

HAND TOOLS INSTITUTE



CONSUMER · SAFETY · PROTECTION

GUIDE TO HAND TOOLS

- SELECTION
- SAFETY TIPS
- PROPER USE AND CARE

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Tarrytown, New York 10591
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FOR

- **PROFESSIONAL TRADESMEN**
- **INDUSTRY SAFETY PROGRAMS**
- **CLASSROOM INSTRUCTION**
- **DO-IT-YOURSELF USERS**

FOREWORD

Much has been written on the subject of Hand Tools. Most of the material is devoted to how-to-do-it information and does provide instruction for professional, amateur or home workshop user. Unfortunately, some of the material contains information which may lead to hazardous misuse. Too little has clearly defined the uses for which particular tools are designed.

This booklet describes various hand tools, including wrenches, pliers, striking and struck tools, screwdrivers, vises, clamps, snips and tool boxes. This booklet defines the intended use of these tools, cautions against misuse and abuse and indicates when a tool should be repaired or retired from service and replaced with a new one for the sake of efficiency and safety.

The booklet is divided into twelve sections for easier reading and reference. Section five provides redressing instructions for those tools requiring redressing in normal use.

Two cartoon characters, "Hazardous Harry" and "Careful Cal," have been created to graphically emphasize the Do's and Don'ts that apply to hand tool use. Harry will illustrate some of the possible results of misuse and abuse. Cal will show you the way a real pro does it. Cultivate Cal's methods . . . avoid Harry's.

HAND TOOLS INSTITUTE

25 North Broadway • Tarrytown, New York 10591 • U.S.A.

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American National Standards Institute
National Safety Council

IMPORTANT

This book is not a substitute for manufacturers' instructions or warnings. Because tools may differ, always consult manufacturers' instructions or warnings if provided.

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SECTION I. WRENCHES

INTRODUCTION

Wrenches are one of the most widely used hand tools. Their main function is holding and turning nuts, bolts, cap screws, plugs and various threaded parts. Since a screw (thread) in use acts as a remorseless wedge, it is possible to strip threads or damage parts by applying excessive torque. Quality wrenches, regardless of their type, are therefore designed to keep leverage and intended load in safe balance.

Standard wrench types are available for almost every conceivable operation and service, with both American Standard Inch and Metric openings. Special wrenches are also available for servicing and overhaul of certain widely used equipment. Today's mechanic need not improvise to find the proper tool for a particular job. This booklet will guide him in selecting the proper tool.

Basic Safety Rules Which Apply to the Use of Wrenches

1. **Never** use a pipe extension or other form of "cheater" to increase the leverage of any wrench.
2. Select a wrench whose opening exactly fits the nut. If the wrench is not exactly the correct size for the fastener, it is apt to damage the corners of the fastener, slip, or break. Care should be exercised in selecting only inch wrenches for inch fasteners and only metric sizes for metric fasteners. High strength fasteners — grades 5 and 8, 12 Pt. nuts and bolts, and many other aerospace fasteners require unusually high torques for their

size and, therefore, require special care in the selection and use of wrenches.



NEVER USE A LEVERAGE EXTENSION ON A WRENCH HANDLE.

WRONG

3. If possible, always **pull** on a wrench handle and adjust your stance to prevent a fall if sudden release occurs.
4. The safest wrench is a box or socket type; both because it is stronger and because it has less chance of slipping off the fastener. Different types of wrenches are of different strengths and are designed for different purposes. Open end, flare nut, and adjustable wrenches are not as strong as the corresponding sizes of box or socket wrenches and are not intended for heavy loads, such as breaking loose frozen fasteners or final tightening.
5. To free a "frozen" nut or bolt, use a striking-face box wrench or a heavy-duty box or socket wrench. Application of penetrating oil beforehand is recommended.
6. **Never** cock an open-end wrench. Be sure the nut or bolt head is fully seated.
7. Adjustable wrenches should be tightly adjusted to the nut and pulled so that force is on the side of the fixed jaw.



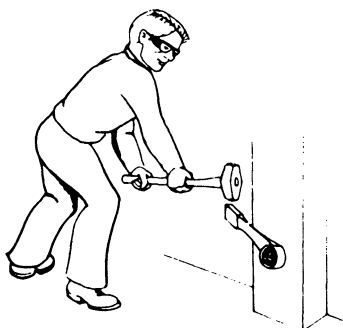
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



**ADJUST YOUR STANCE AND PULL WHEN
APPLYING HIGH TORQUE.**

RIGHT

8. Avoid **over torquing**. A Torque Wrench will permit tightening

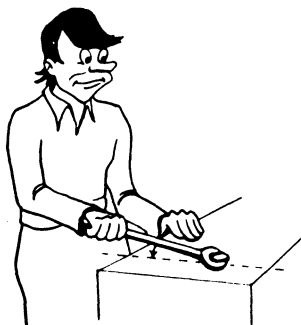


**WEAR SAFETY GOGGLES AND USE A HEAVY
SLEDGE TYPE HAMMER ON A STRIKING
FACE.**

RIGHT

to the exact torque required for best performance, economy and safety.

9. **Never** expose any wrench to excessive heat which may change the hardness and metal structure and ruin the tool.
10. Wrenches should not be ground to change their shape.
11. Periodic inspection of hand tools by competent personnel is a **safety must**. Do not use a wrench



**NEVER COCK OR TILT AN OPEN-END
WRENCH. THE NUT MUST BE
FULLY SEATED.**

WRONG

which has been damaged and probably weakened by being bent, cracked, or severely worn.

12. **WARNING.** Ordinary plastic dipped handles are designed for comfort—not electrical insulation. Other tools that have high dielectric insulation are so identified. The high dielectric insulation is intended only as secondary protection. Never depend on an insulated tool to protect you from electricity.

SOCKETS

Description. There are three types of sockets—hand, power and impact—all different in design and hardness. Hand sockets usually have a bright finish but may have a black finish. Power and impact sockets have a black finish and usually have thicker walls. This booklet is concerned only with hand sockets, **which should never be used on power drive or impact wrenches.**



Hand



Power



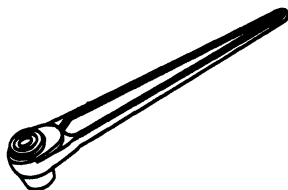
Impact

Hand Socket wrenches are made in a wide range of sizes and capacities. All have square drives ranging from ¼" to 1". Drive size is a measure of capacity.

Sockets are made in regular length and deep length. Openings may be 12, 8, 6 point or square. Spark plug sockets have rubber inserts or other devices to hold the plug. Universal joint sockets are also available.

HANDLE TYPE WRENCHES

Handle types include Reversible Ratchet, Sliding Tee, Speeder and Flex Head. Ratchets with dielectric insulation handles are available for linemen's use. Attachments include extension bars, adapters, flexible joints and various socket bits such as hex, slotted, Phillips screw, etc.

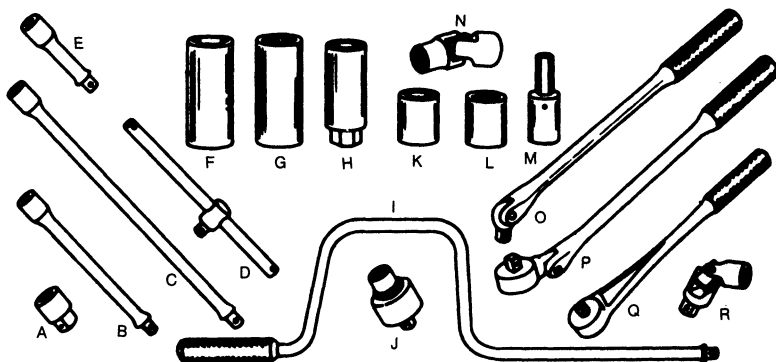


CAUTION: Reversible ratchet wrenches are rated among the strongest hand tool driver in their respective drive size. They are designed to interchange with the full range of all accessory and socket hand tools, also in their respective drive size.

The possibility exists for a lower torque rated accessory or socket or a combination of accessories and socket to be used in conjunction with a higher rated ratchet or drive tool.

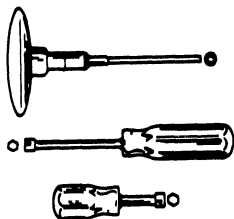
Care should be exercised so as not to overload the weakest component.

Extra Heavy - Duty Ratchet Wrenches. These powerful wrenches are made in various lengths.



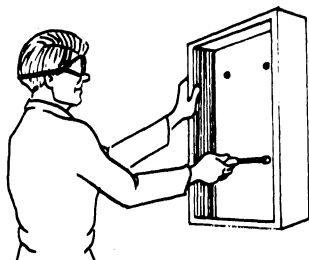
- A - ADAPTER
- B,C,E - EXTENSION BARS
- D - SLIDING T HANDLE
- F - DEEP 6-POINT SOCKET
- G - DEEP 12-POINT SOCKET
- H - SPARK PLUG SOCKET
- I - SPEEDER HANDLE
- J - RATCHET ADAPTER

- K - REGULAR 6-POINT SOCKET
- L - REGULAR 12-POINT SOCKET
- M - HEX SOCKET SCREW SOCKET
- N - UNIVERSAL 12-POINT SOCKET
- O - FLEX HANDLE
- P - FLEX HEAD RATCHET
- Q - REVERSIBLE RATCHET
- R - UNIVERSAL JOINT



Nut Drivers. Nut Drivers are screwdriver-type tools which, in their simplest form, have a one-piece shank and socket secured in a fixed handle. Socket heads have openings for hex nuts, bolts and screws up to $\frac{3}{4}$ " nut size. Shafts may be solid, drilled part way or full hollow—plain or magnetic for holding small fasteners.

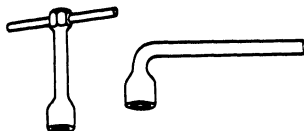
Handles, both regular and reversible ratcheting, are available to accommodate interchangeable shanks for recessed head screws such as Phillips, Frearson, Hex, Spline and ScruLox and for slotted screws as well as for standard $\frac{1}{4}$ " drive sockets.



NUT DRIVERS ARE EXCELLENT CLOSE-QUARTERS TOOLS.

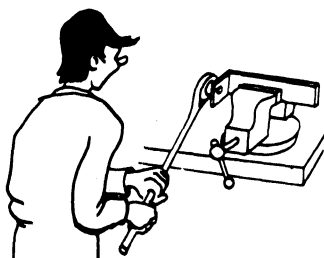
RIGHT

Non-Detachable Socket Wrenches. These wrenches have fixed openings, both hex and square, and are available in tee and offset handle types.



Proper Uses. Since detachable socket wrenches provide an almost endless combination of handles, attachments and sockets, it is possible to assemble a proper tool for almost any type of service within the tool's capacity.

Abuse/Misuse. Do not use a pipe or other improvised leverage extension on handles—go to a larger size wrench. When using adapters, remember that when adapting “down” (big handle, small socket) you build up tremendous torque potential. When adapting “up” (small handle, big socket) stay within safe limits “up” or “down.” Never use hand sockets on power drive or impact wrenches.



THIS HANDLE IS TOO BIG FOR THE SMALL SOCKET.

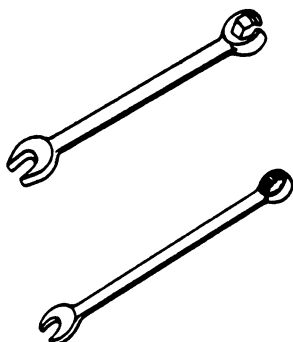
WRONG

When to Repair or Replace. Practically all manufacturers supply parts, repair kits and instructions for servicing their Ratchet wrenches and handles. Periodic cleaning and inspection of handles, sockets and attachments is very important. Repairs should be made with the manufacturer's own parts. Sockets with cracked walls, breaks, or battered points should be discarded.



USE A SPLIT BOX WRENCH ON FLARE NUTS.

COMBINATION BOX — OPEN-END WRENCHES



Description. The most widely used patterns are made in long and short types having a 15° angle open end and a 12-point box opening of the same size opposite. The box opening is offset at a 15° angle to the handle for clearance. Special service types including the following tools. The Split Box or Flare Nut pattern is for use on tube fittings and should not be used for high torque applications. This type has a 6- or 12-point opening offset 15° from the plane of the handle with a tube opening slot at an angle to the axis of the handle. This pattern is also available with openings of different size at each end.

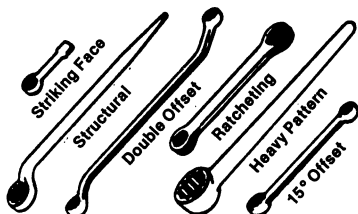
RIGHT

Proper Uses. Combination Box — Open-End wrenches are designed for a wide variety of work. Their box opening adds to their versatility and strength. The Flare Nut pattern with its hex box opening is especially useful in air conditioning and refrigeration work where tubing terminates on flare nuts.

Abuse/Misuse. Do not use the open end of these wrenches to free a “frozen” nut or final tighten a hex nut. Use the box opening. **Never** use an extension on the wrench handle.

When to Repair or Replace. Attempts to repair Box—Open-End wrenches are not recommended. Discard any wrench with spread, nicked or battered jaws on the open end or rounded or damaged points on the box end. Discard wrenches with bent handles.

BOX WRENCHES



Description. Box wrenches are made in long and short patterns with double offset and 15° angle offsets. Twelve-point, hex and square openings are available in regular and heavy-duty patterns. Double head types have different openings in each head. The Ratcheting type has both hex and 12-point openings. The Structural pattern is very similar to the Open-End pattern except that it has a 12-point box opening. The Striking Face wrench is made in both straight and offset patterns with 12-point openings.

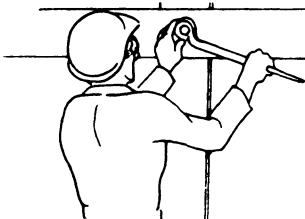
Proper Uses. Box wrenches in the regular pattern are designed for general service. The Heavy-Duty and Striking Face patterns are designed for the service indicated. Ratcheting Box wrenches are for light duty and should not be used in heavy-duty applications. Split box and Flare Nut wrenches are for tubing fitting and should not be used for general nut and bolt applications.

Abuse/Misuse. Use only a sledge type hammer on a Striking Face wrench. **Always wear safety goggles to protect your eyes.** Never use an extension on the wrench handle.

When to Repair or Replace. Attempts to repair Box wrenches are not recommended. Discard any wrench with broken or battered points.



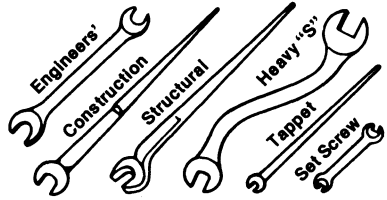
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



THE STRUCTURAL BOX WRENCH IS THE
SAFEST TOOL THE STEEL WORKER CAN USE.

RIGHT

OPEN-END WRENCHES



Description. The most widely used Open-End wrenches are made with openings at a 15° angle, which permits complete rotation of hex nuts with a 30° swing by flopping the wrench. They are available in both single and double head patterns; double head patterns have different openings in each head.

In addition to the above popular patterns, Open-End wrenches are made for special types of service. Ignition wrenches are small, thin wrenches having openings at 15° and 60°. Tappet wrenches, both single and double head, have openings at 15° angles, and are longer and thinner. Construction wrenches have a single 15° opening and a drift handle for aligning bolt holes. Structural wrenches are similar to the Construction pattern except they have straight openings and an offset handle. Set Screw and heavy "S" wrenches have openings at a 22½°, rather than a 15° angle.

Proper Uses. Open-End wrenches are designed for a wide variety of work. Special patterns are intended for the type of service which their name implies; e.g., Tappet, Ignition, Set Screw, Structural, etc.

Abuse/Misuse. Do not use an Open-End wrench to free a "frozen" nut or to final tighten a nut. Use a box wrench because it is stronger. **Never** use a hammer on this type of wrench. **Never** use an extension on the handle.



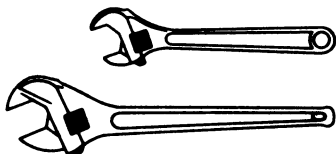
DON'T HAMMER ON THIS WRENCH.

WRONG

When to Repair or Replace. Attempts to repair Open-End wrenches are not recommended. Discard any wrench with spread, nicked or battered jaws, or bent handle.

ADJUSTABLE WRENCHES

Description. Regular pattern Adjustable wrenches are available in lengths from 4 to 24 inches.

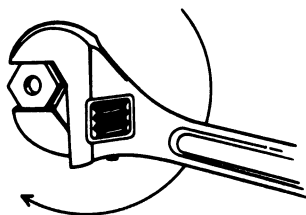


Proper Uses. Adjustable wrenches are designed to provide a wide range of capacity in a single tool and are a convenient service wrench for repairmen, linemen, etc. They are not intended to replace fixed opening wrenches for production or general service work. High dielectric insulated handle types are widely used by linemen and other electrical workers. **WARNING.** Ordinary plastic dipped handles are for comfort only; **not electrical insulation.**

Adjustable wrenches should be

tightly adjusted to the nut and pull so that the force is on the side of the fixed jaw.

Abuse/Misuse. Do not use an Adjustable wrench to free a "frozen" nut or to final tighten a nut. **Never** pull on a wrench adjusted to a loose fit with a fastener. **Never** use a hammer or extension on this wrench.



When to Repair or Replace. Practically all manufacturers supply parts assortments, repair kits and instructions for their Adjustable wrenches. Periodic inspections should be made to detect damaged jaws, knurls, pins and springs. Damaged parts should be replaced. Discard any wrench with spread or damaged fixed jaw or bent handle.

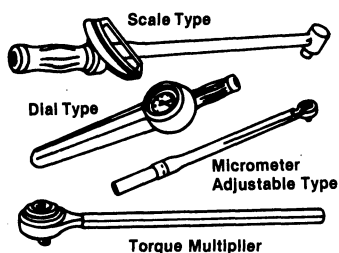


THIS LOOSELY ADJUSTED WRENCH CAN DAMAGE THE NUT, WRENCH AND HARRY.

WRONG

TORQUE WRENCHES

General. Torque wrenches are designed to permit an operator to determine applied torque on bolts, nuts and other fasteners. They measure torque in ounce-inches, pound-inches and pound-feet, as well as metric measure. However, many manufacturers express torque in foot-pounds (rather than pound-feet) since this nomenclature is more familiar to the average tool user. Metric measure torque wrenches are available in Newton meters (N.m), meter kilograms (mkg) and centimeter kilograms (cmkg) with N.m becoming the more modern, universally accepted calibration. Many torque wrenches are available with dual scales for conventional and metric measurements.



Description. Two basic hand torque wrenches are audible signal and visual display. One type signals applied torque by momentarily releasing the wrench for a few degrees of free travel. The release is usually (but not always) accompanied by a click sound thus giving the wrench its popular names: Click Torque wrenches or simply Clickers. Torque value is set to a micrometer scale on the handle or preset by an adjusting screw in the handle cavity (which precludes accidental resetting).

A second type indicates, rather than signals, torque. Applied torque is indicated on a dial or electronic digital display. Some models have memory pointers which remain at the maximum reading attained until manually reset.

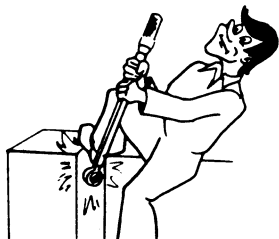
For low torque applications, torque screwdrivers are usually used. They are available in either the release (free wheeling) type, or in the indicating type.

The most widely used Torque wrenches have square drives to utilize standard detachable sockets. Both ratcheting and non-ratcheting types are available.

Torque Multipliers. Torque multipliers are multi-gearred tools generally used with ratchets or ratcheting torque wrenches as the drive component. Input is multiplied through the gearing four or more times depending on the model used. A reaction bar, which locks into the head of the torque multiplier, must rest securely against an object sturdy enough to withstand the force that will be generated. When driving a torque multiplier with a torque wrench, a torque loss factor at the fastener, caused by frictional losses through the gear train, must be taken into consideration in determining the desired torque at the output side of the torque multiplier. Torque loss factors are available from most torque tool manufacturers. Torque wrenches are available which can be used between the output side of the torque multiplier and the fastener. When used in this manner, the actual torque on the fastener may be read without the need to compensate for frictional loss.

Proper Uses. Torque wrenches are used in various operations where proper torquing of nuts, bolts and other fasteners is critical. Such oper-

ations include assembly and inspection of gear trains and bearings, setting of clutches and brakes, maintenance repair, overhaul and experimental work.



HARRY SHOULD PRY WITH A CROW BAR—NOT A TORQUE WRENCH.

WRONG

Always work with clean threads that are free of corrosion. It is important to follow the product manufacturer's instructions for specific torque loadings — particularly whether recommendations are for dry, oiled or plated threads, and other instructions which apply to a particular tool. Avoid overtightening a nut or bolt with a conventional wrench before applying a torque wrench. When not in use, the adjustable type wrench should be set to the lowest torque.

Abuse/Misuse. A Torque wrench is a precision instrument and should not be roughly handled. **Never** use it as a hammer, a pry or as a conventional wrench—use it only as a torque tool. Avoid dropping.

When using adjustable wrenches do not overtorque by applying torque past the release point. At low torque setting, the “click” signal might be very soft, or missing altogether. Learn the feel of the release, rather than relying on the sound.

Read torque values on indicating torque wrenches by looking at the dial at 90° to its surface (this elimin-

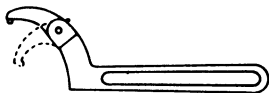
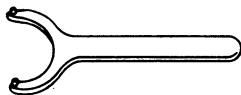
ates parallax error). If this is difficult to do, compensate by observing how much the apparent scale readings change when viewing from different angles.

Most torque wrenches operate accurately only when they are held by their designated grips. Cheater bars should never be used unless specifically permitted (or supplied) by the wrench's manufacturer.

When to Repair or Replace. If a torque wrench has been dropped it should be checked on a torque tester for accuracy. Torque wrenches should be periodically checked for calibration accuracy when in frequent or continuous service. Most manufacturers provide repair and calibration service. The manufacturer will advise if the tool can be repaired or should be replaced.

SPANNER WRENCHES

Description. Spanner wrenches are made in a variety of patterns as illustrated.



Proper Uses. Spanner wrenches are basically a machine shop tool. They are used on machine tools for adjusting collars, lock nuts, rings, spindle bearings, face plate draw nuts, etc.

Abuse/Misuse. Do not hammer on wrench handle. Do not use an extension on the handle.

When to Repair or Replace. Attempts to repair these wrenches are not recommended. If pins, hooks or forging are bent, deformed or cracked discard the tool.

SECTION II. PLIERS

INTRODUCTION

Pliers of various types are used by practically every tool user, both amateur and professional. There are many types and sizes; each designed for specific uses, although their versatility makes some pliers adaptable for many jobs. Choose the right pliers for the job.

Basic Safety Rules Which Apply to the Use of Pliers.

1. Pliers should not be used for cutting hardened wire unless specifically manufactured for this purpose.
2. **Never** expose pliers to excessive heat. This may draw the temper and ruin the tool.
3. Always cut at right angles. **Never** rock from side to side or bend the wire back and forth against the cutting edges.
4. Don't bend stiff wire with light pliers. Needle nose pliers can be damaged by using the tips to bend too large a wire. Use a sturdier tool.
5. **Never** use pliers as a hammer



NEVER EXPOSE PLIERS
TO EXCESSIVE HEAT.

