge show nearly full (with the unit on the level).

An instruction plate, similar to the one shown in figure 12-29, is attached to all compressors. Notice that this plate refers you to the manufacturer's engine and compressor manuals for detailed instructions.

STARTING THE UNIT.— Take the following steps when starting the engine during mild weather:

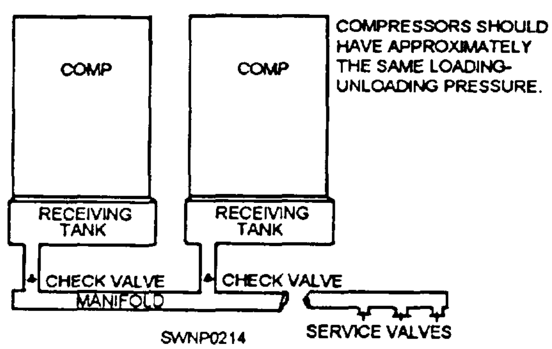

Figure 12-28.—Methods of manifolding compressors.

Figure 12-29.—Operating Instruction plate.

1. Open the service valves about one quarter-not wide open.

NOTE: The reason for starting with the service valves partly open is that they aid in quicker warm-up of the compressor oil.

2. Position the low-pressure, engine-oil-system safety knob to ON (fig. 12-30).

3. Turn the ignition switch to the START position. Immediately after the engine starts, release the ignition switch. If the engine fails to fire within 30 seconds, release the ignition switch and allow the starting motor to cool off for a few moments before trying the starter again.

4. With the engine running, check the engine oil pressure gauge. If no pressure is indicated, turn the engine off. When the oil pressure goes above 22 psi, continue to operate the engine and check the low-pressure engine oil switch. The knob on this switch should be in the RUN position.

NOTE: The engine oil pressure gauge indicates erratically until the engine oil warms up.

5. Open the side curtains on both sides of the engine enclosure and leave them open. The flow of air through the oil cooler and engine radiator will be impeded if the side curtains are closed while the engine is running.

6. After the engine has run about 3 minutes, check the engine coolant temperature gauge. The gauge should indicate less than 210°F. If the gauge is showing more than 210°F, SHUT OFF THE ENGINE.

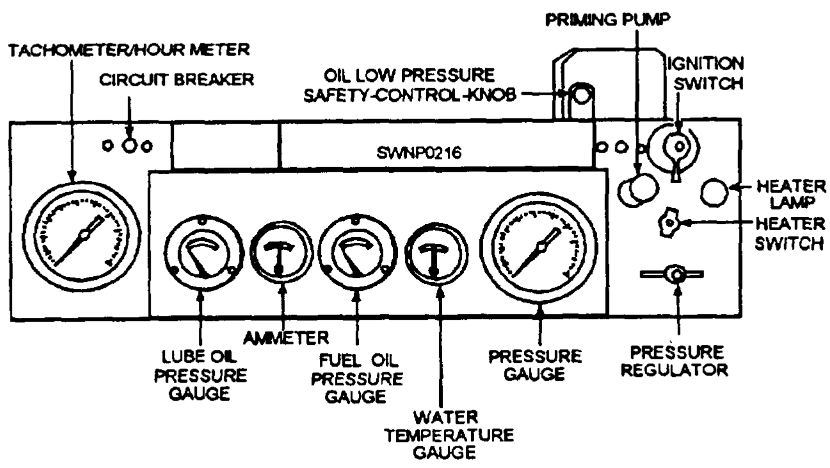

Figure 12-30.—Instrument panel.

7. After 5 minutes of operation, close the service valve and attach the hose or service line of the tool or device to be operated.

8. Open the service valves fully and start the work. After start-up, the unit automatically provides compressed air at the discharge service valves. Only periodic checking of the gauges on the instrument panel is then required.

9. When the engine is started during the day, after the first daily start-up, the above warm-up steps maybe eliminated,

STOPPING THE UNIT.— When stopping the unit at the end of the day, you should take the following steps:

1. Close the service valves and permit the engine to run at idle for 5 minutes. This will allow the engine coolant temperature to level off and the entire unit to cool down.

2. Turn the ignition switch to the OFF position.

COLD-WEATHER START-UP.— The following steps should be completed during cold-weather Start-up:

1. Start the engine using the heater switch and priming pump according to the engine manual.

2. Warm the engine until the engine coolant temperature reaches 120°F. Leaving the side curtains closed for a few minutes helps the engine to warm up.

3. Turn the ignition switch to OFF.

4. When the engine has stopped, start the engine again with the service valves partly open. Be sure the side curtains are open.

5. When the compressor has run for several minutes and the gauges indicate normal operating conditions, connect up the tools and go to work.

LUBRICATING THE UNIT.— The lubrication chart in the operator's manual for the particular make and model of compressor you are operating will show you where the unit should be lubricated, how often to lubricate, and what lubricant to use. The frequency will vary depending upon operating conditions and usage. Operating under abnormal conditions requires more frequent service.

CAUTION

Before servicing the compressor air system or compressor oil system, open the service valves to the atmosphere to relieve all pressure in the systems.

SERVICING THE AIR CLEANER.— A two-stage, dry type of air cleaner, installed inside the engine enclosure at the right rear, falters the intake air (fig. 12-31). Air is drawn into a first-stage element that causes nearly all the dust in the air to drop into a bin. Air then enters the second-stage element, a paper cartridge, where more dust is trapped and collected.

The dustbin should be removed by hand and emptied daily. Some models have a self-emptying dustbin that is piped into an aspirator in the exhaust pipeline, just beyond the muffler. When the aspirator is used, no alterations are allowed to be made to the engine muffler or exhaust pipe.

A service indicator is mounted on the side of the air cleaner housing. As the paper cartridge clogs with dust, a red indicator flag gradually rises in the window. When the cartridge is completely loaded, the window will show all red, and the flag will be locked in place. It is time to replace the paper cartridge, Discard the old cartridge and reset the red flag so that the window shows clear. Cleaning used paper cartridges is not recommended.

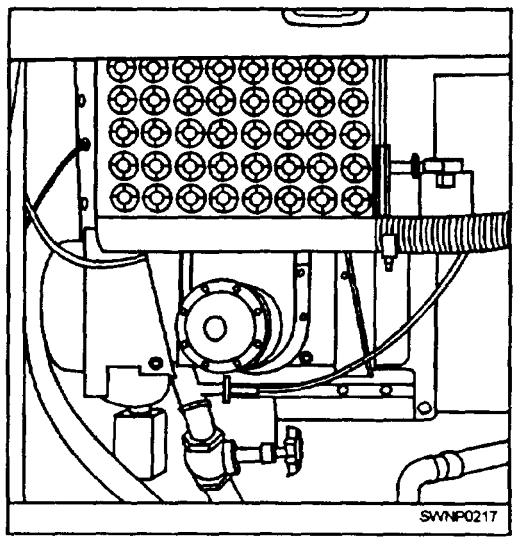

Figure 12-31.—Air cleaner.