WRONG

nor hammer on the handles. They may crack or break, or edges may be nicked by such abuse.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



ALWAYS CUT AT RIGHT ANGLES—DON'T
ROCK SIDE TO SIDE WHEN CUTTING WIRE.

RIGHT

6. **Never** extend the length of handles to secure greater leverage. Use a larger pair of pliers or a bolt cutter.
7. Pliers should not be used on nuts or bolts. A wrench will do the job better and with less risk of damage to the fastener.
8. Oil pliers occasionally. A drop of oil at the hinge will lengthen tool life and assure easy operation.
9. Safety glasses or goggles should be worn when cutting wire, etc. to protect eyes.

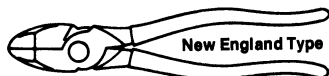


PLIERS ARE NOT MADE FOR HAMMERING.

WRONG

10. **WARNING.** The cushion grips on handles are provided primarily for comfort. Unless specifically specified as **Insulated** handles they are **Not** intended to give any degree of protection against electric shock and should **Not** be used on live electric circuits.

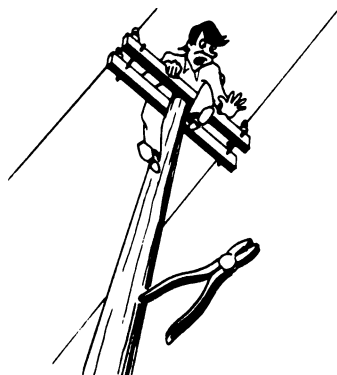
LINEMEN'S SIDE CUTTING PLIERS



Description. Two head patterns are available: Standard, also known as bevel nose, and New England, also known as round nose, which is more streamlined. Handles may be plain, slip-on molded plastic, plastic dipped or high dielectric. High leverage patterns are also available, as are pliers incorporating sleeve twist-ers and threaded bolt-holding openings. Sizes range from 6¼ to 9¼ inches in length.

Proper Uses. These are heavy-duty tools designed for the professional engaged in electrical, communications and construction work.

Abuse/Misuse. Never expose pliers to excessive heat. Don't rock pliers from side to side when cutting wire. Always cut at right angles. **Never** use pliers as a hammer, or drop on hard or paved surfaces.



DON'T DROP PLIERS ON HARD OR PAVED SURFACES.

WRONG

IRONWORKERS' PLIERS

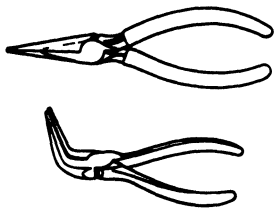


Description These pliers are very similar to Linemen's pliers except that they have a hook bend on one handle and may have a coil spring to hold the jaws open. Sizes range from 7 to 9 inches in length. Available in standard and high leverage patterns.

Proper Uses. These wire cutting pliers are designed for tying concrete reinforcing bars and form work involving pulling, twisting and cutting wire.

Abuse/Misuse. Never expose pliers to excessive heat. Don't rock pliers from side to side when cutting wire. Always cut at right angles. **Never** use pliers as a hammer or drop on hard or paved surfaces.

LONG NOSE PLIERS



Description. This type of plier embraces three nose configurations; needle, round and chain. They are available with and without side cutters and with cutters notched for stripping insulated wire. Small and miniature sizes are designed for electronic work. Handles may be plain, slip-on plastic, or dipped. Certain patterns are made in both straight and curved nose design. Sizes range from 4 to 8 inches in length.

Proper Uses. Most Long Nose Pliers are designed for electrical, telephone and electronic work involving smaller wire gauges. They will reach into awkward places and perform work difficult with any other tool. Their usefulness, however, is not limited to wire work.

Abuse/Misuse. Never expose these pliers to excessive heat. Don't bend stiff wire with the plier tip. Never rock side to side when cutting. Cut at right angle to the wire. Never pry with the plier nose.

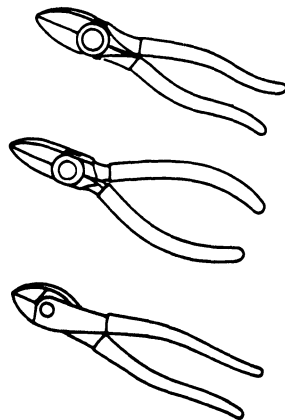


DON'T BEND STIFF WIRE
WITH THE PLIER TIP.

WRONG

When to Repair or Replace. Attempts to repair Linemen's side cutting, Long Nose and Ironworker's pliers are not recommended. Discard any plier which is cracked, broken, sprung, or has nicked cutting edges. Dull cutting edges may be touched up with a small, medium grade honing stone. Serrations inside of nose may be cleared of foreign materials by brushing with a file card or stiff wire brush.

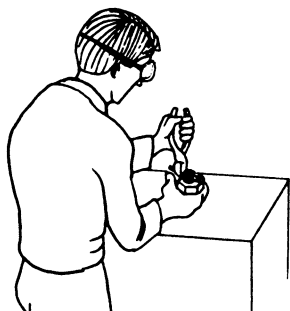
DIAGONAL CUTTING PLIERS



Description. Diagonal Cutters are made in several patterns ranging from the high leverage, heavy-duty pattern down to the midget pattern for electronic work. They are available with and without a top bevel on the cutting edges for flush cutting. Some have wire skinning holes—some have coil springs to open the jaws. Handles may be plastic dipped, slip-on molded plastic, or plain. Sizes range from 4 to 8 inches in length.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



**HEAVY DIAGONALS ARE FINE FOR CUTTING
THE SPREAD ENDS OF COTTER PINS.**

RIGHT

Proper Uses. Diagonal Cutting pliers are designed for electrical, electronic, telephone, general and automotive work. Flush cutting edge pliers should be used only for cutting small soft wires used in electronic work. It is recommended that the standard cutting edge pliers be used for all general cutting requirements except hard wire.

Abuse/Misuse. Never expose pliers to excessive heat. Don't rock pliers from side to side when cutting wire. Always cut at right angles. Never use pliers as a hammer, or drop on hard or paved surfaces.

When to Repair or Replace. Attempts to repair these pliers are not recommended. Discard any plier which is cracked, broken, sprung, or has nicked cutting edges. Dull cutting edges may be touched up with a small, medium grade honing stone.

FLAT NOSE PLIERS

Description. Often referred to as "Duck Bill," these pliers have a flat nose in various widths. Available with plain or plastic dipped handles in sizes from 4-1/2 to 8 inches in length.



Proper Uses. Flat Nose pliers have diverse uses in the electrical, telephone, electronic and other fields. They are extensively used in typewriter repair and assembly work and in textile weaving and knitting operations.

Abuse/Misuse. Never expose these pliers to excessive heat. Do not use as a hammer or as a pry.

When to Repair or Replace. Attempts to repair these pliers are not recommended. Discard any plier that is cracked, broken or sprung.

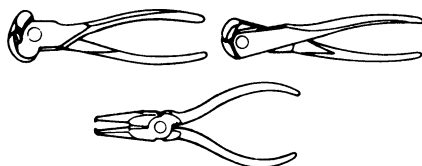


**DON'T USE FLAT NOSE PLIERS
TO PRY OR TWIST.**

WRONG

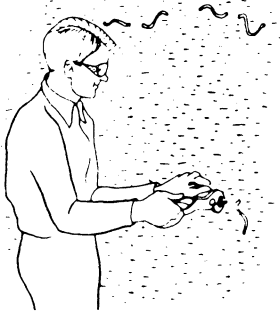
END CUTTING PLIERS

Description. End cutting pliers or nippers range in size from the heavy-duty, high leverage pattern down to the traverse end cutter designed for precision electronic work. Many are available with plain or plastic dipped handles. Sizes range from 4 1/2 to 8 inches in length.





**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



**END CUTTERS ARE IDEAL FOR CUTTING TIE
WIRES CLOSE TO THE CONCRETE WALL.**

RIGHT

Proper Uses. End Cutting pliers are designed for cutting soft wire, nails, rivets, etc. close to work.

Abuse/Misuse. Never expose these pliers to excessive heat. Never use as a hammer.

When to Repair or Replace. Attempts to repair these pliers are not recommended. Discard any plier which is cracked, broken, sprung, or has nicked cutting edges. Dull cutting edges may be touched up with a small, medium honing stone.

SLIP JOINT PLIERS

Description. These widely used pliers are available in several patterns; standard, thin nose, bent nose and heavy-duty. Their slip joint capability increases the capacity range. Available with or without wire cutters in sizes from 5 to 10 inches in length. Also available with plastic dipped grips or slip-on plastic grips.



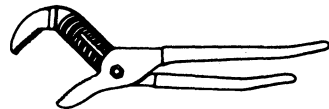
Proper Uses. These versatile tools are designed for a wide range of service involving gripping, turning and bending.

Abuse/Misuse. Never expose these pliers to excessive heat. Never use as a hammer. Never place a piece of pipe on plier to achieve more strength.

When to Repair or Replace. Attempts to repair these pliers are not recommended. Discard any plier that is cracked, broken or sprung.

TONGUE AND GROOVE PLIERS

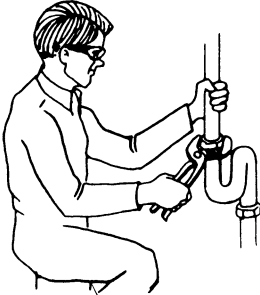
Description. These wide-range capacity pliers are made with a tongue and groove adjustment design. Jaw capacities up to 4¼ inches are available. Jaws may be smooth, straight, or curved toothed. Sizes range from 4½ to 16 inches in length.



Proper Uses. These pliers are widely used by plumbers, electricians, auto mechanics and professionals in the construction and industrial fields. They will grip round, square, flat and hexagonal objects and are capable of applying limited torque without damage to the work.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



**PLUMBERS, ELECTRICIANS AND
MAINTENANCE WORKERS HAVE MANY
JOBS WHERE TONGUE AND GROVE PLIERS
ARE INVALUABLE.**

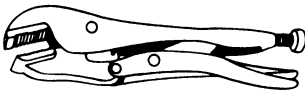
RIGHT

Abuse/Misuse. Never expose these pliers to excessive heat. **Never** use as a hammer.

When to Repair or Replace. Attempts to repair these pliers are not recommended. Discard any plier that is cracked, broken or sprung.

LOCKING PLIER-WRENCHES AND CLAMPS

Description. Locking plier-wrenches are available in a variety of sizes with straight or curved jaws. Compound leverage systems lock jaws and hold various shapes and sizes of work.



Proper Uses. These wrenches are combination tools which function as pliers, wrenches, portable vises or clamps. They are not intended to

replace open-end or box wrenches because of possible damage to the fitting or fastener.



**DON'T HAMMER ON PLIERS TO CUT WIRE
OR BOLTS.**

WRONG

Abuse/Misuse. Do not hammer to tighten jaws or to cut wire or bolts. Do not expose wrenches or clamps to heat from welding torches or to contact with welding electrodes. When subjected to severe vibration such as encountered during riveting, locking wrenches or clamps holding the work pieces should be wired or taped closed to prevent accidental opening. Do not use pipe, other extensions, or hammering to increase torque applied to these tools. They should **never** be used as steps or ladders to support personnel.

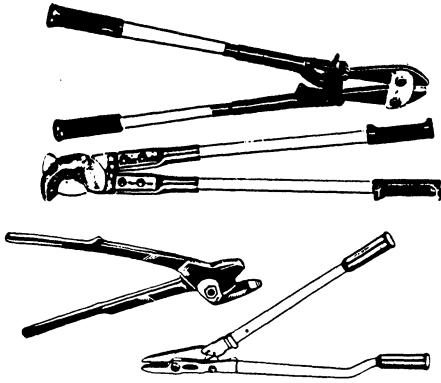
When to Repair or Replace. Avoid excessive wear on working parts by frequent lubrication. Attempts to repair these tools are not recommended. Discard any damaged tool.

CUTTERS

INTRODUCTION

There are many types and sizes of cutters used to cut selected ferrous and non-ferrous metals described

below. Each cutter is designed for a specific type and size of material to be cut. Always use the proper cutter for the job.



TYPES OF CUTTERS

Description. There are different head styles and tool configurations ranging in length from 9" to 42" for cutting different materials. Models which have blades that pass each other normally cut only non-ferrous cable.

Proper Uses. Cutters are used to cut ferrous materials such as steel wire and cable, rod wire rope, aircraft cable, guy strand, fencing, bolts and steel strapping. Other cutters are used for cutting non-ferrous material such as copper and aluminum. Cutters are used in plant maintenance, construction, electrical construction and maintenance, and other operations. Be certain to select the proper cutter for the job. Follow manufacturers' instructions or obtain professional advice.

Proper Care. Cutters should be adjusted and lubricated daily when in use. Jaws may be sharpened according to instructions shipped with the cutter.

When to Replace. Attempts to re-

pair cutters are not recommended. Discard any cutter which is cracked, broken or shows signs of looseness or play due to wear in the compound leverage toggle.

DO'S AND DON'TS

Wear protective gloves and safety goggles when using cutters.

Wear safety shoes.

Keep cutting tools in good repair; lubricate moving parts only.

Don't attempt to use a cutting tool until its proper and safe uses are fully understood.

Remember that metal flies when cut. The harder the metal, the farther it will fly. One way to prevent injury from flying metal is to wrap a burlap bag, wiping cloth or rag around the cutting jaws so metal pieces cannot fly.

When using a cutter, warn those in the area to take precautionary measures to avoid possible injury from possible flying metal pieces.

Don't cut diagonally.

Remember that the hardness of the stock being cut is as important as its size.

Use all tools as recommended:

1. Do not exceed rated capacity of tool as shown on jaws.
2. Do not pry or twist with tool when cutting. Keep material being cut at right angles to the cutting edges of jaws.

Improper cutting may contribute to personal injury or damage to tool.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

SNAP RING-RETAINING RING PLIERS

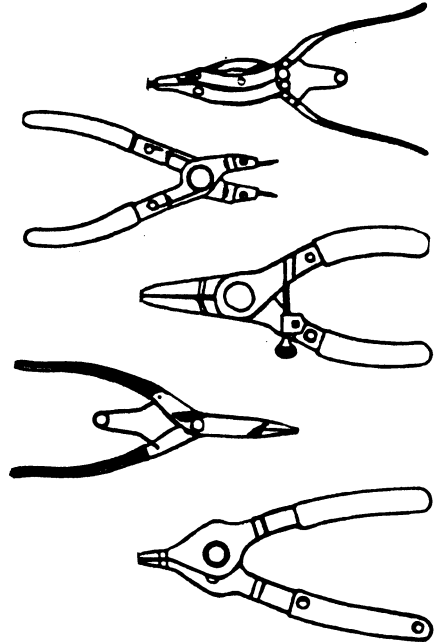
PROPER USES. These pliers spread snap lock rings used on brakes, transmissions, pedalshafts, clutch shafts and machine tools. Can also be used to spread piston rings.

SAFETY TIPS

1. First loosen circlip with punch or similar tool to remove bond from rust and accumulated dirt in groove.
2. Use largest tips that fit in the holes in the circlip.
3. Push tips as far as possible into circlip holes before squeezing plier handles.
4. Use minimal pressure needed to remove or install ring.
5. Never use your pliers for anything other than installing and removing circlips.
6. Caution: Take care that circlips do not get dislodged from tips of pliers — always protect eyes. Wear safety goggles.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



SECTION III. STRIKING TOOLS

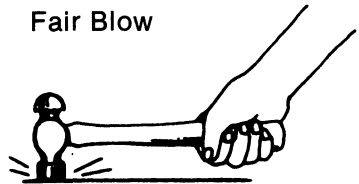
INTRODUCTION

Hammers and other striking tools are perhaps the most widely used, and probably the most often abused of all hand tools. They are made in various types, sizes and configurations for specific purposes. They should be selected for their intended use and used only for those purposes for which they are designed. Misuse can cause the striking face to chip, possibly resulting in eye or other serious injury. Proper use of virtually all types involves certain basic rules:

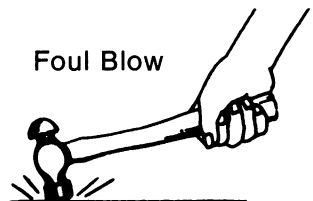
- (1) A hammer blow should always be struck squarely with the hammer striking face parallel

with the surface being struck. Always avoid glancing blows and over and under strikes.

Fair Blow



Foul Blow



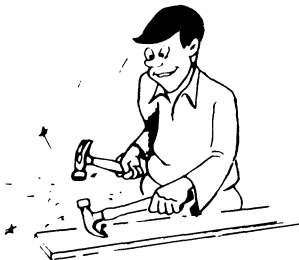


**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



RIGHT

- (2) When striking another tool (chisel, punch, wedge, etc.), the striking face of the proper hammer should have a diameter approximately $3/8''$ larger than the struck face of the tool.
- (3) Always use a hammer of suitable size and weight for the job. Don't use a tack hammer to drive a spike, nor a sledge to drive a tack.
- (4) Never use one hammer to strike another hammer or a hatchet.



WRONG

- (5) Never use a striking or struck tool with loose or damaged handle.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



RIGHT

- (6) Discard any striking or struck tool if tool shows dents, cracks, chips, mushrooming, or excessive wear.
- (7) Never regrind, weld or reheat-treat a hammer.

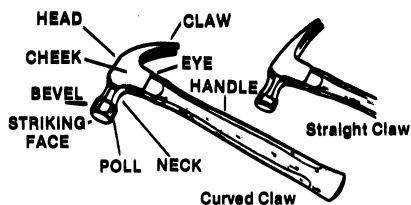


WRONG

NAIL HAMMERS

Description. Nail hammers are made in two patterns; curved claw and straight or ripping claw. The face is slightly crowned with the edges bevelled, although certain heavy-duty patterns may have checkered faces designed to reduce glanc-

NAIL HAMMERS



ing blows and flying nails. Handles may be wood, tubular or solid steel, or fiberglass. Tubular steel, solid steel and fiberglass are generally furnished with rubber-type grips which are occasionally used also on wood handles.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Proper Uses. Nail hammers are designed for driving unhardened common and finishing nails only and nail sets, using the center of the hammer face. The claws are for pulling common and finishing nails and ripping woodwork and should not be struck against metal.

Abuse/Misuse. Never strike one hammer with another hammer or a hatchet. Never strike concrete, steel chisels or similarly hard objects with a nail hammer as the hammer face may chip, possibly resulting in eye or other serious bodily injury.

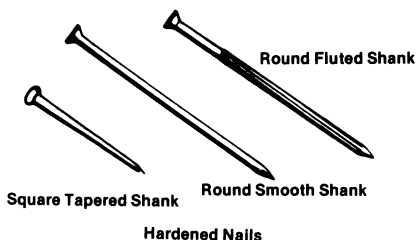
Never use a hammer with loose or damaged handle. Never strike with the side or cheek of a hammer.

WARNING: Hardened steel-cut, pole barn and masonry nails should **never** be driven with a nail hammer. These nails may shatter or may cause a hammer face to chip with an indirect or glancing blow, and should **never** be driven unless safety goggles are worn. When not driven through a piece of wood, a hole should be started with a small star



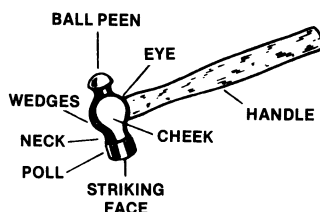
WRONG

drill or masonry bit. A hand drilling hammer or sledge is the proper tool to use.



When to Replace. Discard any hammer if the striking face or its bevel show dents, chips, mushrooming or is excessively worn, or if the claws show indentations or nicks inside the nail slot, or if claw is broken. If handle only is damaged, replace it with an equivalent new handle.

BALL PEEN HAMMERS



Description. Ball peen hammers are one of the most commonly used hammers. They have a rounded,

slightly crowned striking face with bevelled edges and a round, ball-shaped peen. Handles may be wood, solid steel, or fiberglass. The solid steel and fiberglass types are generally furnished with rubber-type grips which are occasionally used also on wood handles.

Proper Uses. Ball peen hammers of the proper size are designed for striking chisels and punches, and for riveting, shaping and straightening unhardened metal.

When striking a struck tool (chisel or punch), the striking face of the hammer should have a diameter approximately $\frac{3}{8}$ " larger than the struck face of the tool.

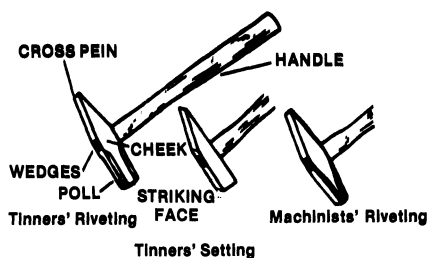
Abuse/Misuse. Never use a hammer with a loose or damaged handle. Avoid glancing blows to minimize chipping of the hammer. Never strike with the side or cheek of the hammer.



WRONG

When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming, or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

RIVETING AND SETTING HAMMERS



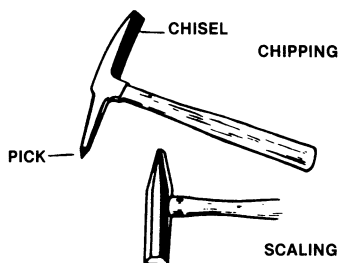
Description. These hammers are designed for machinists' and tinnern's use. Handles are usually wood. The **Machinists' Riveting** hammer has a round poll with slightly bevelled, flat striking face and rounded cross peen. The **Tinnern's Riveting** hammer has an octagon poll with a flat striking face with slightly bevelled edges. The cross peen is slightly rounded. The **Tinnern's Setting** or **Paneing** hammer's face has sharp corners and no bevels. The cross peen has a sharp bevelled edge.

Proper Uses. The Riveting hammer is designed for driving and spreading rivets on sheet metal work. The Setting hammer is designed for forming sharp corners, closing and peening seams and lock edges, and for use by glaziers for inserting glazier points.

Abuse/Misuse. Never use these hammers for general purpose work—they are strictly specialized tools intended only for driving and spreading unhardened rivets and forming sheet metal. The square, sharp corners and sides of the setting hammer make it especially vulnerable to chipping if improperly used.

When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming, or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

SCALING AND CHIPPING HAMMERS



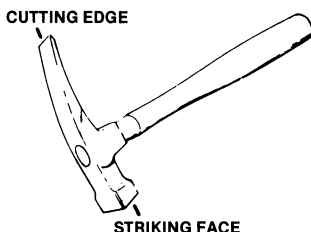
Description. Scaling and chipping hammers are special-purpose tools and are made in varying configurations by different manufacturers. The two patterns illustrated are typical.

Proper Uses. These hammers are popular in iron foundries and welding shops. They are designed for chipping welds, scale, rust and paint from unhardened metal.

Abuse/Misuse. **Never** use these hammers for any but the above purposes. **Never** use a hammer with loose or damaged handle.

When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming, excessive wear, or dulling. If handle only is damaged, replace it with an equivalent new handle.

BRICKLAYERS' HAMMERS



Description. Bricklayers' hammers are special-purpose tools. The striking face is flat with bevelled

edges. The blade has a sharp, hardened cutting edge. Handles may be wood, solid steel or fiberglass and may be furnished with rubber-type grips.

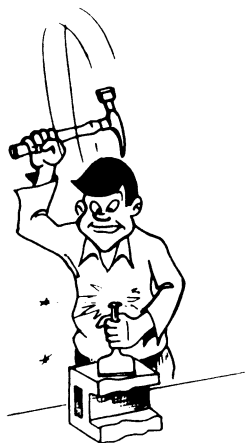
Proper Uses. Bricklayers' hammers are designed for setting and cutting (splitting) bricks, masonry tile and concrete blocks, and for chipping mortar from bricks.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

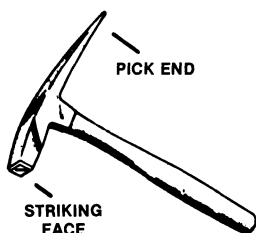
Abuse/Misuse. **Never** use these tools to strike metal or to drive struck tools (including brick sets and chisels). Use a hand drilling, blacksmith or engineer's hammer.

When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming, excessive wear or dulling. If handle only is damaged, replace it with an equivalent new handle. Cutting edge may be re-dressed. See instructions in section V.



WRONG

PROSPECTING PICKS



Description. These are special-purpose tools used by geologists and prospectors. The striking face is flat with bevelled edges. The long pick is pointed and may be either round or square. Handles may be wood, solid steel or fiberglass, and may be furnished with rubber grips.

Proper uses. Prospecting picks are designed for splitting rock and for digging and prying out rock with the pick. The pick is also used as an aid in climbing.



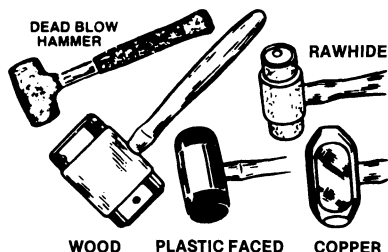
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Abuse/Misuse. Never use these tools to strike metal or to drive struck or hammered tools. Never use a pick with loose or damaged handle.

When to Replace. Discard the pick if it shows dents, cracks, chips, mushrooming, excessive wear, or dulling. If handle only is damaged, replace it with an equivalent new handle.

SOFT FACE AND NON-FERROUS HAMMERS AND MALLETS

Description. Soft face hammers and mallets are made of various non-ferrous materials (wood, rawhide, rubber, plastic, copper, brass,



lead, etc.). Heads are cylindrically shaped with two flat striking faces. Handles are usually wood or fiberglass.

Proper Uses. Soft face hammers are intended for striking blows where steel hammers would mar or damage the surface of the work. Wooden mallets are properly used for striking wood and plastic-handled chisels, gouges, wood pins and small stakes, and to form or shape sheet metal. Rubber and plastic hammers are used for setting stone. Plastic hammers usually have replaceable tips, available in varying degrees of hardness.

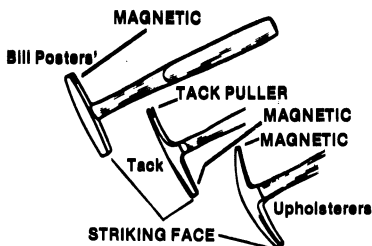
Abuse/Misuse. Never use these tools to drive nails or screws, or to strike sharp metal objects. Never use a hammer or mallet with loose or damaged handle.

When to Replace. Discard any hammer or mallet if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

MAGNETIC HAMMERS

Description. Magnetic hammers are usually made in the patterns illustrated. One end of the head is magnetized to hold tacks. Handles are usually wood.

Proper Uses. Primary use of these light-duty hammers is holding and



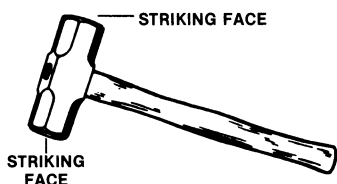
driving tacks. The tack hammer has a long thin claw for pulling tacks in corners and along walls; also used for removing light mouldings. The heads of the other two patterns are designed for starting and driving tacks only. The magnetic end is used for starting the tack; the opposite end, for driving.

Abuse/Misuse. Never use these hammers for driving other than tacks and upholstery nails. Never use a hammer with loose or damaged handle.

When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.



ENGINEERS' HAMMERS AND SLEDGES, DOUBLE FACE



Description. This is the most commonly used type of sledge hammer and is made in slightly different head configurations. All patterns

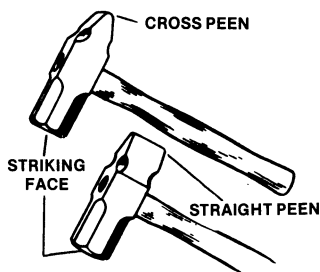
have crowned striking faces with bevelled edges.

Proper Uses. Sledges are designed for general sledging operations in striking wood or metal. Common uses are drifting heavy timbers and striking spikes, cold chisels, star drills and hardened nails.

Abuse/Misuse. Never use a sledge to strike a hammer, sledge, or maul. Never use a sledge with a loose or damaged handle.

When to Replace. Discard any sledge if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

BLACKSMITHS' HAND HAMMERS AND SLEDGES, STRAIGHT AND CROSS PEEN



Description. These heavy-duty hammers are designed for blacksmiths' use in striking metal. Striking face is crowned with bevelled edge.

Proper Uses. The striking face is designed for general blacksmith work in striking unhardened metal. The peens are used for shaping (fullering) and bending unhardened metal.

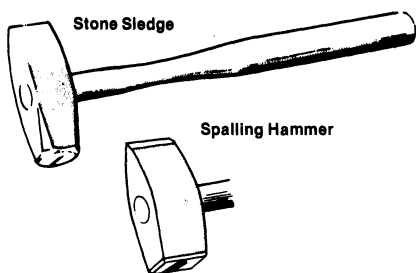


RIGHT

Abuse/Misuse. Never use a sledge to strike a hammer, sledge, hatchet, axe or maul. Never use a sledge with loose or damaged handle.

When to Replace. Discard any sledge if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

STONE SLEDGES AND SPALLING HAMMERS



Description. These are stone masons' tools and are made in slightly varying configurations by different manufacturers. The sledge usually has a crowned, oval striking

face with a napping face opposite. The spalling hammer may have a bevelled or straight edged face.

Proper Uses. Stone sledges are designed for breaking up stone and concrete. The spalling hammers are designed for cutting and shaping stone and concrete.

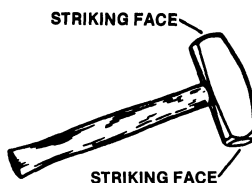


RIGHT

Abuse/Misuse Never use these tools for striking metal. Never use a tool with loose or damaged handle.

When to Replace. Discard any sledge if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

HAND DRILLING OR MASH HAMMERS

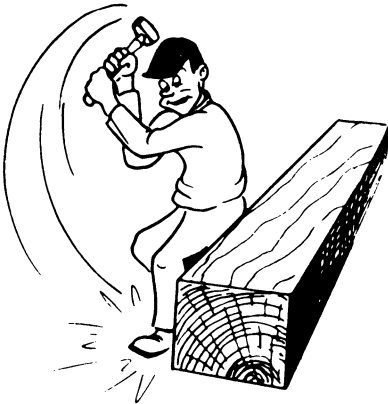


Description. These heavy, short-handled hammers are made in slightly varying configurations by different manufacturers. The double-faced head has crowned and bevelled striking faces.

Proper uses. These hammers are designed for uses with chisels, punches, star drills and hardened nails. Their design permits heavy blows with limited swing—especially advantageous in restricted working areas.



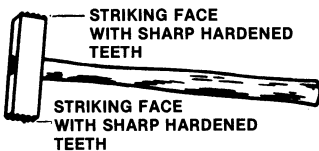
Abuse/Misuse. Never use these tools for sledging or stone work. Avoid glancing blows against other hardened surfaces. **Never** use a hammer with loose or damaged handle.



WRONG

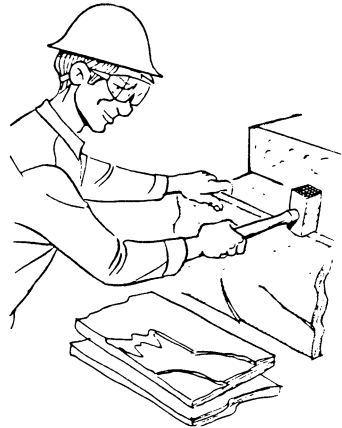
When to Replace. Discard any hammer if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle.

BUSH HAMMERS



Description. This is a striking tool of compact, rectangular design hav-

ing striking faces with sharp, hardened teeth.



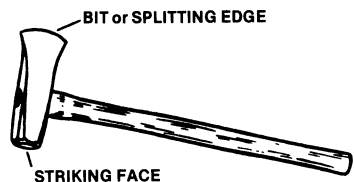
RIGHT

Proper Uses. Bush hammers are designed for a single purpose — roughing and chipping concrete.

Abuse/Misuse. Never use this tool for striking anything but concrete. **Never** use a hammer with loose or damaged handle.

When to Replace. Discard the tool if teeth are dull and/or flattened. If handle only is damaged, replace it with an equivalent new handle.

WOODCHOPPERS' MAULS



Description. Woodchoppers' mauls have a round, bevel-edged striking face with a splitting edge opposite.

Proper Uses. These tools are designed for splitting wood. Also they are used in conjunction with wood

splitting wedges by first making a notch with the splitting edge and then driving the wedge with the maul's striking face.

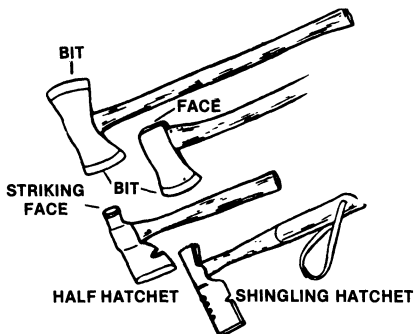


Abuse/Misuse. Never use this tool to strike concrete. Never drive one maul by striking with another maul, sledge or other striking tool. Never use a maul with a loose or damaged handle.



When to Replace. Discard any maul if it shows dents, cracks, chips, mushrooming, or excessive wear. If handle only is damaged, replace it with an equivalent new handle. Redress the bit as instructed in section V.

AXES AND HATCHETS



Description. Axes are made in various patterns and head configurations. The more widely used types are illustrated.

Hatchets are made in an even greater variety of patterns, since specific types are intended for use by various tradesmen (carpenters, roofers, dry wall installers, rig builders, etc.). Handles may be wood, tubular or solid steel, or fiberglass. Tubular steel, solid steel and fiberglass handles are generally furnished with rubber-type grips.

Proper Uses. The double bit axe is usually used to fell, trim or prune trees and to split and cut wood. It is also used for notching and shaping logs and timbers. The single bit axe, in addition to the above uses, is used to drive wood stakes with the face.

Hatchets are used for cutting, splitting, trimming and hewing, and driving unhardened nails and stakes with the striking face.

Abuse/Misuse. The cutting edges of axes and hatchets are designed for cutting wood and equally soft materials. The should **never** be struck against metal, stone or concrete. The striking faces of hatchets are properly hardened for driving common nails but should **never** be used to strike chisels, punches, star drills or other hardened metal tools, or for striking stone or concrete. **Never** use an axe or a hatchet as a wedge or a maul. **Never** strike with the sides, and **never** use an axe or hatchet with loose or damaged handle.



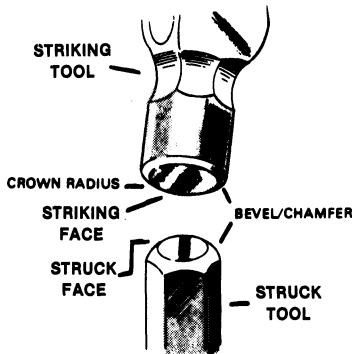
When to Replace. Discard any axe or hatchet if it shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle. Cutting edges may be redressed if properly done. See instructions in Section V.



SECTION IV. STRUCK OR HAMMERED TOOLS

INTRODUCTION

This section deals with the use-related tools that are struck with the tools described in Section III.

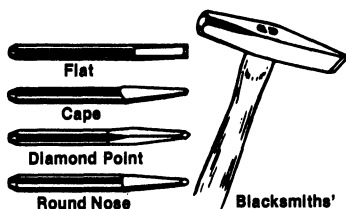


A knowledge of the basics of good tool design will be helpful. The striking and struck faces of tools are designed to direct the force of blows toward the center or body of the tool. Blows struck off center are not directed toward the body of the tool where they can be absorbed, but rather travel directly along the sides of the tool where there is insufficient back-up material. The net effect is shearing which is dangerous.

The angle and thickness of the cut-

ting edges of tools are designed to give maximum cut and durability. When the cutting edge becomes dull, not only does the cutting ability decrease, but the durability is drastically reduced. Many failures are caused by dullness.

COLD CHISELS



Description. With the exception of the blacksmiths' pattern, cold chisels may be made from round, square, hexagon or octagon steel stock. The blacksmiths' cold chisel is fitted with a handle.

Proper Uses. Cold chisels have a cutting edge at one end for cutting, shaping and removing metal softer than the cutting edge itself such as cast iron, wrought iron, steel, bronze, copper, etc. and a struck face on the opposite end.



WRONG

Abuse/Misuse. Never use cold chisels for cutting or splitting stone or concrete. Never use a dull chisel or one with a mushroomed head. Never use a blacksmiths' cold chisel with a loose or damaged handle.

When to Replace. Discard any chisel if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle. If cutting edge is dull, it may be redressed as instructed in Section V.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Proper Uses. Hot chisels are designed for cutting hot steel.

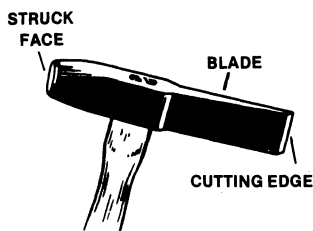
Abuse/Misuse. Never use hot chisels for cutting cold metal, stone or concrete. Never use a dull chisel or one with a mushroomed head. Never use a chisel with loose or damaged handle.



WRONG

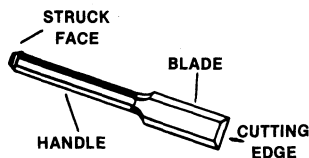
When to Replace. Discard any chisel if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. If handle only is damaged, replace it with an equivalent new handle. If cutting edge is dull, it may be redressed as instructed in Section V.

HOT CHISELS



Description. Hot chisels or hot cutters are very similar to blacksmiths' cold chisels except that the cutting edge or bit is wider and the blade is thinner.

ALL-STEEL WOOD AND RIPPING CHISELS



Description. This type of wood chisel is made from a single piece of steel comprising blade, handle and struck face.

Proper Uses. These are heavy-duty wood cutting tools designed for rough work.

Abuse/Misuse. Never use an all-steel chisel with a mushroomed struck face or a chipped or dull cutting edge. Never use on metal.

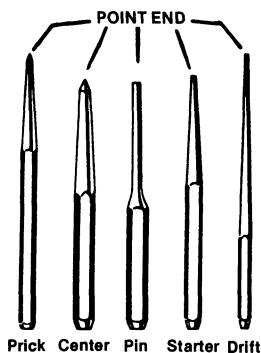
When to Replace. Discard any chisel if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. If cutting edge is dull, it may be redressed as instructed in Section V.



RIGHT

HAND PUNCHES

Description. Hand punches are made in the various patterns illustrated from square, round, hexagon or octagon steel stock.



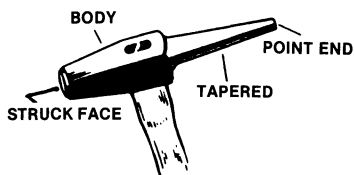
Proper Uses. Punches are designed to mark metal and other materials softer than the point end, drive and remove pin and rivets, and align holes in different sections of material.

Abuse/Misuse. Never use a punch with a mushroomed struck face or with a dull, chipped or deformed point.

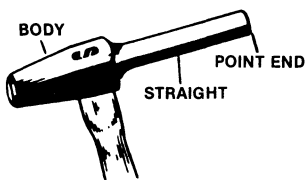
When to Replace. Discard any punch if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. If point is dull or deformed, it may be redressed as instructed in Section V.



BLACKSMITHS' PUNCHES ROUND



BACKING OUT



Description. Blacksmiths' round and backing out punches are made from a solid piece of steel. The punch end of the round punch is tapered from point to body, whereas the punch end of the backing out punch is the same diameter from point to body. Both types are fitted with handles.

Proper Uses. Blacksmiths round punches are designed for drifting holes, aligning and driving pins.

Blacksmiths backing out punches are designed for backing out bolts, rivets and pins.

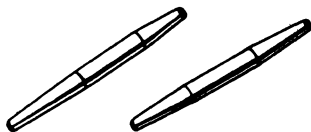


**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Abuse/Misuse. Never use a punch with a mushroomed struck face or a chipped or deformed point. Never use a punch with a loose or damaged handle.

When to Replace. Discard any punch if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. If point end is deformed, it may be redressed as instructed in Section V. If handle only is damaged, replace it with an equivalent new handle.

DRIFT PINS



Plug, Taper or
Standard Type

Barrel Type

Description. Drift pins are made from round steel stock. The Plug or Standard type has an abrupt taper at one end and a longer taper at the other end. The Barrel type has equal tapers at both ends.

Proper Uses. Drift pins are designed for aligning holes in metal.

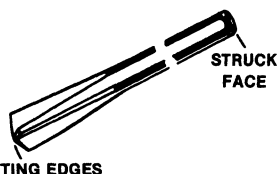
Abuse/Misuse. Never use a drift pin as a punch. Never strike a drift pin if either end is chipped or mushroomed.

When to Replace. Discard any drift pin if it is bent or either end shows dents, cracks, chips, mushrooming or excessive wear. Deformed points may be redressed as instructed in Section V.



WRONG

STAR DRILLS



Description. The cutting end of a star drill resembles four chisels joined at their cutting edges to form a cross.

Proper Uses. Star drills are designed for drilling holes in masonry (stone, concrete, brick, etc.). They should be struck squarely with a



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**



RIGHT



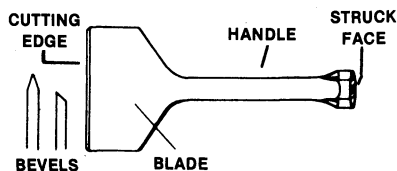
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

hand drilling hammer or sledge, and the drill should be rotated after each blow.

Abuse/Misuse. Never use a star drill on anything but masonry. Never use a star drill with a dull cutting edge or with a chipped, battered or mushroomed struck face.

When to Replace. Discard any star drill if it is bent or shows dents, cracks, chips, mushrooming, or excessive wear. If cutting edges are dull, they may be redressed as instructed in Section V.

BRICK CHISELS AND BRICK SETS



Description. These types of chisels and sets are made from a single piece of steel comprising blade, handle and struck face. The chisel has a double bevel; the set, a single bevel to form the cutting edge.

Proper Uses. These chisels and sets are designed for scoring and cutting, adjusting and trimming bricks or blocks. They should be struck with a hand drilling hammer or sledge—not a bricklayers' hammer or a nail hammer.

Abuse/Misuse. Never use these tools on metal—they are strictly masonry tools. Never use a chisel or set with dull cutting edge or with chipped, battered or mushroomed struck face.

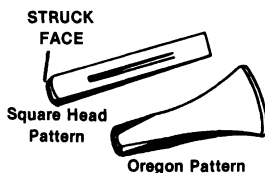
When to Replace. Discard any chisel or set if it is bent or shows



WRONG

dents, cracks, chips, mushrooming or excessive wear. Dull cutting edges may be redressed as instructed in Section V.

WOOD SPLITTING WEDGES



Description. Wood splitting wedges are usually made from a solid piece of steel. They are made in various patterns, the ones illustrated being the most commonly used.

Proper Uses. Wood splitting wedges are designed for splitting logs, firewood, staves and other wood products. Always use a woodchoppers' maul or an axe to make a starting notch. Wedges should be struck with a sledge or woodchoppers' maul having a larger striking face than the struck face of the wedge.

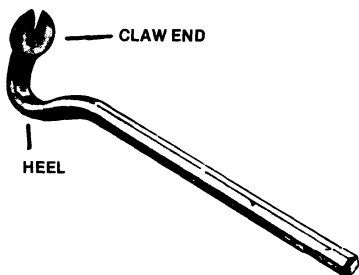


**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Abuse/Misuse. Never use a wedge with a mushroomed or chipped struck face.

When to Replace. Discard any wedge if it shows dents, cracks, chips, mushrooming, or excessive wear. If splitting edge is dull it may be redressed as instructed in Section V.

NAIL PULLER BARS



Description. Nail puller bars are made from bar steel stock. The claw ends are formed at an angle to pull nails.

Proper Uses. The nail puller bar is designed for extracting deeply imbedded nails. The claw is driven into the wood under the nail head by striking the heel of the claw with a heavy hammer such as a hand drilling hammer or sledge. The nail is then extracted at an angle by pulling the bar in the direction of the user.

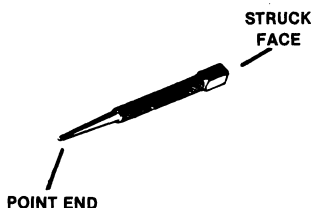


**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Abuse/Misuse. Never use a nail hammer to strike a nail puller bar. The striking face is too small and may chip.

When to Replace. Discard any bar that is bent or has a chipped or broken claw or a rounded or dull bevel.

NAIL SETS



Description. Nail sets are made from bar steel stock and have a cupped point end opposite the struck face.

Proper Uses. Nail sets are used to drive finishing nail heads below a wood surface.

Abuse/Misuse. Never use a nail set for punching holes in metal, marking metal, aligning holes or driving pins or rivets.

When to Replace. Discard any nail set if it is bent or shows dents, cracks, chips, mushrooming or excessive wear. Discard — do not redress.

SECTION V.

REDRESSING INSTRUCTIONS

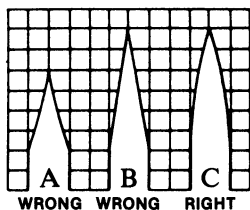
The redressing and reshaping of tools having chipped battered or mushroomed striking or struck surfaces is not recommended. When a tool has reached this stage through normal use or abuse, it should be discarded.

There are three basic rules which apply to the redressing of dull cutting edges:

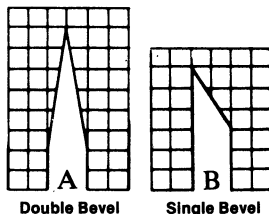
1. Rigidly support the tool being redressed.
2. Use a hand file or whetstone only, **never** a grinding wheel. File or stone away from the cutting edge.
3. Original contour of cutting edge should be restored.



Axes. Use a hand file for redressing. Start 2 or 3 inches back from the cutting edge and file to about $\frac{1}{2}$ inch from the edge. Work for a fan shape, leaving reinforcement at corners for strength. File the remaining $\frac{1}{2}$ inch, blending into previously filed area preserving the original contour of the cutting edge. Remove all scratches with a whetstone or hone $\frac{1}{2}$ " back from the cutting edge. See cross section C illustration below for the "right" way to shape the edge in redressing axes. Other illustrations show "wrong" ways to redress axes.

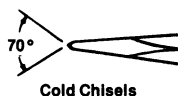


Hatchets. Hatchets with double bevels should be redressed as illustrated in A below. Hatchets with single bevels should be redressed as illustrated in B below. Use a hand file for redressing removing scratches with a whetstone.



Cold Chisels (Flat). Cold chisels are hardened on the cutting edge. Redressing may be done with a hand file or whetstone restoring to original shape or to an included angle of ap-

proximately 70 degrees (see illustration below).



Cold Chisels

Other Machinists' Chisels. Other commonly used metal-working chisels are Round Nose, Diamond Point and Cape. Redressing instructions are the same as for flat cold chisels except that bevel angles are approximately as illustrated.



Cape



Round Nose

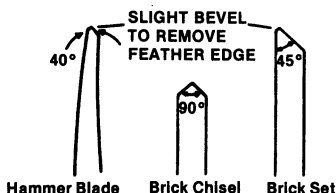


Diamond Point

Hot Chisels. These are handled tools used for cutting hot metal. Redressing instructions are the same as for cold chisels.

Punches. The working end of pin and rivet punches and blacksmiths' punches should be redressed flat and square with the axis of the tool. The point of center punches should be redressed flat and square with the axis of the tool. The point of center punches should be redressed to an included angle of approximately 60 degrees; prick punches, to an included angle of approximately 30 degrees.

Bricklayers' Tools. Bricklayers' tools should be redressed to approximately the angles illustrated.



Woodchoppers' Mauls and Wood Splitting Wedges. The instructions for redressing axes apply also to these tools although they have heavier heads and thicker sections in the bit. Hand file the splitting edge to an included angle of approximately 70 degrees. See cold chisel illustration for 70 degree included angle.

Star Drills. Hand file all cutting edges; to an included angle of approximately 70 degrees. See cold chisel illustration for included angle of 70 degrees.

Prospecting Picks. Redress with a hand file to restore original contour of the pick end.

SECTION VI. SCREWDRIVERS

INTRODUCTION

Next to the hammer, the screwdriver is probably the most abused tool in the homeowner's or professional's tool kit. Screwdrivers are available in a wide variety of shapes, sizes, and materials. But, they are all intended for one simple use: driving and withdrawing threaded fasteners such as wood screws, machine screws, and self-tapping screws. Unfortunately, the screwdriver is misused for prying, chiseling, scraping, scoring—and only sometimes for its intended use of driving screws!

However, the most common abuse is using a screwdriver that doesn't match or fit the screw. You wouldn't wear a pair of shoes that is too small or too big for your feet—you would be abusing your feet. For the same reason you should not use a screwdriver that is too small or too big for the screw it is to drive. Use the right screwdriver and you won't chew up the screw head, damage the screwdriver or bark your knuckles.

The abuse of a screwdriver—and the screw—is most often due to the fact that the homeowner or professional simply does not have a proper assortment of screwdrivers on hand.

A screwdriver should **never** be

used as a pry bar. If it is overstressed in this manner, the blade might break and send a particle of steel into the operator's arm or perhaps even into his eye.

Bear these points in mind when using a screwdriver: always match the size of the screwdriver to the *job* and always match the type of screwdriver to the *head* of the screw.

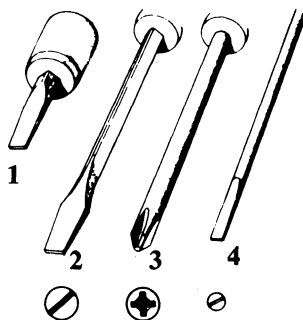


FIG. 1. Typical screwdrivers

1. Stubby screwdriver for working in close quarters.
2. Screwdriver with a square shank to which a wrench can be applied to remove stubborn screws.
3. Screwdriver for Phillips screws.
4. Cabinet screwdriver has a thin shank to reach and drive screws in deep, counterbored holes.

After all, you wouldn't want to drive a large No. 12 screw with a small 3/32- or 3/16-inch screwdriver and neither would you drive a Phillips screw or other recessed screw with a conventional screwdriver.

Be careful not to confuse a Phillips screwdriver with other "cross point" screwdrivers. They are not interchangeable. See Page 41 for how they differ.

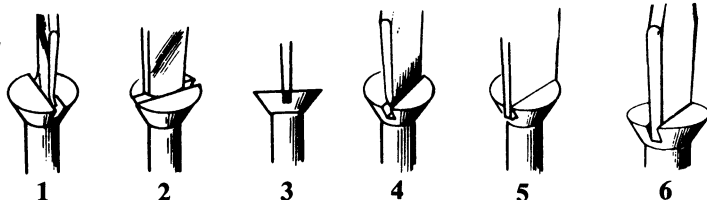
BASIC SAFETY RULES THAT APPLY TO THE USE OF A SCREWDRIVER



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

1. Make sure that the tip fits the slot of the screw; not too loose and not too tight.
2. Do not use a screwdriver as a cold chisel or punch.
3. Do not use a screwdriver near live wires (or any other tool, for that matter).
4. Do not expose a screwdriver to excessive heat.
5. Redress a worn tip with a file in order to regain a good straight edge.
6. Discard a screwdriver that has a worn or broken handle.
7. A screwdriver should **never** be used as a pry bar. If it is overstressed in this manner, the blade might break and send a particle of steel into the operator's arm or perhaps even into his eye.

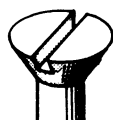
FIG. 2



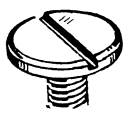
1. This tip is too narrow for the screw slot; it will bend or break under pressure.
2. A rounded or worn tip. Such a tip will ride out of the slot as pressure is applied.
3. This tip is too thick. It will only serve to chew up the slot of the screw.
4. A chisel ground tip will also ride out of the screw slot. Best to discard it.
5. This tip fits, but it is too wide and will tear the wood as the screw is driven home.
6. The right tip. This tip is a snug fit in the slot and does not project beyond the screw head.

COMMON SLOTTED HEAD SCREWS

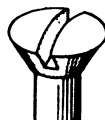
FIG. 3



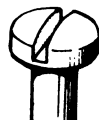
Flathead



Pan



Oval Head



Fillister Head

DRIVING THE SCREW

Always make a pilot hole before driving a screw. This is especially important when driving a screw into hardwood or when the screw is near the edge of a board. Pilot holes can be made in softwoods, and in some hardwoods, with an awl—if the screws to be used are small. However, if you are driving No. 6 and larger screws it is best to *drill* a pilot

hole or use a threaded screw hole starter. Pilot holes should always be made if the screws are to be driven into dense hardwoods.

If the screw is a flathead, the pilot hole should also be countersunk so the head of the screw will be flush with the work when it is driven home.



THE RIGHT WAY TO DRIVE A SCREW

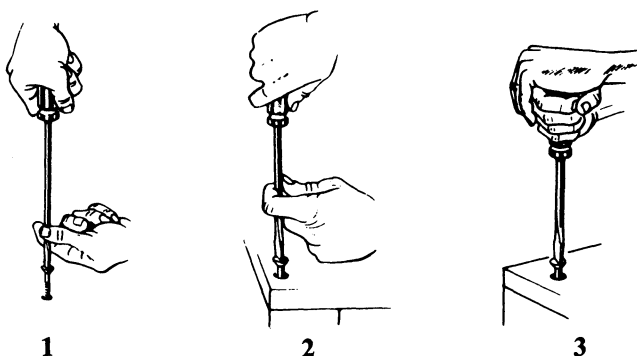


FIG. 4

1. Insert the tip of the screw in the pilot hole. Insert the screwdriver tip in the slot of the screw. Hold the tip steady with one hand and make sure the shank of the screwdriver is perpendicular to the head of the screw and in line with the shank of the screw.
2. Use the left hand (if you are right-handed) to keep the blade steady as you turn the handle of the screwdriver.
3. After the screw is almost in, it is safe to use both hands as shown for extra turning power to seat the screw. Note the position of the left hand (if you are right-handed). This will allow additional downward pressure to be applied, thus making certain that the driver tip is firmly seated in the screw slot. If the screw is a flathead, make sure that the pilot hole has a countersunk recess at top and screwdriver tip is narrow enough to avoid touching wood.

The job of driving the screw can be eased considerably if the threads are given an application of wax—this is preferable to soap, as soap has a tendency to rust the screw threads making possible future withdrawal difficult.

Unless you have drilled or made some sort of a pilot hole, a screw will tend to follow the grain of the wood. So, having drilled or made a pilot hole, hold the screw as indicated in Fig. 4 with the screwdriver tip firmly engaged in the slot. Turn the screwdriver gently to engage the first one or two threads of the screw and *make sure that the screw is being driven straight*. After the screw has been started, and you

know it will be driven straight, remove your fingers from the screw and apply your talents and attention to the screwdriver. The screw should now be absolutely perpendicular to the surface of the work (unless the screw is to be driven at an angle) with the screwdriver held in line with the screw.

It is much easier to drive a screw straight if the handle of the screwdriver is large enough to maintain the necessary torque for the size of the screw to be used.

A good quality blade, properly hardened, is a must especially when driving large diameter screws into tough woods.

CLEARANCE HOLES

Sometimes a clearance hole, in addition to a pilot hole should be drilled in order to do a workmanlike job. For example, when fastening a metal bracket to wood or when screwing two pieces of wood together, a clearance hole equal to the

diameter of the screw body or shank is necessary. Without the clearance hole, the body or the threads of the screw will hang up on the metal, or the leading piece of wood, preventing them from being drawn together tightly. See Fig. 6.

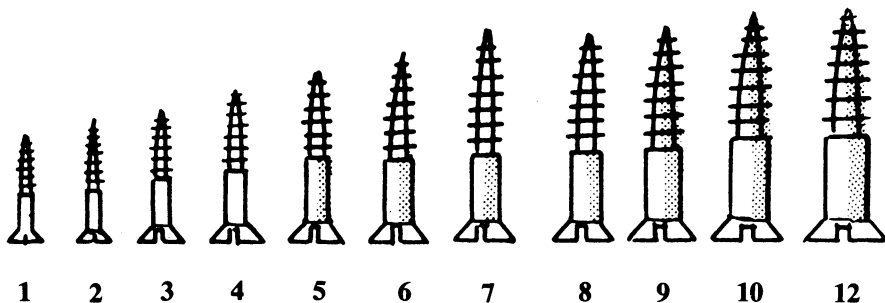


FIG. 5. Screws are available in many lengths. However, the number by which a screw is designated, such as a No. 10, always refers to its shank diameter. This drawing shows actual size screws and their corresponding number.

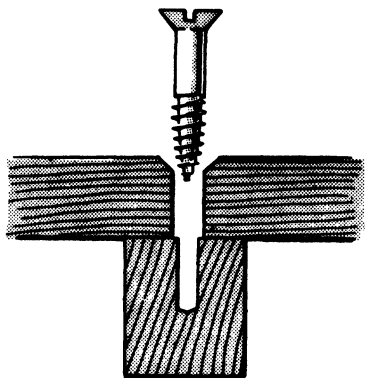
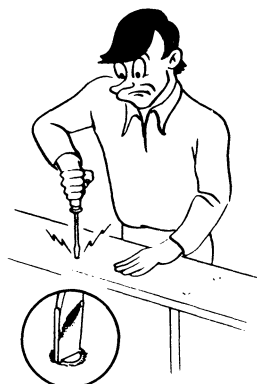


FIG. 6. A clearance hole is necessary when screwing two pieces of wood together.



RIGHT

FIG. 7. Cal is using the right technique in driving this screw home. The blade of the screwdriver is a snug fit in the slot of the screw and does not quite project to the edge.



WRONG

FIG. 8. Don't use a screwdriver whose tip extends beyond the length of the slot in the screw. Too wide a tip will chew up the wood as the screw is being driven home.

SCREWDRIVERS FOR SLOTTED STYLE SCREWS

Now that we have learned a little bit of how to use a screwdriver, let's consider the various kinds of screwdrivers that are available and the

right and wrong way to use—and abuse—these screwdrivers.

The so-called standard, or conventional screwdriver is used for screws with slotted heads. These screwdrivers are usually classified according to tip width and blade length. Generally, the longer the length, the wider the tip—but not always as some rather long screwdrivers may have a narrow tip. Cabinet style screwdrivers, which have long shanks and narrow tips, are useful for driving screws into recessed and counterbored openings in fine furniture and, obviously, cabinets. On the other hand there are short, stubby screwdrivers with rather wide tips for driving screws in confined quarters.

The great assortment of screwdrivers available today means that you can buy a screwdriver in practically any length and in any tip size desired.

Most screwdriver tips are tapered. The tip thickness determines the size

of the screw that the screwdriver will drive without damaging the screw slot. The taper permits the screwdriver to drive more than one size of screw.



RIGHT

FIG. 9. Careful Cal knows enough to drill pilot and clearance holes when driving screws that are near the edge of a board. A little wax on the threads will ease the job.

Heavy duty screwdrivers are available with square shanks so that a wrench can be used on the shank for extra turning power. *Never* use pliers on a screwdriver shank when the going gets tough. You will only wind up by chewing up the shank. What to do in such a case? Use the largest possible screwdriver that will fit the slot of the screw. As a rule, the bigger the screwdriver, the larger the diameter of the handle, and the larger the diameter of the handle, the greater the torque, or turning power. If absolutely necessary, use a wrench on the shank to apply the extra power (torque) needed. But, use

a wrench only on a screwdriver with a square shank *especially designed for that purpose.*



WRONG

FIG. 10. Harry, you will always split the wood if you drive a screw too close to the end of the work without first drilling a pilot and clearance hole.

RATCHET SCREWDRIVERS

One type of rapid-action screwdriver is the **spiral ratchet** screwdriver. This screwdriver has a springloaded mechanism in the handle. Pushing down on the handle causes the bit of the screwdriver to turn rapidly, thus driving the screw in a shorter time than could be accomplished with the use of a conventional screwdriver. Letting up on the handle allows the operator to continue the action. These screwdrivers come in several styles. Some have the mechanism as part of the handle; others have it as part of the shank. In either case a small lever is set so that even though the operator moves the handle back and forth—or up and down—the bit of the screwdriver moves in only one direction,

to drive the screw. The lever can also be set so that the ratchet action removes the screw. And it also can be set so that the screwdriver can be used as a conventional screwdriver, with no ratchet action.

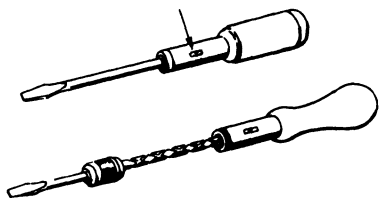


FIG. 11. Two types of ratchet screwdrivers. The one at the top has the ratchet mechanism in the handle. The lower screwdriver has the ratchet in the handle and operates with a spiral action.

When using any spiral ratchet screwdriver, it is best to push down firmly and slowly—until the screw is properly started—otherwise you may find that the bit has slipped out of the slot. These screwdrivers should be stored only in the extended position to prevent the possibility of a sudden, unexpected release by someone unfamiliar with the tool.

Large screws in tough wood can be easily driven by using special bits that fit into a carpenter's brace. Because tremendous turning power is generated by the brace, make sure you have a proper pilot hole, as it is quite easy to shear off the head or even to twist the screw in half if too much pressure is applied to a balky screw. Needless to say, it is always best to drill a pilot hole when driving large screws with a carpenter's brace.

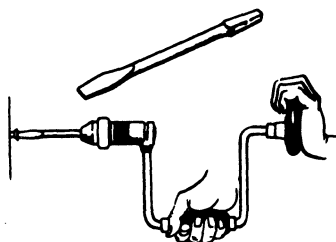


FIG. 12. Special screwdriver bit that can be chucked into a carpenter's brace.



WRONG

FIG. 13. Hazardous Harry strikes out again. Please, Harry, don't use pliers on the shank of a screwdriver in order to remove a stubborn screw.



WRONG

FIG. 14. Never, never use a screwdriver as a cold chisel. Just look what Hazardous Harry has done to the tip of a perfectly good screwdriver. In addition, our hero is not even wearing safety goggles.



SCREWDRIVERS FOR SCREWS WITH RECESSED OPENINGS

The most common screw with a recessed "slot" is the Phillips screw. These screws have what appears to be two slots at right angles to each other. But, a conventional screwdriver should never be used to drive

a Phillips screw—or any other type of a screw with a specialized opening. Such screws are shown in Fig. 16. *Always* use the screwdriver especially designed to drive these fasteners.



RECESSED SCREWS AND SCREWDRIVERS

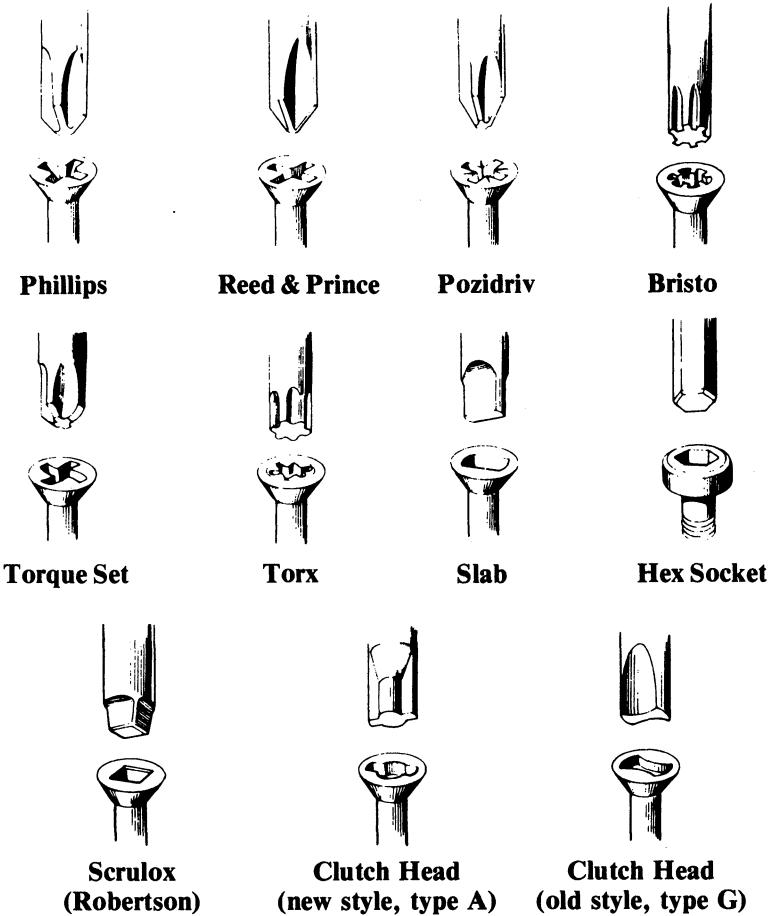


FIG. 16.

SPECIALTY SCREWDRIVERS

In addition to the types of screws and screwdrivers described so far, there are many screwdrivers whose use is quite specialized. Let us look at some.

Jeweler's Screwdrivers. These are distinguished by a rotating head which is held by the forefinger to steady the screwdriver while the thumb and middle finger turn the screwdriver to remove or install the small screws used by jewelers, model railroad fans, and persons who work with tiny parts and screws.

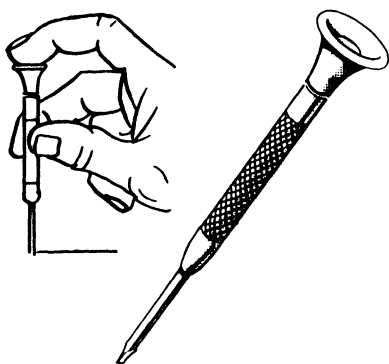


FIG. 17. Jeweler's screwdriver, used with tiny screws, is steadied by placing forefinger on the free-turning knob.

Offset Screwdrivers. These screwdrivers are designed for removing and inserting screws in place where it is impossible to use a straight shank screwdriver. They are available in many combinations: narrow tip on one side and a wide tip on the other side; Phillips tip on one side and a conventional tip on the other side; with two Phillips tips (one large and one small); with same size tips at each end, but one tip is at right angles to the handle while the other tip is parallel to the handle

(this arrangement makes the screwdriver extremely handy when turning area is limited).

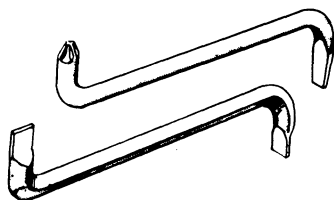


FIG. 19. Offset screwdrivers for driving screws in awkward places.

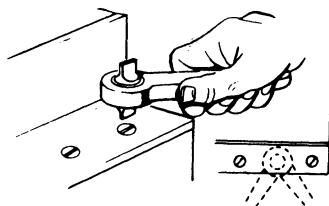


FIG. 20. A ratchet-type offset screwdriver for working in tight spots; it is reversible.

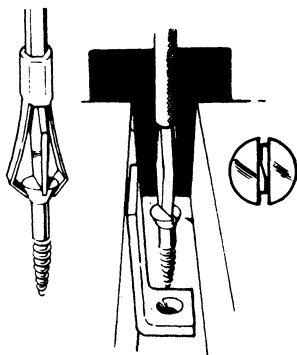
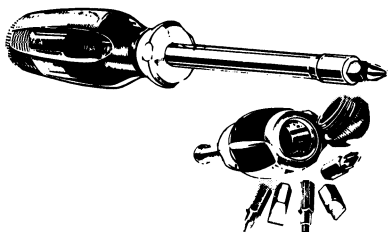


FIG. 21. The screw-holding screwdriver is a must for working in close quarters as shown. The type shown at the left uses clips to hold the screw. The one at the right has a sliding collar that spreads the split blade of the screwdriver to hold the screw. After the screw has been firmly started, further driving can be done with a conventional screwdriver.

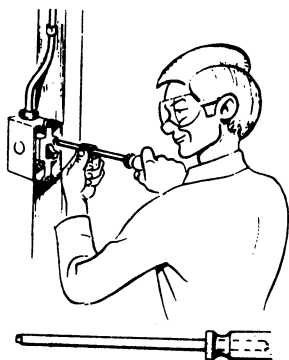
MAGNETIC TIP SCREWDRIVER



Interchangeable Magnetic Tip Screwdrivers. These screwdrivers have a magnet in the shaft so that they not only hold the bit but can also hold the screw. In addition, the variety of bits for this type of screwdriver is limitless and the unused bits can be stored in the handy compartmented handle.

Interchangeable Blade Screwdrivers. The hollow handle of this type of screwdriver will accept a number of different type blades. Sometimes the blades are double-ended with a narrow tip on one end and a wider tip on the other end. Combinations of Phillips, conventional, Clutch Head, Scrulox, and hex head are available.

Insulated Screwdrivers. These are used by electricians and maintenance workers. As their name implies, the shank as well as the handle are completely insulated with a dielectric material intended only as a secondary protection. Never depend on an insulated screwdriver handle, shank cover, or blade to insulate you from electricity. Insulated blades are intended only as a protective measure against shorting out components.



RIGHT

FIG. 22. Careful Cal is using an insulated screwdriver. Handle and shank are covered with an insulated material that is intended only for secondary protection. Turn off current when doing this kind of work.

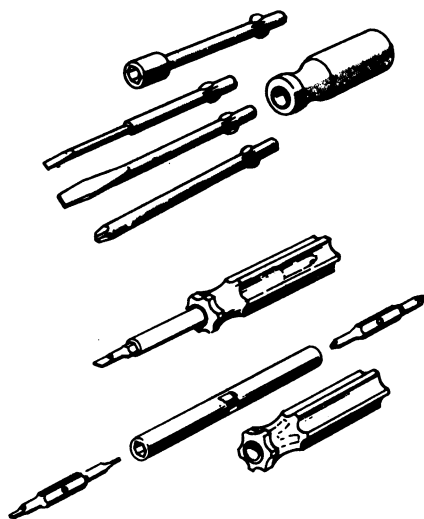


FIG. 23. Two types of screwdrivers that use interchangeable bits. The one at the left has a hollow handle that will accept any one of the four bits shown. The screwdriver at the right has two double-ended bits held in each end of a tube. The tube is reversible in the handle and the bits are reversible in the tube.





WRONG

FIG. 24. As usual, Hazardous Harry is wrong again. But this time on two counts. First of all, he never bothered to turn off the current before starting to work on that outlet. Secondly he doesn't seem to know enough to use an insulated screwdriver when doing such work.

Non-sparking Screwdriver. Found chiefly on yachts and boats, these screwdrivers are made out of an alloy—usually beryllium copper—that will not emit a spark if accidentally struck against metal. They minimize the risk of explosion when used under hazardous conditions, such as when working in the hold of a ship that may be filled with gasoline fumes.

The Awl. A handy accessory to a screwdriver set is an awl. With it, you can make a starting hole in soft wood for a screw.

Force the awl into the wood with a twisting motion. The hole need not be as deep as the length of the screw. With large screws—and especially when working with hard wood—it is always advisable to first drill a pilot hole before attempting to drive the screw.

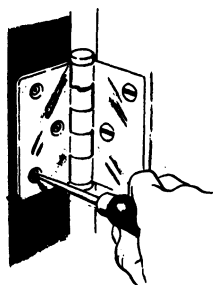


FIG. 25. An awl can be used to make a starting hole for small screws in soft wood.

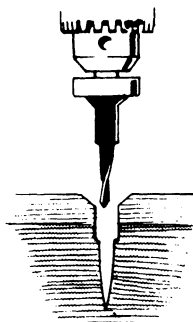


FIG. 26. This device drills a pilot hole, a clearance hole, and counter-sunk recess for flathead screws all in one operation.



DO'S AND DON'TS WHEN USING SCREWDRIVERS

- Don't hold the work in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot (we told you to use the right size screwdriver!) you will be most likely to receive a gash on your hand.
- Don't use a screwdriver with rounded edges or tips; it will slip and cause damage to the work or yourself.
- A rounded tip should be re-dressed with a file; make sure the edges are straight.
- Don't use a screwdriver near a live wire or for electrical testing.
- Don't use a screwdriver to check a storage battery or to determine if an electrical circuit is live.
- Don't use a screwdriver for prying, punching, chiseling, scoring, or scraping.
- Use a screw-holding screwdriver to get screws started in awkward, hard-to-reach area.
- Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.
- Use a ratchet-type screwdriver for speed and comfort when a great number of screws are to be driven.
- Don't use pliers on the handle of a screwdriver to get extra turning power. A wrench should only be used on the square shank or bolster of a screwdriver that is especially designed for that purpose.
- Don't expose a screwdriver blade to excessive heat as it may reduce the hardness of the blade.
- Don't use a screwdriver for stirring paint.
- Don't use a screwdriver with a split or broken handle.
- Screwdrivers used in the shop are best stored in a rack. This way, the proper selection of the right screwdriver can be quickly made.
- Keep the screwdriver handle clean; a greasy handle is apt to cause an accident.
- A screwdriver should **never** be used as a pry bar. If it is overstressed in this manner, the blade might break and send a particle of steel into the operator's arm or perhaps even towards his eye.



SECTION VII. VISES

INTRODUCTION

The vise, sometimes called the third hand (but no hand can grasp work as firmly as a vise) is *the* indispensable tool in the tool room or home workshop. Vises are usually mounted on a workbench or a similar firm support, to hold the material to be worked on.

There are eight basic categories of vises and many special purpose vises. While most of these vises can be used for a wide variety of work, it is important to select the vise most suitable for the prime application and strong enough for any work required.

TYPE	CHIEF APPLICATION
Machinist's Vise	Heavy industrial work
Utility or Workshop Vise	For light work and home workshop
Automotive Vise	Service station work
Woodworker's Vise	Carpentry and general wood work
Clamp-On Vises	Light work requiring portability
Pipe Vise	Plumbing and pipe work
Milling Machine Vise	For milling machine work
Drill Press Vise	To hold work on a drill press

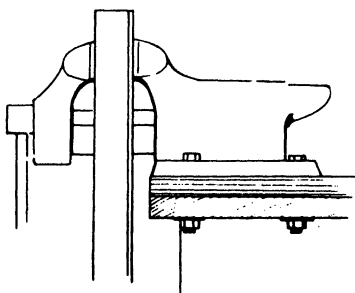


FIG. 27. It is important to mount any vise with the stationary jaw projecting slightly beyond the edge of the workbench so that long work can then be clamped in the vise without interference from the edge of the workbench.

THE MACHINIST'S VISE

This designation applies to the strongest, heavy-duty vises made. They are designed to withstand the great strains in industrial work and similar applications. These vises are available in jaw widths of three to eight inches. Models are made with stationary bases, swivel bases, pipe jaws (combination vises), with replaceable jaw inserts, and even with jaws that swivel.

Special purpose vises include the **sheet metal worker's vise** (thin, tapered jaws that allow close work)

and hydraulic models with a rapid movement of the sliding jaw. Smooth jaw models and copper jaw caps are available to prevent possible marring of the work.

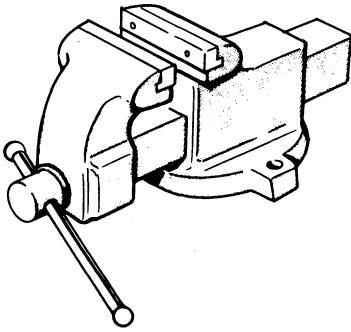


FIG. 28. The Machinist's Vise should always be bolted, never screwed, to the workbench.

THE UTILITY VISE

The utility, or workshop vise, is a lighter duty version of the machinist's vise. It usually has pipe jaws located below the flat jaw facings and comes in jaw widths from three to five inches. The Acme thread, or the screw that draws the jaws together, may or may not be exposed. Most models are made with swivel bases and replaceable jaw inserts.

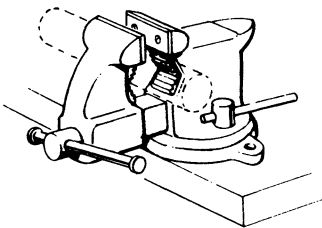


FIG. 29. The Utility Vise, like the machinist's vise, should also be bolted to the workbench top, never screwed in place.

THE AUTOMOTIVE VISE

The automotive vise is specifically designed for the automobile after-market such as service stations, garages, and automobile and truck agencies. This vise has the combined features of the machinist's and workshop vises. It has the pipe jaws and economy of the workshop vise with a machined bench plate having a 360° swivel and the positive lock feature of the machinist's vise.

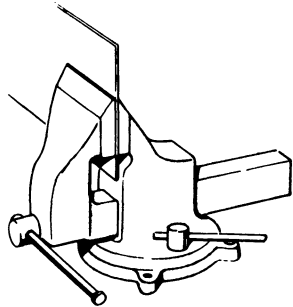


FIG. 30. The Sheet Metal Vise has a deep throat and thin, tapered jaws to allow for close work. The jaws on this type of vise are smooth.

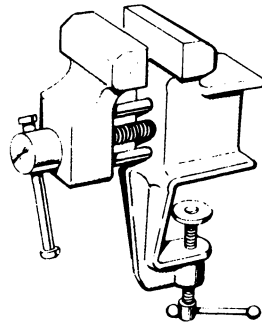


FIG. 31. The Clamp-on Vise can be quickly mounted at the edge of any convenient work surface.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

WOODWORKER'S VISE

The **woodworker's vise** is used when working with wood. To protect the work, and to get a good grip on large pieces of wood, the jaws on these vises are much larger than the jaws on other vises, generally being four by seven inches and even larger—four by ten inches. This type of vise is available with a rapid-action nut which allows the movable jaw to be moved in and out quickly with the final tightening by turning the handle a half-turn or so.

Woodworkers' vises usually have drilled and tapped holes so that liners of wood can be mounted in the jaws to prevent marring the work.

A well-equipped shop may have a metal-working vise mounted at the left side of the workbench and a woodworking vise mounted at the right.

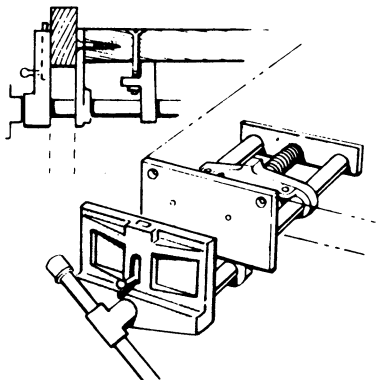


FIG. 32. The Woodworker's Vise is bolted to the underside of the workbench. Mount it so the top of the vise jaw is flush with the surface of the bench and flush with the corner of the bench.



CLAMP-ON VISES

These are generally used for light duty work. Instead of being bolted to the workbench, they are clamped to the workbench with a sort of C-clamp arrangement. One of their benefits is their portability as they can be quickly moved from place to place.

Smaller vises for working with wood also have a C-clamp arrangement for mounting. These are known as saw horse vises, or carpenter's vises. These vises usually have pre-drilled holes for attaching wood faces. This vise is "L" shaped which makes it ideal for holding work in either a vertical or horizontal position. These vises are favored by carpenters for use at a job site.

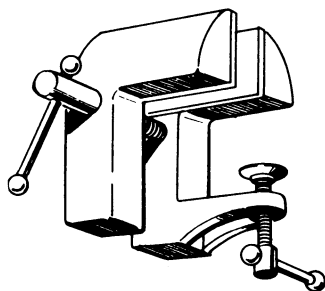


FIG. 33. Clamp-On Vise designed for woodworkers is portable and holds work horizontally or vertically.

PIPE VISES

Pipe vises are especially designed to hold pipe or round stock. They are often mounted on trucks and beams as well as on workbenches. They are available with capacities to hold pipe up to eight inches in diameter. The two main types are the **yoke vise** and the **chain vise**, with the latter specially designed to hold

irregular work. Both types are available with tripods and are called **tripod vises**. A **clamp kit vise** can be mounted without drilling holes for temporary attachment where light-duty work is to be performed.

Pipe vises are made in a number of different forms, including vises with bolt holes for permanent mounting and portable vises with clamp attachments for temporary mounting on benches, studs, posts, etc. Yoke pipe vises should not be used for holding or pulling vertical pipe.

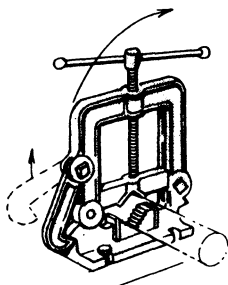


FIG. 34. Yoke Type Pipe Vise is bolted to the workbench. Note the hinge at one end and the hook at the other so that the pipe need not be “threaded” through the vise jaws to be worked on.

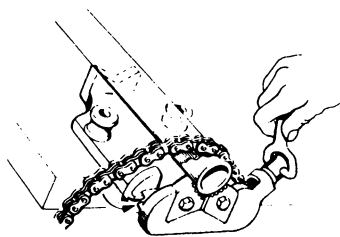


FIG. 35. The Chain Vise is designed to hold pipe as well as irregular work. Work is released from the vise by loosening the nut and then removing the pipe—or other work—from the vise. This allows the pipe to be installed or removed without having to slide its entire length through the vise.

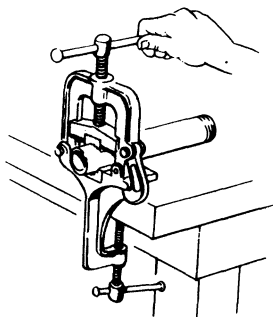


FIG. 37. The Clamp Kit Vise can be temporarily mounted without drilling holes, sometimes on the nearest 2x4, for light-duty work.

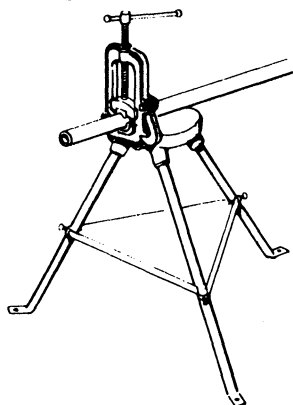


FIG. 36. The Yoke Type Vise and the Chain Vise are available in portable workbench models with a tripod stand.

THE DRILL PRESS VISE

As its name indicates this vise is used in conjunction with a drill press. The jaws are made so that it will accept round, square, or oddly shaped work and hold it firmly in place. Some have a quick release



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TO PROTECT YOUR EYES**

feature—the movable jaw can be quickly moved up to the work, or away from the work, without turning the handle. The handle is then used for the final half-turn or so to loosen or tighten the jaws.

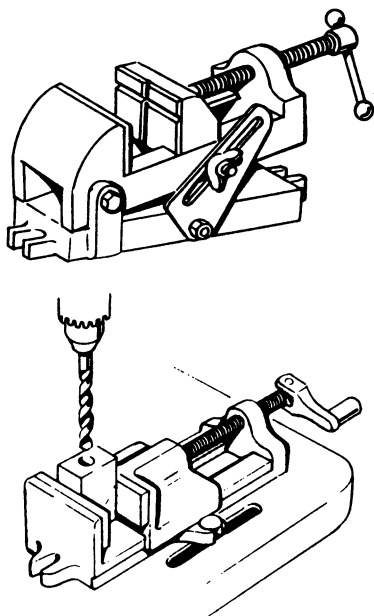


FIG. 38. The Drill Press Vise should be securely bolted to the drill press table through the lugs provided in the base of the vise. Some drill press vises, as shown in upper drawing, are adjustable for drilling holes at an angle.

MILLING MACHINE VISE

These vises, used with milling machines, have a swivel base graduated in the degrees of a circle; also available with an air-hydraulic operating system.

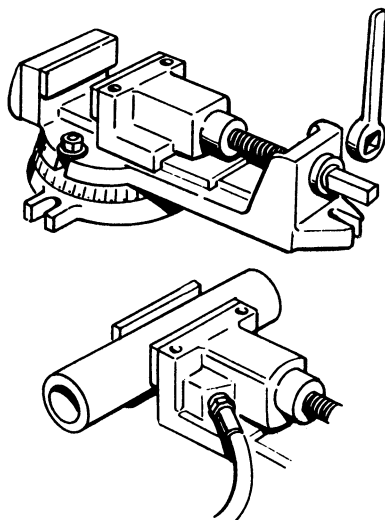


FIG. 39. Milling machine vises, used in machine shops, are made with graduated swivel and stationary bases. They are also available for power operation using an air-hydraulic system. Caution: Make sure the base is securely bolted to the bed of the machine.

SPECIALTY VISES

Hydraulic Vises. Two types are available. One kind has a built-in hydraulic booster-reservoir to multiply the power of your hand as the handle is turned. The other type, used in production work, operates by means of an air-hydraulic system controlled with a foot pedal. The big advantage with such a vise is the amount of time saved in installing and removing the work and the extra tightness with which they hold the work.

Model Maker's Vise. (Also known as the Hand Vise) A light duty vise with 2-inch jaws, hand held for use with small work. The jaws are tightened by means of a thumb nut. Model railroad fans and model airplane workers use these vises.



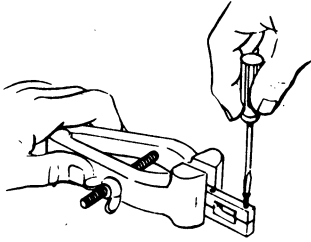


FIG. 40. The Model Maker's Vise (also known as the Hand Vise) is usually hand held as shown for holding small parts to be assembled or worked on. It can also be mounted on a larger vise when the use of both hands if required. Caution: Do not over-tighten the jaws of the vise.

Vacuum Base Vises. These vises even require less work to mount than the clamp-on vises. Their base consists of a rubber pad which is arched into a concave shape by means of a lever. When the vise is placed on a smooth surface and the lever is turned, a vacuum is created that firmly holds the vise in place. These vises of course are designed for comparatively light duty work.

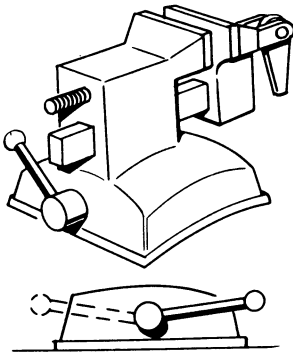


FIG. 41. The Vacuum Base Vise can only be fastened to a smooth non-porous surface. A handle, moved as indicated, creates a vacuum that secures the vise to the table's surface. Such vises are used for light duty work only.

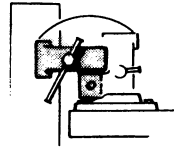
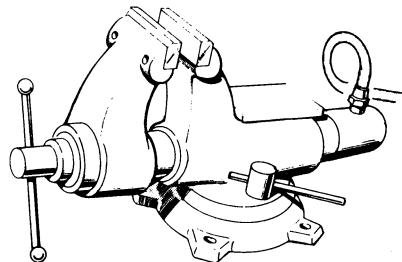


FIG. 42. This type of vise is designed so that it can be flipped to hold the work in a vertical position as shown in the small illustration. After flipping, an auxiliary handle is used to keep the jaws in their new position.



FIG. 43. The Hobby Vise, used by model makers and kindred folks, has a clamping arrangement in its base that allows it to be tilted in practically any direction and then firmly locked in place.



The air-hydraulic vise opens and closes by means of a foot control. It locks on to the work with a force of more than 2,000 pounds. Made with stationary and swivel bases in jaw widths up to six inches.

DO'S AND DON'TS WHEN USING A VISE



- Use bolts in all the holes in the base of the vise.

- Use lock washers under the nuts.

- Do not use the jaws of the vise as an anvil.

- When work is held in the vise for sawing, saw as close to the jaws as possible (to prevent vibration). Be careful not to cut into the jaws.

- When clamping extra long work, support the far end of work rather than putting extra pressure on the vise.

- Avoid clamping work with heavy pressure at the corner of the vise jaws as they may break off a corner of a jaw.

- Wear safety glasses when hammering or pounding on an object held by the vise.

- Replace a bent handle.

- Replace worn jaw inserts.

- Adjust for play between nut and screw or replace them when excessive play develops in the handle.

- Lightly oil all moving parts.

- Never use an extension handle for extra clamping pressure.

- Use jaw liners with a vise if there is any possibility of marring the work.

- If the threaded part of the vise is exposed, keep it free of chips and dirt.

- Discard any vise that exhibits the slightest hairline fracture.

- Never pound on the handle to tighten beyond hand pressure.

- Never try to repair a vise by welding or brazing.



RIGHT

FIG. 44 Use a vise large enough to hold the work without strain. Base of vise should be bolted to a smooth even surface to prevent unnecessary stresses to base when vise is in use. Note that Careful Cal has the vise bolted to the bench.



WRONG

FIG. 45. Don't try to bend a heavy rod in a light vise. Harry has now ripped the vise from its moorings. And he still couldn't bend the rod shown.

SECTION VIII. CLAMPS

INTRODUCTION

Clamps are versatile tools that serve as temporary devices for holding work securely in place. They are used for many applications including carpentry, woodworking, furniture making, welding, construction and metal working.

There are many clamp styles including C-clamps, bar clamps, pipe clamps, handscrews, etc. In selecting the proper clamp style and size match the work-holding requirements of the application with the following clamp features:

- strength and weight
- opening-length of reach
- throat depth—depth of reach
- ease of adjustment
- clamping surface — material used and size

C-CLAMPS

The most common clamp is the C-clamp. C-clamps vary in size and strength from a 3 oz. aluminum clamp with a $\frac{3}{4}$ " opening to a 40 lb. heavy duty drop forged steel C-clamp with a 12" opening. C-clamps generally have four parts: the frame, the screw, the handle and the swivel pad. The frame is usually made from stampings, castings and drop forged steel. Generally drop forged steel provides the most strength. Most clamps have a sliding crosspin handle or a wing nut for tightening the clamp. Certain heavy duty clamps have screws that end in a square head and the tightening is done with a wrench. The swivel pad at the end of the screw allows the clamp to position itself on non-par-

allel work and prevents work from being marred. Certain C-clamps designed for heavy duty applications are designed without swivel pads.

The C-clamps, like any fine tool, can be damaged by rough handling, improper job selection, and overloading. Keep C-clamps in racks when not in use to protect them from damage. Use clamps of the proper capacity. You wouldn't drive a railroad spike with a tack hammer—and neither should you use a light-duty clamp for a heavy-duty application or a large, heavy-duty clamp where a small light-duty clamp would do the job.

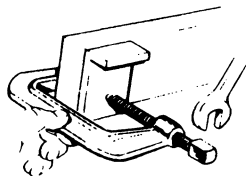


FIG. 46. This type of extra heavy-duty forged steel clamp uses a wrench for tightening.

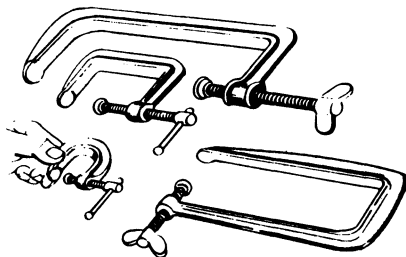


FIG. 47. Typical C-clamps.

MACHINIST'S CLAMPS

Machinist's Clamps somewhat resemble C-clamps but are made entirely of drop-forged steel. Their jaws are parallel to each other; they

cannot be set to non-parallel positions. Two screws, one in the center and one at the end are used to tighten the clamp against the work.

Always choose a clamp in relation to the work involved. Too large a clamp may prove to be an awkward obstruction causing hazardous working conditions, while too small a clamp will not provide adequate pressure to hold the work securely.

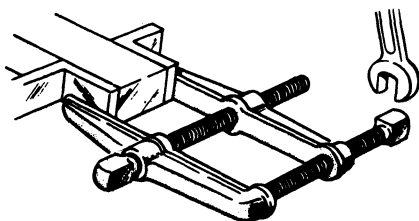


FIG. 48. The Machinist's Clamp, designed for pattern-making and machine shop use, is made of tough steel and heat-treated for extra strength.

DEEP THROAT C-CLAMPS

As a general rule, the larger the clamp, the deeper the throat. However, there is no need to go to extra large C-clamps just for the sake of the extra wide throat capacity that may be needed. The job can quite often be accomplished by using special C-clamps that have an extra deep throat, even though their overall size may be quite small in relation to its throat.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

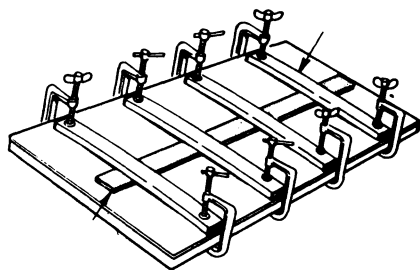


FIG. 49. How a number of C-clamps can be used to apply pressure to the center of a panel. The 1x2-in. boards transmit the pressure applied to them by the C-clamps to the 1x3-in. board in the middle. This technique is useful when gluing up large panels or veneering a door.

WELDER'S C-CLAMPS

Welder's C-Clamps are specially protected to prevent welding spatter from adhering to and eventually ruining the clamp. Its parts may be coated with a spatter-resistant plating (copper or cadmium). In addition, welder's C-clamps are made with shields to protect the screw against damage.

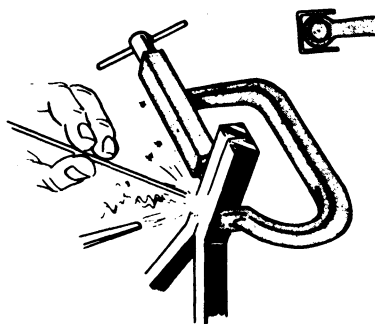


FIG. 50. The Welder's Clamp.

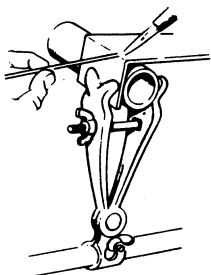


FIG. 51. Another type of welder's clamp especially handy for holding odd-shape work.

BAR CLAMPS

A variation of the C-clamp is the **bar clamp** which consists of a steel bar with a fixed jaw at one end and a sliding or adjustable part that has a screw with a handle and swivel. In use, the sliding part that has the screw is pushed up to the work and then the handle is turned to tighten the clamp. Bar clamps vary in size from six inches to six feet in length.

Many bar clamps have disc clutches in the sliding jaw to engage the clamp at any place on the bar. These clutches provide rapid adjustment in addition to secure hold. Certain bar clamps use an "I" shaped bar which provides great strength for its weight. A crank handle is used for applying the final pressure.

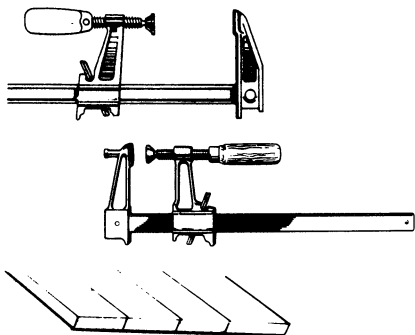


FIG. 52. The bar clamp is extremely useful for gluing up extra wide work, as shown above.

PIPE CLAMPS

A close relative of the bar clamp is the **pipe clamp** or **gluing clamp**. It is used with $\frac{1}{2}$ -inch or $\frac{3}{4}$ -inch threaded pipe. The pipe is screwed into a fixed jaw and a movable adjustable jaw is installed on the other end of the pipe. In use, the adjustable jaw is pushed up to the work and the handle or crank of the clamp is turned to secure the work. The capacity of the pipe clamp is only limited to the length of the pipe available.

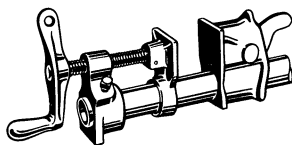
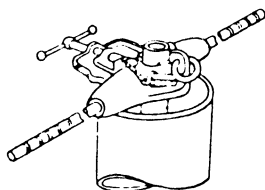


FIG. 53. These pipe clamps operate on the same principle. Their mechanism is mounted on half-inch or three-quarter-inch pipe. The clamp has its threaded part screwed to the end of the pipe while the back-up part can be slid along the pipe to the desired spot.

WELL DRILLER'S CLAMPS

This clamp is specially designed for holding and lifting pipe vertically. Pipe jaws are corrugated perpendicular to pipe. Do not exceed manufacturers recommended limits for holding or lifting pipe.



Well Drillers Clamp

WEB CLAMPS

These clamps have a heavy duty nylon strap which is wrapped around the work to be glued or held together. By means of a ratchet, the web, or strap is drawn together to apply the required pressure. The web clamp is especially useful for gluing up large work (such as the outside edge of a table) as its capacity is limited only to the length of the strap.

Caution: Inspect the web for fraying or cuts before applying pressure as the ratchet action of the clamp develops tremendous pressure.

Keep these clamps rolled up when not in use. Be sure you remove all tangles and knots before applying to the work. The nylon belts are tightened with a small wrench while the heavy duty canvas belts are tightened with their own built-in clamping handles.

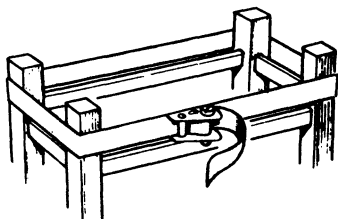


FIG. 54. The Web or Strap Clamp is made of nylon. Its great advantage is that it can be used to apply pressure to large and oddly shaped work.

HANDSCREWS

The **handscrew** can be used to clamp work whose sides are not parallel to each other. This clamp has two screws, one with a left-hand thread and the other with a right-hand thread. The openings through

which the screws pass are slightly elongated so that the jaws can assume a non-parallel position—if necessary—to match the surfaces of the work. The jaws move in opposite directions due to the action of the right- and left-hand threads as the handles are turned.

Keep the threaded rods of these clamps lightly oiled. But, make certain that there is no oil on the jaws; and keep the jaws smooth to protect the work.

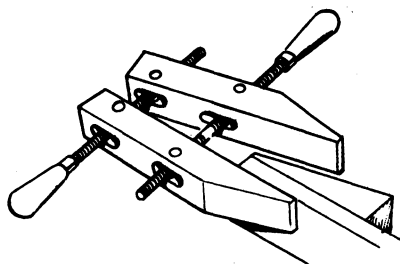


FIG. 55. The handscrew can be adjusted to clamp work whose sides are not parallel to each other. The smooth, hard wood jaws protect the finish of the work by spreading the pressure over a broad surface. One end of each spindle has a left-hand thread, the other end, a right-hand thread.

SPRING CLAMPS

While most people associate spring clamps with light duty work, some spring clamps exert so much pressure that two hands are needed to open their jaws. These clamps range in capacity from one to four inches and are available with vinyl padded jaws to protect the work. Use them only where moderate pressure is required for gluing or for holding work in place while some other operation is to take place.

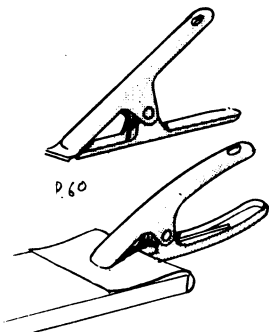


FIG. 56. The spring clamps are not to be sneezed at — they are for clamping! They range in capacity from one to four inches and are generally used for light duty clamping. The holes at the handle ends are for hanging them up when not in use.

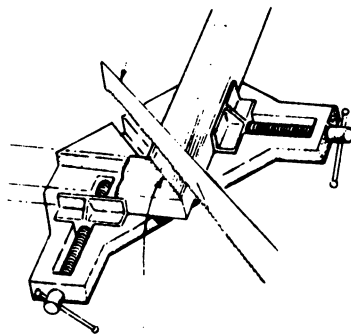


FIG. 58. The Corner Clamp has a dual function. It can be used to hold mitered corners together while the glue sets and it can also be used as a jig for cutting 45° miters.

MITER CLAMPS

The **Miter Clamp** is used to apply pressure to all four joints of a square or rectangular frame simultaneously. Two fairly common types are illustrated. However, ordinary C-clamps can also be used

rather effectively to glue up corner joints as shown in the drawing on the next page.

Caution: Test for squareness at each corner before applying final pressure.

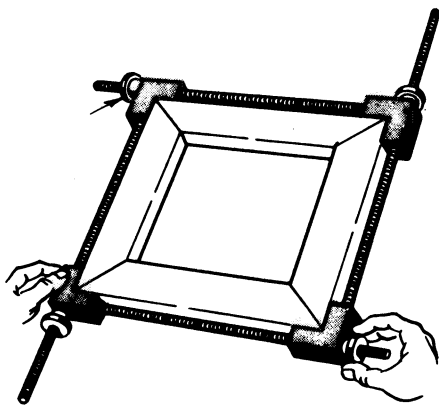
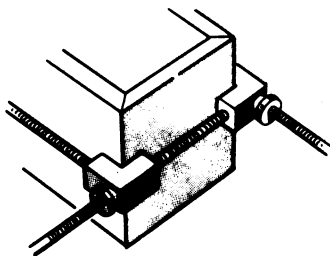


FIG. 57. This clamp is especially designed to apply pressure while gluing up mitered corners (such as picture frames). A thumb nut is at each corner. This clamp can also be dismantled for use when all four clamps are not needed as shown in the drawing to the right.



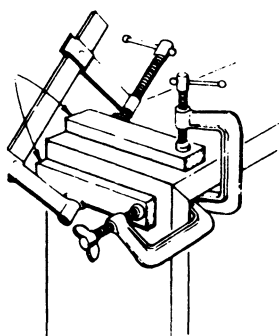


FIG. 59. How ordinary C-clamps can be used to apply pressure for gluing up a mitered corner.

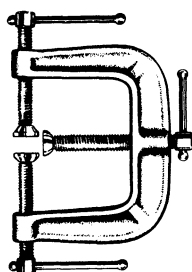


FIG. 60. The three-way Clamp. An ingenious clamping device that allows pressure to be applied in two directions as shown. Extremely handy for applying veneers to table edges.

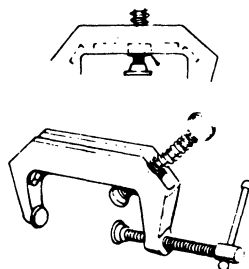


FIG. 62. This unusual C-clamp has a slot along its back and a spring-loaded threaded post which passes through the slot. The post can be positioned anywhere along the slot where it will do the most good and then tightened in place. Note the nut at the bottom which engages the post.

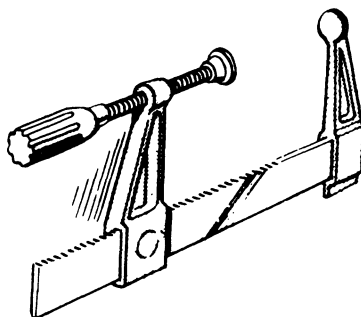


FIG. 63. This type of clamp features a serrated bar. To use, the movable part of the clamp is pushed up to the work and then the handle is turned for final tightening.

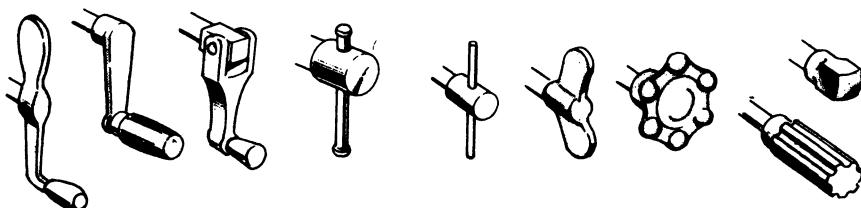


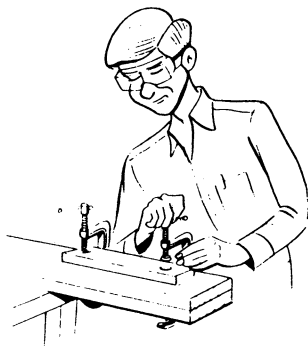
FIG. 61. Types of handles used to tighten C-clamps and bar clamps.

DO'S AND DON'TS WHEN USING CLAMPS



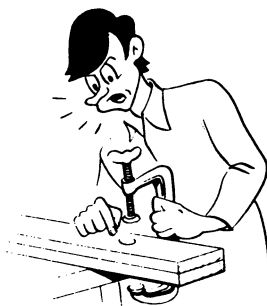
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

- Store C-clamps by clamping them in a rack, not in a drawer.
- Use pads with C-clamps to avoid marring the work.
- Discard any clamp that has a bent frame or a bent spindle.
- Do not use a wrench, pipe, hammer, or pliers, to gain extra tightening; a wrench should be used only on those clamps especially designed for tightening with a wrench.
- Keep all moving parts lightly oiled and clean; however, make sure there is no dirt or oil on any part that will come in contact with the work.
- Make sure swivel at end of the screw is turning freely before using.
- Never use a C-clamp for hoisting work. Special lifting clamps are made for this purpose.
- Avoid using extra large clamps just for the sake of their large throats; instead use deep-throat clamps.
- Never use a C-clamp for hoisting or for supporting a scaffold or platform that may be used to carry people.
- Do not use C-clamps for securing a load that may be carried over a public highway; vibration may cause the clamps to loosen and the load to break loose.
- Always remove clamps as soon as the required job is finished. Clamps serve only as temporary devices for holding work securely in place.



RIGHT

FIG. 64. Careful Cal knows enough to use the right size clamp and he places scrap wood under the clamps to avoid marring the surface of the work.



WRONG

FIG. 65. Too big a clamp, and too much pressure will leave a dimple in the work. Hazardous Harry never seems to have heard that pads should be used with C-clamps to avoid dimples.

SECTION IX. SNIPS

INTRODUCTION

Snips, sometimes called tinner's snips, are used to cut sheet metal. They are used by the sheet metal worker, the automotive mechanic, in industrial plants, and by the home owner.

While their primary purpose is to cut sheet metal, snips are also used to cut screening, chicken wire fencing, steel strapping, gaskets, linoleum, canvas, and other hard to cut materials. However, some snips are designed to cut mild sheet metal up to 18 gauge thickness.

There are five basic types in common use today—straight pattern,

combination, circular (or duckbill) pattern, compound leverage aviation, and compound leverage offset.

Straight pattern snips are generally used for making straight line cuts, although curved cuts can be made if the curve is not too sharp. When cutting with a straight pattern snip, a straight line can be easily maintained by guiding the material sliding it, butted firmly against the wall of the inside ground surface at the bolt hole. (See Figure 66) Their cutting edges are sharpened at an angle of 78° to 85° to the inside of the blade. The sizes range from 7 to 16 inches in overall length, with the most popular sizes being 7, 10, and $12\frac{1}{2}$ inches.

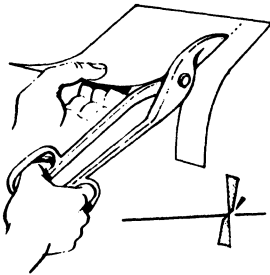


FIG. 66. The straight pattern snips are generally used for making straight cuts. They can also be used for making shallow curves.

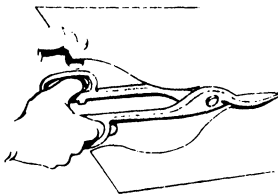


FIG. 67. The duckbill snip can be used for straight cutting as well as cutting curves. Make certain that the bolt holding the blades together is tight; looseness between the blades will cause ragged cuts.



Combination and duckbill snips are used for cutting curves in either direction. They can be used for straight cutting, but will require slightly more effort to cut with than the straight pattern snip. The most popular sizes are 7, 10, and $12\frac{1}{2}$ inches, although 14- and 16-inch sizes are available. The thickness of the metal that can be cut is approximately the same as for the straight pattern snip.

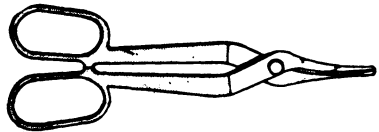


FIG. 68. The duckbill snip will cut smooth curves in sheet metal in either direction. They can also be used for straight cuts, but not as satisfactorily as the regular straight pattern snips.

There are other types of snips available, such as the **curved blade**, **hawk-bill**, **bulldog**, **light metal**, **jeweler's**, and **pipe and duct**. These are used mainly by the professional metal worker or in a specialized profession. There are also straight and combination snips available which have a high carbon or alloy steel blade welded to the basic snip frame. They do not cut any easier than a regular solid steel snip, but may stay sharp longer. There are also straight pattern snips with aluminum handles and replaceable blades. Snips are made for right-handed use although they can be used in either hand.

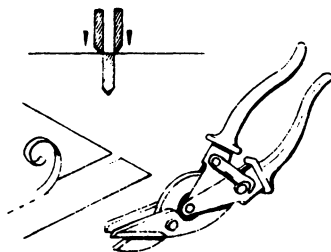


FIG. 70. Pipe and Duct Snip. This type of snip has a compound action. In use, it cuts out a narrow section of metal equal to the width of the center blade. The work on either side of the blade tends to stay flat as only the narrow waste takes a curl as it is cut out. It is used for cutting panel openings in gutter and downspout work where metal distortion on either side of the cut is not wanted.



WRONG

FIG. 69. Hazardous Harry is using snips to cut heavy wire. It may work, but he could ruin the cutting edge of the snips leaving a nick in the blades. And the next time he tries to cut sheet metal with these snips, he will get a ragged edge. Too bad, Harry!

Compound leverage snips have become popular in all fields of metal working. Their double fulcrum compound lever action requires less effort to cut. The blades of these snips are usually made from an alloy steel so that they are harder and tougher than regular snips. Standard size for the professional-type compound leverage snips is 10 inches overall.

Aviation snips are available in three types of cut; straight for cutting straight lines; left cut for cutting curves to the left; and right cut for cutting curves to the right. These snips are generally used for heating, air conditioning, gutter work, and for general industrial use.

Offset snips are available in two types of cut: left cut for cutting curves to the left; and right cut for cutting curves to the right. The left and right offset snip will also cut straight. Offset snips permit the user to cut without interfering with the flash or the finished piece.

When cutting sheet metal, the hand stays clear. Metal flows under and over the blades permitting a cut directly through the center of a sheet without distortion.



RIGHT

FIG. 71. Careful Cal knows enough that only wire cutters should be used to cut wire. Metal cutting snips are for cutting sheet metal, not wire.

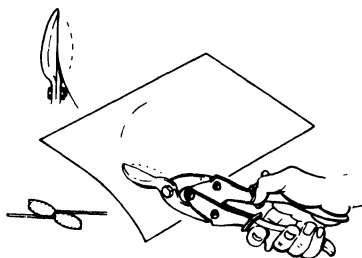


FIG. 72. Right cut snips will make straight cuts as well as cuts to the right as shown in drawing.

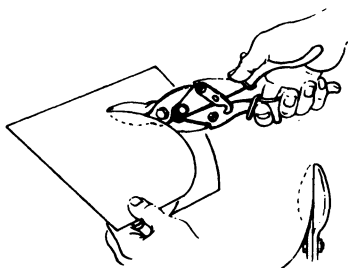


FIG. 73. Left cut snips are for making cuts to the left as well as straight cuts.

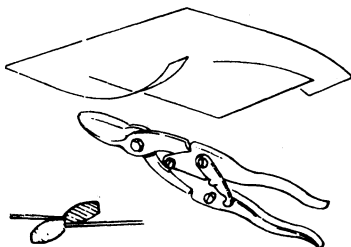


FIG. 74. Straight cut snips are used for making straight cuts as well as shallow cuts to right or left.



FIG. 75. The offset snip permits your hands to remain above the cut, cuts directly through the center of a large sheet.

PROPER USE OF SNIPS

It is advisable not to cut exactly on the layout line (to avoid extra finishing work). It is good practice to leave about 1/32-in. of metal beyond the layout line for final dressing and finishing. As the cut is being made, try not to make the cut the full length of the blades. If the points of the blades are allowed to meet at the end of the cut, the sheet metal will have a tendency to tear as the cut is completed. Stop the cut about 1/4-in. before the tip of the blades and then take a fresh bite.

When cutting a large sheet of metal, it is best to cut at the left side of the sheet. This way the waste will be curling up and out of the way while the rest of the sheet will remain flat.



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TO PROTECT YOUR EYES**

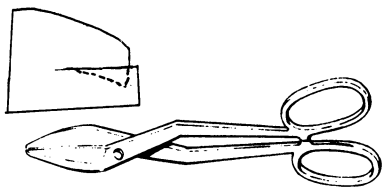


FIG. 75A. If you are right-handed, cut so that the waste is on the right, as shown above.

When making a straight cut, place the work over the work bench so that the layout line is slightly beyond the edge of the bench. Hold the snips so that the blades are at an exact right angle to the sheet metal. The edges of the metal will be bent and even burred if the blades are not at right angles to the work.

In order to make a large hole in sheet metal, start by making a hole in the center of the sheet and pro-

ceed to make a spiral cut leading out to the desired circumference. Keep cutting away until all the non-wanted material is removed.

To cut a disk in sheet metal, start from the outside and make a cut tangent to the layout line but slightly beyond it to allow for dressing and finishing. This way you will always be able to see the layout line and still have material left over for final dressing and finishing.

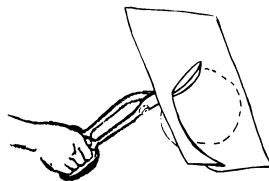


FIG. 76. How to start and cut a disk out of sheet metal. Use a curve-cutting snip for this job.

DO'S AND DON'TS WHEN USING SNIPS



- Wear safety goggles when using snips.
- Be careful of the sharp edges on the cutting edges of these tools.
- Wear gloves when working with snips.
- Never cut sheet metal that is thicker than 0.062 inches.
- Use snips for cutting soft metal only. Hard, or hardened metal may damage the cutting edges of the snips.
- Use the right size and type of snips for the job on hand. Don't try to cut sharp curves with straight cut snips.
- Avoid springing the blades. This is the result of trying to cut metal that is too thick for the snips you are using, or by trying to cut heavy wire or nails.
- Use only hand pressure for cutting. Never hammer, or use your foot to get extra pressure on the cutting edges. If you are resorting to such a technique, you are using too small a snip—the metal is too thick for the capacity of the snip.
- Oil the pivot bolt on the snips occasionally.
- Keep the nut and the bolt properly adjusted at all times.
- The average user does not have the proper equipment to sharpen snips. Do not attempt to sharpen a snip blade in a sharpening device designed for scissors, garden tools or cutlery.
- Do not use “cheater bars” on handles of snips. You are trying to

cut material which is too thick if you have to resort to this.

- Don't use snips as a hammer, a screwdriver or a pry bar. *There are tools for such purposes—use them.*

If the snips you own have locking clips, use them when the tools are not

in use.

- Snips should be carefully put away after use. Wipe the cutting edges with a lightly oiled rag. Don't dump them in a drawer with other tools. Tools with cutting edges should always be treated with extra respect.

SECTION X. TOOL BOXES, CHESTS AND CABINETS

INTRODUCTION

First of all, tool boxes are meant to hold tools, not to stand on, use as an anvil, a saw horse, or to store your lunch. Light weight tool boxes are made of plastic, or steel, but strong, heavy duty tool boxes are made out of steel. Steel tool boxes can be divided into three classes—**hand boxes**, **chests**, and **cabinets**. Cabinets are mounted on casters while the smaller tool boxes (some with drawers and some without) are designed to be hand carried.

Let's consider the portable type first. These may have up to five

drawers, a lift-out tray, and possibly a cantilevered tray that automatically opens out when the cover is lifted. All seams should be welded and smooth with no protruding edges to catch clothing or hands. In addition to the handle on the top of the tool box cover, look for handles at each end for those boxes designed to hold an extra heavy load of tools. A good tool box will have a catch or a hasp at each end and should be able to be locked with either a padlock or its own built-in lock. Look for weather-proof construction that will allow rain to drain away without entering the inside of the tool box.

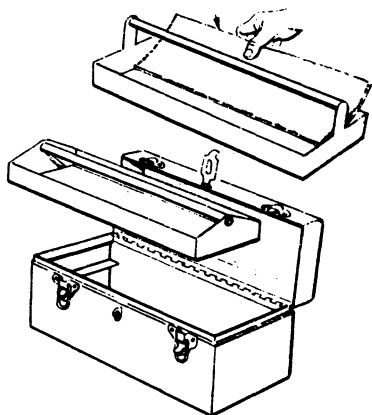


FIG. 77. Tool box with lift-out tray. Protect tools by lining the bottom of box and tray with felt.

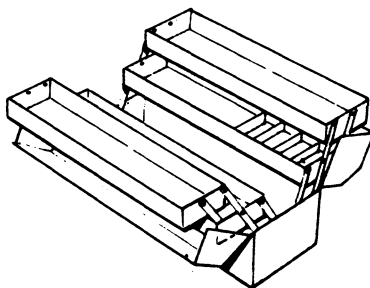


FIG. 78. This tool box has lever-operated trays that open automatically as the cover is lifted.

Tool Chests are big brothers to tool boxes. They are usually heavier, stronger, and of course have a much greater capacity than tool boxes. The drawers (as much as ten and even more) on the better models can be secured with their own built-in locks. Some have a tote tray that can be removed for carrying only those tools needed for a particular job. Most tool chests are designed to be placed on top of tool cabinets.

It is always a good idea to line the bottom of the drawers with a soft material such as felt, or scrap carpeting, to protect the tools. This applies especially to drawers holding tools with cutting edges.

Mobile Tool Cabinets—the kind on wheels—may have ten or more drawers and if they are designed to hold a chest, sometimes as many as twenty or more drawers. Look for a locking arrangement that will lock all drawers automatically and for construction that will allow drawers, no matter how heavily loaded to roll out freely. Casters should be of ball-bearing construction with two wheels that can be locked by means of a brake to prevent rolling. A good tool cabinet should be adequately braced to prevent any possibility of swaying as the tool cabinet is rolled around.

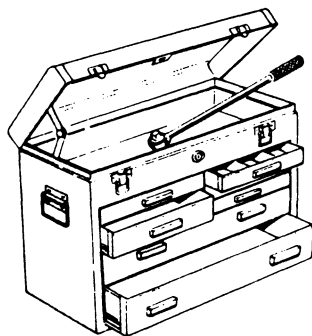


FIG. 79. Tool Chests, more substantial than tool boxes, may have from two to ten drawers.

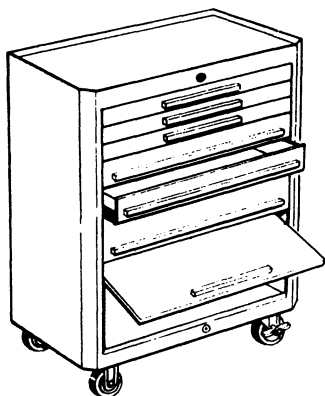


FIG. 80. Tool Cabinets are always mounted on casters; chests can be added to the top of the cabinet.

TAKING CARE OF TOOL BOXES, CHESTS, CABINETS

- Lightly oil all moving parts such as drawers, trays, and hinges at regular intervals.
- Use graphite, not oil, on locks and padlocks.
- Touch up all rusted spots, pay particular attention to the bottom of tool boxes.
- Make sure that the wheels on

tool cabinets are turning freely.

- Drawers and trays that hold sharp-edged tools such as chisels, screwdrivers, etc. should be lined with cork, felt, or scrap carpeting.
- Check the handle; is it firmly attached to the tool box?
- Keep your tool box or chest locked when not in use.



WRONG

FIG. 81. Harry, we have trouble with you. Never use a tool box for an anvil or a similar purpose.

- Sand, or file down, any sharp edges that may cause damage to clothes or fingers. Such sharp edges are usually caused by dropping the tool box to the floor instead of *placing* it on the floor.

- Always replace your tools in the same tray or drawer that you removed them from. Use this system and you will not waste time hunting for a particular tool that you know is “just there.”



WRONG

FIG. 82. What’s the matter, Harry, haven’t you ever heard of a ladder to get hard-to-reach items?

- Wipe away all grease and moisture from tools before storing them in the tool box, chest, or cabinet.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

DO’S AND DON’TS FOR TOOL BOXES, CHESTS AND CABINETS.

- Don’t pull a tool cabinet as you won’t see where you are headed. Push it in front of you so you can see where you are going.

- Do not stack a tool cabinet with too many extra chests or tool trays; it may tip over at the most unexpected time.

- Do not open up too many loaded drawers at a time; close each drawer before opening up another. Heavily loaded open drawers are an invitation to tipping.

- Lock all drawers before trying to roll the tool cabinet into a new work area.

- Do not roll a tool cabinet too quickly; a pot hole in the floor or some hardware on the floor may cause an accident.

- Don’t use a tool cabinet for a workbench.

- Don’t overload the drawers; if you haven’t got room for all of your tools, you need a larger tool cabinet or chest.

- Do not roll a tool cabinet with loose tools or parts on top of the cabinet.

- Set the brakes on the locking casters after you have rolled the cabinet to your work area.

- Treat your tool cabinet, chest, or tool box, with respect—it is helping *you* earn a living.

- Label your tool box with your name—and it is also a good idea to scratch your initials or name on your most valuable tools.



RIGHT

FIG. 83. Careful Cal knows enough to close all drawers before moving his tool cabinet; in addition, he is keeping an eye on where he is headed. Cal, we are with you all the way.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

- A tool box loaded with an extra heavy load of tools will be easier to move if you mount small casters at each corner. Use the plate-type caster with rubber wheels. Check the load limit of the casters before installing them.

- Tool chests with top tills, unless the box is specially designed for heavy duty road use, are designed for stationary use on work benches or cabinets and not designed to be placed in trucks subject to continual bouncing and impact.



WRONG

FIG. 84. Now look here Harry, if you are going to pull that tool cabinet that way, you are sure to lose some of your tools from those open drawers, trip over any obstacles on the floor, and you may even dump the cabinet over on its side. Please, Harry, never pull a tool cabinet. Always push it — and look where you are headed.

SECTION XI. AUTOMOTIVE TOOLS

INTRODUCTION

There are well over 300 different non-power hand tools available on the market specifically intended for servicing cars, each with a special configuration of its own to service parts of the car, such as the carburetor, cylinders, drive train, valves, shock absorbers, windshield wipers, etc. Some of the tools are shaped to reach into difficult to get into places and remove special fittings while other tools, such as the slide hammer puller, will make the removal of a rear axle from a car a

relatively easy job.

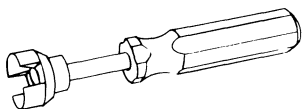
If you're a weekend do-it-yourself auto mechanic who enjoys working on the car in the driveway or a professional mechanic who uses tools all day, safety begins well before the car ignition is turned on; it begins with using the proper tool for the job and using it safely.

Before you service a car, be certain you are qualified to do the job correctly, using the proper tool safely. Whenever using any tool, always wear safety goggles to prevent possible eye injury.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

BRAKE SERVICE TOOLS



BRAKE SHOE RETAINING SPRING TOOL

To remove and replace dish type washer. Knurled cup securely grips washer on both small and standard cars.



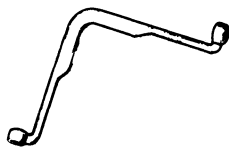
BRAKE ADJUSTMENT TOOL

Use to adjust drum brakes. Shape fits drum opening; angle provides leverage for easy adjustment.



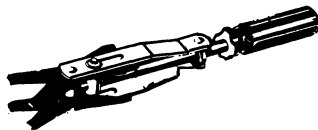
BRAKE CYLINDER HONE

Hones all cylinders with straight bore or blind end.



BRAKE BLEEDER WRENCH

Hex ends fit on bleeder valves to bleed brake cylinders.



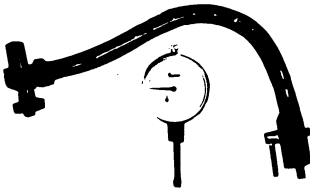
DISC BRAKE PAD SPREADER

Spreads pads and holds them in position when assembling caliper over rotor.



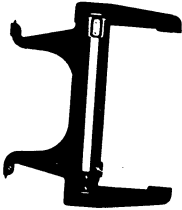
TIRE TREAD AND BRAKE LINING GAUGE

Measures the amount of lining remaining on drum and disc brake pads. Measures tire tread depth. Works on disc brakes without removing caliper.



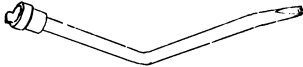
DISC ROTOR/BALL JOINT GAUGE

Checks ball joint wear and disc rotor runout. Includes roller contact for checking wheel runout and 1" diameter radiused contact for checking tire runout. Can also be used as general purpose gauge for checking gear backlash, valve guide wear and camshaft wear.



BRAKE RESETTING GAUGE

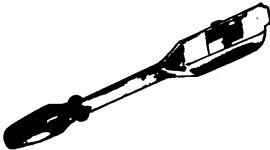
Determines proper clearance between brake lining and drum. Inside calipers measure drum diameter. Outside calipers transfer measurement to brake shoes. Knurled knob locks measurement.



BRAKE SPRING TOOL

Use special socket for removing Return Spring and the other end for replacing spring.

ENGINE TOOLS



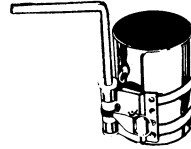
FLYWHEEL TURNER

Use when working on clutches, transmissions, installing rings or other jobs that require the crankshaft to be in a specific position.



THROTTLE ADJUSTING TOOL

Adjusts RPM without disturbing original carburetor setting. Handy for tune-ups, timing, or air-conditioning service. Compact size. Can be used without removing air-cleaner.



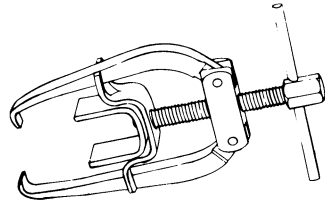
PISTON RING COMPRESSOR

Designed for use on all passenger cars. 2 1/8" to 5" capacity. Two-band ratchet type with enlarged crimped edge to prevent compressor from entering cylinder.



METRIC WRENCHES FOR SOCKET SCREWS

Used to install and remove metric bolts on most foreign cars and some domestic compacts.



VALVE SPRING COMPRESSOR

For use on overhead valves. Longer jaws enables use on high performance engines. Offset jaws designed to grip valve spring in parallel compression. There's no need to remove the cylinder head. Hex head on center screw allows use of ratchet wrench for faster use. The sliding "T" handle is designed for use in tight places. For use on cars and light trucks.



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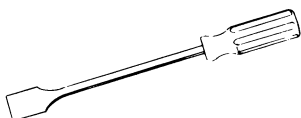
HYDRAULIC TAPPET REMOVER

Removes sticking hydraulic valve tappets. Jaws spread apart to clamp recessed area of tappet. Sliding hammer bangs them out.



AIR HOLD FITTING

Used to apply air pressure to keep valves closed while servicing single valves. Engine may rotate slightly when air applied. Use caution, avoid pinch points.



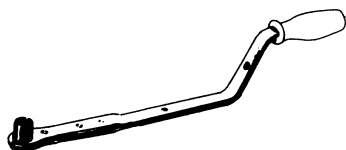
GASKET SCRAPER

Scrapes mating surfaces clean before installing new gaskets on water pumps, thermostat housings, cylinder heads, etc.



CARBURETOR AND DISTRIBUTOR ADJUSTING TOOL

Allows fine adjustment and easy access. No need to remove the air filter. Unique 90 degree and 30 degree angles get into the most cramped areas. Includes screw-driver attachment for carburetor.



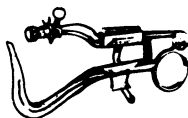
REVERSIBLE FAN WRENCH

Removes and installs fan bolts and clutch fans on most air conditioned cars. Handle is offset to prevent skinned knuckles on honeycomb radiator structure. Also provides easy access to nuts under car seats.



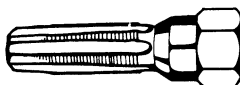
PISTON RING FILER

File piston rings with this portable rotary filer. Use to accurately size any make, type or diameter ring. Place opening of piston ring over cutter. Turn handle until proper ring clearance is obtained. Includes extra hard carbide coated cutter file.



PISTON RING GROOVE CLEANER

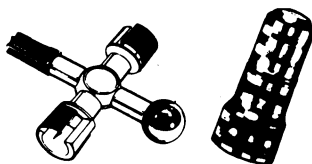
Holder secures piston in position during cleaning. Spring release for quick removal of piston.



CYLINDER HEAD RETHREADER TAP

Repairs damaged speak plug threads with thread inserts.

BATTERY SERVICE TOOLS



CLAMP AND POST CLEANER

PROPER USE. Turn brush clockwise and counterclockwise on post and inside clamp to remove corrosion.

WRONG. Never reinstall a clamp without removing all corrosion from post and clamp, thereby insuring a good electrical connection.



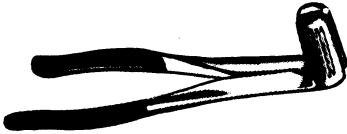
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TO PROTECT YOUR EYES**



BATTERY PLIER

PROPER USE. Grasp battery clamp nut firmly. Turn one quarter turn at a time. Do not hit battery case.

WRONG. Never use a standard plier. It will round corners off battery nut and may break battery case.



BATTERY TERMINAL CLAMP SPREADER

PROPER USE. Insert head inside clamp, spread, and ream inside of clamp.

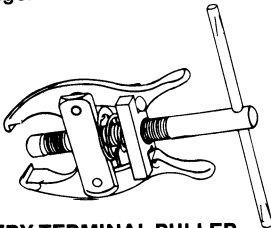
WRONG. Never use a hammer to pound clamp or post. This will break post or battery case.



BATTERY CARRIER

PROPER USE. Adjust so all three grips fit tightly on battery before lifting.

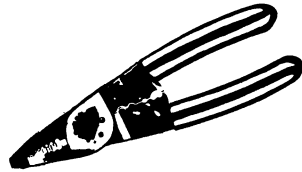
WRONG. Do not pick up battery without a carrier. It can drop and cause injury or breakage.



BATTERY TERMINAL PULLER

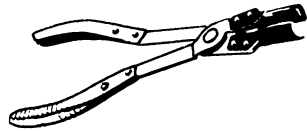
PROPER USE. Removes corroded clamps, including spring types. The sharp jaws engage either below or on sides of cable terminals and lift tightest terminals without damaging battery cases or posts. Center screw swivel makes it an effective puller for generator bearings and magneto gears.

IGNITION AND ELECTRICAL TOOLS



WIRE STRIPPER AND CRIMPER

An all-around tool for crimping solderless terminals, splicing, cutting and stripping.



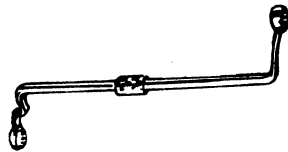
BULB BASE REMOVER PLIER

Removes corroded base when bulb is broken. Serrated lip on jaws gives firm hold for tight, positive grip without crushing bulb base.



SPARK PLUG OPENING THREAD CHASER

Cleans threads of carbon corrosion and metal.



DISTRIBUTOR CLAMP WRENCH

A necessity for any shop doing distributor work. Gets to the nut locking the distributor and enables the mechanic to loosen nut, adjust timing, and lock distributor.

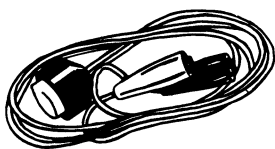


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HIGH-LOW VOLTAGE TESTER

Tests for voltage, spark and continuity in 6, 12 and 24 volt systems. Ground clip and touch probe to point being tested. Tester bulb will light if voltage present. Screw probe into opposite end of handle to check for spark.



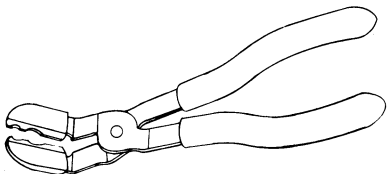
REMOTE CONTROL STARTER SWITCH

Use to bypass ignition switch on any engine with a solenoid starter switch. Lets you crank engine while working in engine compartment.



SPARK PLUG GAP GAUGE

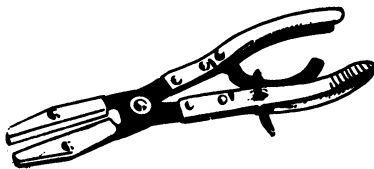
Measures spark plug electrode gap on wide gap plugs from .035" to .080". Includes two electrode adjusting tools.



INSULATED SPARK PLUG TERMINAL PLIER

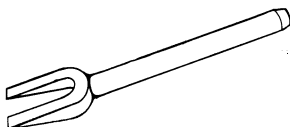
No more shocks with this special tool designed to remove cable terminals from spark plugs quickly and easily.

MISCELLANEOUS TOOLS



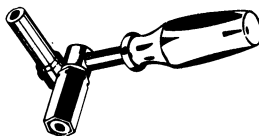
RADIATOR HOSE "PINCH-OFF" PLIER

Eliminates necessity of draining cooling system when installing thermostats and water pumps on all pressurized cooling systems. Also works on heater hose.



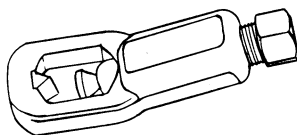
BALL JOINT SEPARATOR

When placed between the ball joint and steering knuckle, and given a few sharp blows with a hammer, this tool separates these stubborn parts with ease.



SHOCK ABSORBER WRENCH

This tool is a must for the easy removal and installation of shock absorbers on most American cars.



UNIVERSAL NUT CRACKER

Splits most stubborn nuts 5/16" through 3/4" in diameter. Works in channels not accessible to other tools. Parallel action of pusher cracks nuts without damaging bolt threads.



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MUFFLER & TAIL PIPE TOOLS



EXHAUST AND TAIL PIPE CUTTER

Adjustable for cutting various diameters of exhaust and tail pipes. Oil cutter wheel before use.



EXHAUST & TAIL PIPE EXPANDER

Flares and shapes the pipe end as well as expands it.



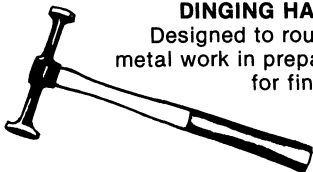
MUFFLER AND TAIL PIPE CHISEL

A few blows and muffler & tail pipe are ready to slip apart.

BODY & FENDER HAMMERS

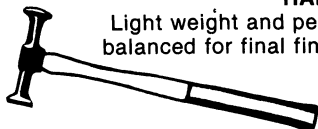
DINGING HAMMER

Designed to rough out metal work in preparation for finishing.



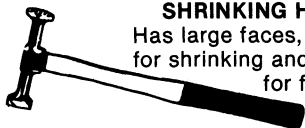
LIGHT FINISHING HAMMER

Light weight and perfectly balanced for final finishing work.



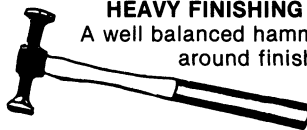
SHRINKING HAMMER

Has large faces, serrated for shrinking and smooth for finishing.



HEAVY FINISHING HAMMER

A well balanced hammer for all-around finishing work.



LONG FINISHING HAMMER

Designed for finishing metal work in areas where long reach is required.



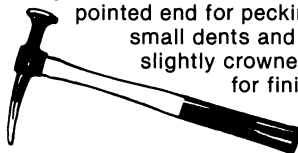
FINISHING HAMMER

A light weight, well-balanced finishing hammer with a wedge-shaped cross pein for use on fender beads and similar work surfaces.



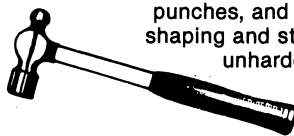
PECKING HAMMER

Forged steel head combines long pointed end for pecking out small dents and round slightly crowned face for finishing.



BALL PEEN HAMMERS

Designed for striking chisels and punches, and for riveting, shaping and straightening unhardened metal.



DEAD BLOW HAMMERS

Designed for no-bounce blows. Use wherever hammer bounce could be a problem.



Abuse/Misuse. Strike squarely and avoid glancing blows that may cause the edge of the face to chip, possibly resulting in eye or other serious injury. Never strike with or against the side, or cheek, of any hammer.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Abuse/Misuse. Never use these special-purpose hammers for any but the purposes for which they are designed.

Abuse/Misuse. Never use urethane coated hammers in extreme temperatures such as below freezing, or when wear and abrasion expose the steel inner surface of the face.

Abuse/Misuse. Never use these tools to drive nails or screws or to strike sharp metal objects. Never use a hammer with loose or damaged handle.

BODY REPAIR DOLLIES



LOW CROWN DOLLY

Useful, popular shape with many different curves and angles.



UNIVERSAL OR "RAILROAD" DOLLY

Ideal for bumping out dents.



TOE DOLLY

Has many radii with flat bottom and side. Ends are high crowned. Ideal for both flat and curved surfaces.



WEDGE OR "COMMA" DOLLY

A popular dolly designed for fender beads and flanges. Flat side works well on long curves while thin edge is ideal for corners and beading.



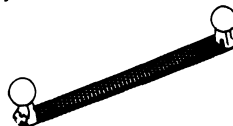
HEAVY WEDGE DOLLY

Unique shape and low crown are ideal for shrinking body metal and for raising beads and molding.



HEEL DOLLY

Semi-elliptical shape has two flat and two crowned working surfaces. Useful in restricted spaces. May be used for shrinking body metal.



"CHEESE GRATER" BODY FILE

Files look like a cheese grater, are used to shape plastic body filler before the patch is fully hardened.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

MECHANIC GEAR PULLERS

INTRODUCTION

Mechanical Gear Pullers are used for the removal of gears, pulleys, bearings, flanges and fly wheels from shafts and/or housings for the repair

or replacement of any of these components. Care should be taken in choosing the proper puller for a pulling job. For example, if the gear to be removed has a 6" diameter, choose a puller designed for pulling gears in that size range.

BASIC SAFETY RULES FOR USE OF GEAR PULLERS:

1. Always select the proper gear puller for each pulling job. Always use a gear puller equal to or larger than required.
2. Before use, the center screw should be lubricated with machine oil.
3. Always wear safety goggles when using gear pullers.
4. Always use hand tools on gear pullers. Avoid the use of air powered tools.
5. Always make sure that the gear puller is aligned with the shaft, assuring a straight pull during its operation.
6. **Never** apply heat to any gear puller. Applying heat could cause the puller to lose its "strength."
7. Should it become necessary to strike the puller for removal of a stubborn gear or bearing, care should be taken to strike the head of the center screw squarely. If after one or two sharp blows, the gear or bearing remains stuck, select a larger puller and proceed to remove the gear or bearing.
8. **Never** alter any part of a gear puller by cutting or grinding.
9. Always clean the gear puller after use and store in a clean dry place.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

Description. Although it may sometimes appear that there are several different types of pullers, actually there are two general types:

1. Jaw type — consisting of two or more jaws, a center screw, a yoke, several links and a quantity of bolts and nuts for attachment of the jaws to the yoke.

- a) Adjustable: allows the user to increase reach.
 - b) Reversible: allows internal and external pulling.
2. Bolt type: consisting of a cross arm, a center screw, and several side screws in various sizes for the attachment of the tool to the gear or pulley to be removed.

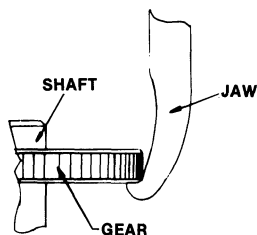
BASIC SAFETY RULES WHICH APPLY TO THE USE OF PULLERS:

Remember: Operator safety comes first! A significant amount of force can be exerted with a puller. Respect this force and observe safety precautions at all times.

CAUTION: It is impossible to predict the exact force required for every pulling job. Set-up requirements and the size, shape and condition of the part being pulled vary a great deal. In addition, the puller, its attachments and accessories are versatile. Therefore, it is possible that components in a pulling set-up may have different strength. The lowest "capacity" component then determines the capacity of the set-up. These tools should be used only by trained personnel, familiar with them. Use only after the operating instructions have been read and fully understood. If you are at all unsure of which tool or attachment to select or the proper use of the selective tool, contact the tool manufacturer.

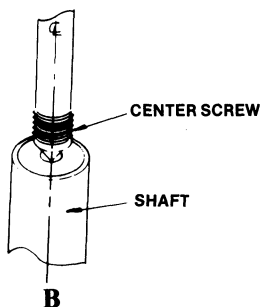
After it has been decided which size and type of gear puller is the right one for your particular application, care should be taken. Always wear safety goggles. Before attaching the puller, lubricate the center screw with machine oil. Attach the "jaws" to the pulley or gear so that the "jaw gripping" surface is in direct contact to the gear or pulley

with as much area as possible. Position the center screw in the center of the shaft with the point of the center screw in this indentation.



A

**PROPER ALIGNMENT
FOR GEAR REMOVAL**



B

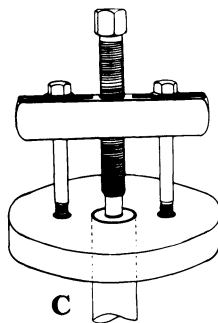
**CENTER SCREW ON
CENTER OF SHAFT**

Next, hand tighten the center screw until the puller is snug on the part, making sure that the “jaw gripping surfaces” are still in the correct position. Before proceeding, make sure that the center screw is well oiled, especially in the area about to be used. Next, attach a box-end wrench or socket and ratchet to the center screw hex head. Turn the center screw clockwise until the gear or pulley is removed. It may on rare occasions be necessary to provide additional force to remove the gear or pulley. This should be done by striking the center screw head with a machinist or ball pein hammer. Only one or two blows should be required and only to free up a stuck gear or pulley for the first few turns of the center

screw. Before striking, be sure to remove the wrench or socket. A center screw should never be struck more than one or two times. If the gear or pulley is still not loosened, it may be necessary to use a larger capacity puller. Never heat any part of a gear puller with a torch or other heating device; gear pullers are made of steel that is heat treated and this would weaken them.

BOLT TYPE PULLER

If the bolt type puller is to be used, first lubricate the center screw as previously described. Choose the correct side screws considering thread size, length and number of screws needed. Next, place the yoke and center screw assembly on the shaft. While holding the assembly with one hand, place the side screws through the slots provided in the yoke and into the threaded holes in the pulleys or gears or gear, turning them evenly so that when the center screw is tightened, the yoke will remain properly aligned with the shaft.

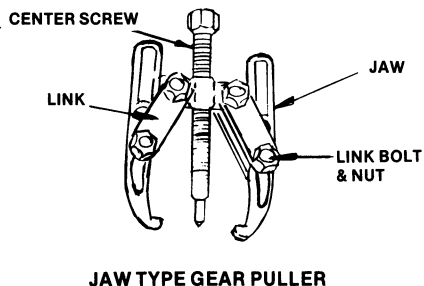
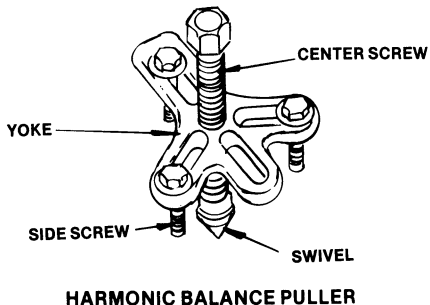
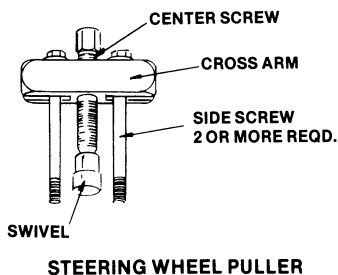


Check to make sure that the center screw is well oiled. Attach the appropriate wrench or socket and ratchet to the center screw hex head and turn the center screw clockwise



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

until the gear or pulley is removed. It is seldom necessary to strike the center screw with the hammer, but if it does become necessary refer to the cautions mentioned earlier. When selecting a gear puller for a pulling job, first determine if a jaw type or bolt type is to be used. If a jaw type is to be used, determine the diameter of the part to be pulled as well as the length of the pull necessary.



A FEW EASY TIPS TO REMEMBER

Cover work with canvas: With high forces being exerted on the part being pulled, parts being pulled may sometimes fracture, resulting in flying parts. By covering the work with a canvas the user reduces the possibility of flying parts.



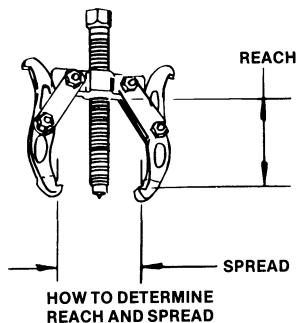
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

BEARING PULLING ATTACHMENTS

These attachments may not withstand the full capacity of the pullers in which they are used. The shape and condition of the part being pulled affects the capacity at which the puller blocks and/or studs may bend or break. Always select the largest attachments which will fit the part to be pulled.

HOW TO MEASURE REACH AND SPREAD

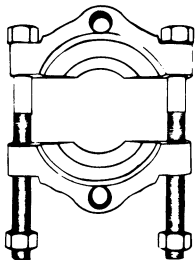
Reach and spread dimensions of the job must first be determined. A typical example of the reach and spread dimension is shown below. Notice that the length of the protruding shaft and the thickness of the component determine the reach needed. The width of the component determines the spread required.



WHEN TO REPAIR OR REPLACE

Discard or replace any puller, or puller and accessory components when any of the functioning parts show excessive wear, dents, cracks, chipping or if puller center screw shows signs of galling or seizing. Puller link or cap screws should be replaced only with a manufacturer's replacement part or its equivalent.

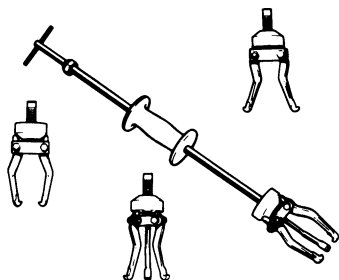
PULLING ATTACHMENTS



Pulling attachments are used in conjunction with jaw and bolt type pullers to get behind the parts being pulled.

When the housing lacks sufficient surface for the puller legs to bear against, a pulling attachment may be used to provide support.

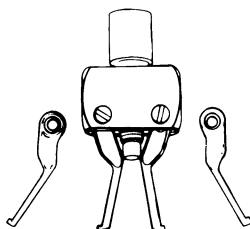
SLIDE HAMMER PULLERS WITH ATTACHMENT



Slide hammer pullers, when used in conjunction with puller jaws or other attachments, can be used to

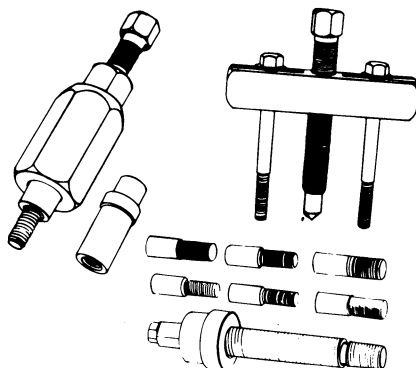
pull various size pilot bearings, oil seals, bushings, timing gears, harmonic balancers, axle shafts and other tightly fitted parts. A slide hammer puller is combined with an internal pulling attachment. It is ideal for removing parts from blind holes, especially when there is no housing to brace the puller legs against; and when no center shaft is present to rest the center screw of the puller against.

INTERNAL PULLERS



Internal pulling attachments are used to get a straight pull, thus avoiding damage to a housing or other parts. Used in combination with a bolt puller or a slide hammer puller, this attachment enables one to easily reach into a blind hole and remove a bearing race, threader or oil seal. Jaws of the attachment are readily adjustable to fit various diameters.

SPECIAL PULLERS



Special pullers are designed for such unique pulling jobs as removing harmonic type balancers, timing gears for pulleys, alternator and power steering pump pulleys, and for removing bearings, bushings, sleeves and other parts from blind holes. Hydraulic assisted pullers are used in industrial and off the road applications, seldom for automotive uses and thus not given much attention in this automotive book.

WHEN TO REPAIR OR REPLACE

Discard or replace any functioning parts showing excessive wear, dents, chipping, cracks or if center screw threads or attaching fasteners show signs of galling or seizing. If attaching fasteners are replaced they should be replaced only with a manufacturer's replacement part or with its equivalent.

SECTION XII. PIPE TOOLS

INTRODUCTION

This section deals with those hand tools used to cut, ream, or thread pipe.

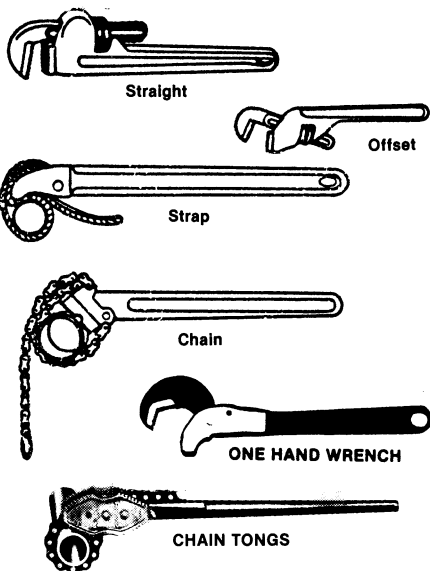
PIPE WRENCHES

Pipe wrenches are manufactured in six (6) basic types. Each type has a special purpose and some types offer choices of material for jaws and handles.

The most common type of heavy duty pipe wrench is the straight handle pattern. The straight pattern is offered with high tensile strength handles with forged jaws, in both ferrous and non-ferrous materials. For hazardous applications, some aluminum wrenches can be supplied

with beryllium copper jaws, springs, and pins to comply with safety requirements.

Offset Wrenches are similar to the straight wrench, but the opening of the jaws is angled at 25° or parallel to the long axis of the handle instead of 90° as with the straight wrench.



Strap Wrenches provide gripping power without scratching or deforming plastic or polished metal pipe. A specially woven nylon strap is extra strong and treated for slip resistance.

The Chain Wrench is for similar service to the standard pipe wrench, but is designed to ratchet in either direction, and is also useful in gripping odd shapes. Chain Tongs are used for larger, extra heavy duty jobs. They employ longer, forged steel handles and pre-tested chains.

Compound Leverage Wrenches provide additional mechanical advantage for a given handle length.

The One Hand Wrench is adjustable to different sizes without finger adjustment, and is useful for

working in very confined, hard to reach areas.

Proper Uses. The jaw and chain type wrenches are designed for turning and holding pipes and fittings in service where tooth marks are not objectionable. Use a Strap Wrench to avoid tooth marks.

When using a straight or offset pipe wrench always maintain a gap between the back of the hook jaw and the pipe. This position concentrates pressure on the jaws, producing the maximum gripping action and rotating force. The offset handle pattern is ideal for close quarters where the normal entry of a straight handle is limited. Always **PULL** rather than push on the wrench handle.

Abuse/Misuse. Periodic cleaning and inspections should be made to detect worn or broken teeth on jaws which should be replaced. Replacement pins and chains are available for chain wrenches and replacement straps for strap wrenches. Discard any wrench with bent handle or broken housing. Do not use pipe wrench on square stock (such as pipe tap or extractor). High loads on serrations from corners of square can result in chipped jaws and danger to operator.

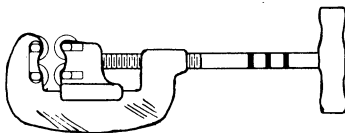


PIPE CUTTERS

Pipe Cutters are made in the popular "C" shaped frame type, hinged type and rotary type. Pipe cutters are made for cutting most piping materials, and typically have one cutter wheel and two rollers, or three or four cutter wheels and no rollers. Advantages of three and

four wheel cutters are that the pipe can be cut in close quarters by moving the cutter back and forth without rotating cutter completely around the pipe. Standard steel pipe cutters usually cut 1/2 to 2 inch pipe with some made for 3, 4 and 6 inch.

"C" FRAME CUTTER



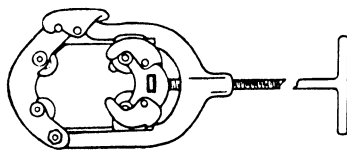
"C" FRAME CUTTER

The "C" shaped frame cutter is made with a feed screw that causes the moveable housing to slide forward making contact with the pipe.

Another variation of the "C" frame cutter is made with spring tension guide bars that help provide square alignment on corroded pipe surfaces.

HINGED CUTTER

The unique feature of this cutter is that the frame hinges are open and is locked solidly around a pipe thereby saving time when performing large diameter pipe repair. Designed for tight places in cutting

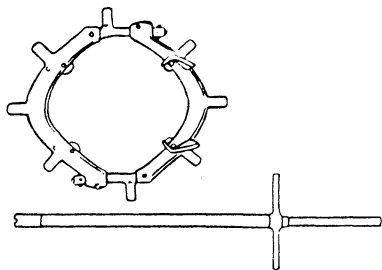


HINGED CUTTER

steel, cast and ductile iron with 4 cutter wheels, these cutters do not have to be rotated around the pipe. They cut pipe diameters from 4" to 12". Guides insure square cut off.

ROTARY CUTTER

Rotary Cutters are designed for cutting pipe diameters from 6-30 inches, are of closed frame design, use 4 cutter wheels and feature an auxiliary extension handle. Guide insure a square cut.



ROTARY CUTTER

Proper Uses. Mount cutters perpendicular to the pipe. Lightly tighten cutter and rotate the cutter 360° to insure proper tracking. Firmly tighten the cutter every revolution while cutting. Oil working parts to reduce friction.

Abuse/Misuse.

- **Don't** use a pipe cutter as a "C" clamp;
- **Don't** use the cutter as a lever to break off a partially cut piece of pipe.

• **Don't** use wheels designed for steel in cutting ductile or cast iron.

• **Don't** apply excessive pressure. Especially when used in conjunction with a power drive, reduce the feed rate, as an unreasonable amount of pressure could fracture the cutter wheel causing injury.

Repair/Replacement. Inspect cutter wheels for worn edges or breaks and replace with proper wheels as required. Also check the rollers, pins and screws for wear and replace as required.



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

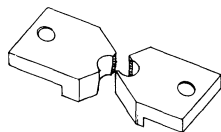
PIPE THREADERS AND DIES

Pipe threaders are made for the purpose of threading pipe, conduit or bolt stock. Special dies, which have a different rake angle, are made for threading PVC plastic pipe. Types of pipe dies include solid, adjustable, split, and segment dies. Solid die chasers are a non-adjustable part of the die and cut a standard gage thread. Adjustable dies, which are made as a matched set, are used in maintenance or other work where adjustments for thread size are required because of variance from standard O.D. Segment type chasers are used in drop head ratchet threaders. Dies are manufactured to exacting tolerances in several different universally recognized standards. The most common standard in the United States is the American Standard Taper Pipe Thread which is simply referred to by the letters "NPT." There are also straight pipe thread dies known as National Pipe Straight Mechanical Dies, "NPSM."

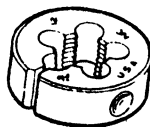
Pipe Dies used in drop head or standard threaders are full width dies and the correct pipe taper is built into the die itself.



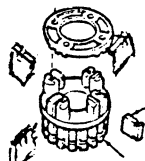
BLOCK DIE



ADJUSTABLE SPLIT DIE



SPLIT BUTTON DIE



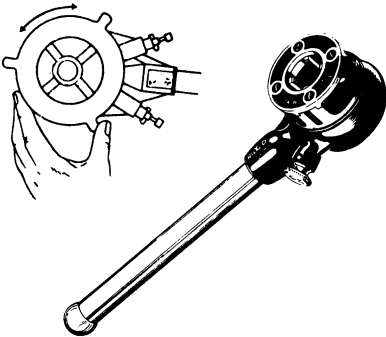
SEGMENT DIES
(NON ADJUSTABLE)

Bolt Dies (Round Button Dies) which have straight threads rather than tapered threads, are primarily manufactured to two U.S. standards; Unified National Coarse and Unified National Fine, denoting the number of pitches or threads per inch.

Proper Uses. All dies have a throat or flared opening for starting the die on the pipe.

To thread pipe the operator simply puts the leading edges of dies against the pipe end and starts to ratchet, while applying end pressure against the stock to start the threading. A good cutting oil should be used during thread operation. When the end of the pipe is flush with the end of the die a "Full Width Thread" has been achieved and the die head is reversed to remove it from the threaded pipe.

DROP HEAD RATCHET THREADER



Adjustable Guide

Description. The Drop Head Ratchet Threader (Pipe) is found in virtually every plumber's tool box. It's ideal for low volume threading and can be used with or without a power drive. These threaders feature replaceable cutting dies which are frequently referred to as die segments or dies. The drop head threader features an integral guide, and the entire head is

exchanged when changing sizes. Another style of threader features an integral adjustable guide similar to a lathe chuck, and only the die is exchanged to change size.

THREE WAY THREADER



3-Way Pipe Threader

The three way threader is used by both plumbers and electricians because they feature the three die sizes most commonly used. This type of threader uses the same type dies as the drop head threader but does not have a ratcheting feature, but rather has two handles.

RECEDING THREADER



Receding Threader

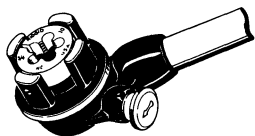
In this type of threader, the dies, which are narrower than a "Full Width" die, automatically follow an angled path or taper, and hence recede. Most commonly made in 1-2 inch range or larger, the feed of dies is controlled by a lead screw arrangement that is secured on the pipe by a quick operating chuck.

Because the threader uses half width dies, it requires less pulling effort by the operator.

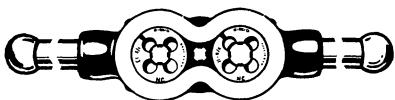


**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

These threaders use the round button dies to cut bolt threads (UNC or UNF) from ¼ inch through 1 inch. They can be used by hand or with a power drive.



Ratchet Bolt Threader



3-Way Bolt Threader

Abuse/Misuse. Always use a quality cutting oil while threading for proper cooling and longer life of the die. It promotes clean threads and prevents chips from being welded to the die and tearing threads. Insufficient oiling causes poor threads which could result in leaky installations, and reduced die life. Always thread the pipe flush with the outer end of the die to give a full nipple.

Repair/Replacement. Replace dies when teeth break, produce torn threads or when dies do not produce standard size threads.



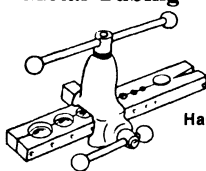
**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

FLARING TOOLS

One method of joining light metal and plastic tubing to fittings is by flaring. Fittings and flares are categorized by degree, commonly 45° or 37°. There are two types of

flaring tools, hammer and screw type. Different types of flaring tools are used for plastic and for metal tubing as illustrated below.

Metal Tubing

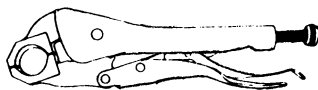


Hammer-Type Flaring Tools

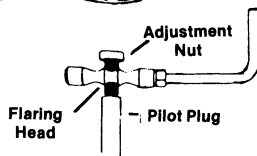


Eight sizes for all 3/8" through 2" water tube.

Plastic Flaring Tools



**Clamping
Pliers**



SCREW TYPE FLARING TOOL FOR METAL TUBING

Proper Uses. Screw Type—Select a tool which forms the correct flare to match the angle of the fitting. Tubing to be flared should be cut with a tubing cutter to assure a straighter cut. Then ream the inside diameter of the tube to remove burrs for a smoother flare. Position and clamp tubing in flaring bars with end of the tube flush with top of bar and center cone over tubing. Screw the cone down until flare is made.

Hammer Flare—Used for water tube. Insert tool in tube—strike with hammer to produce flare. (See Section IV—Struck or Hammered Tools.)

Abuse/Misuse. Do not flare hard copper or tubing not designed for flared joints. Do not use flaring tool clamp for holding rod or pipe.

Repair/Replacement. Replace or repair flaring tool when clamp no longer holds tube without slipping or when flare becomes misaligned.

PLASTIC FLARING TOOLS

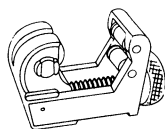
Proper Uses. Plastic pipe inside diameters vary with pipe materials and uses. The pilot plug of the flaring tool must match the inside diameter of the tubing. Tubing needs to be cut square and be free of burrs. Back off flaring head to nut stop, insert pilot plug in tubing and clamp firmly. Screw down the flaring head all the way to form full flare, reverse to nut stop and unclamp. Lightly oil threads on plug for easier operation.

Abuse/Misuse. Do not use clamp as pliers for holding other objects. **Never** use tool as a hammer, and protect flaring plug threads from damage.

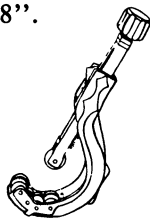
Do not attempt to use on sizes or classes of pipes not stamped on the tool.

TUBING CUTTERS

Tubing Cutters usually contain one cutter wheel and, with a quick change of the cutter wheel, are used for cutting metal or plastic. Sizes range from 1/8" to 8".



Mini Cutter



**Quick Acting
Tubing Cutter**

Proper Uses. Tubing Cutters are used to make quick, square cuts leaving a minimum burr. Select the proper cutter wheel type for cutting metal or plastic. Use light feed pressure on the first revolution to make sure cutter tracks. Firmly tighten the screw every revolution. Keep rotating parts clean and lightly oiled.

Abuse/Misuse. To maintain cutter alignment, be careful not to drop or throw cutter. Do not use to cut glass tubing or steel pipe. **Never** use a copper cutting wheel for plastic, or vice versa.

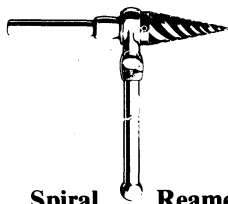
Repair/Replacement. Inspect cutter wheels for worn or broken edges and replaced when needed. Inspect and repair cutter when it does not track or cut square.



PIPE REAMER

While a pipe is being cut, a burr forms on its inside diameter. This burr could act as a trap to snag sediment or mineral deposits which might flow through the pipe. Therefore, it is necessary to cleanly remove the burr. There are two basic models of hand-held reamers—the straight fluted reamer and the spiral reamer.

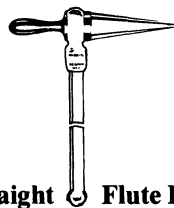
Proper Uses. The straight fluted reamer is most frequently used when the pipe is being rotated by a power drive. The operator should use only enough force to remove burr; it is not necessary to bevel the inside of the pipe. If the pipe is being held stationary in a vise, then slight end pressure coupled with a ratcheting action will easily remove the burr.



Spiral Reamer

The spiral ratchet reamer has self-feeding design especially useful for easy, fast, manual reaming. This type of reamer is also commonly used to enlarge holes in conduit box outlets or other sheet metal applications.

Abuse/Misuse. Do not use a



Straight Flute Reamer

spiral reamer on a rotating pipe. The spiral is self-feeding and its sharp edges could dig into the wall of the pipe and get hung up. The ratchet handle could then rotate out of control causing injury to the operator.

DO'S AND DON'TS WHEN USING PIPE TOOLS



**ALWAYS WEAR SAFETY GOGGLES
TO PROTECT YOUR EYES**

When using a heavy duty Pipe Wrench, adjust size to maintain a gap between the back of the hook jaw and the pipe. This concentrates the pressure at the jaw teeth only and produces the maximum gripping force and aids ratcheting action.

Always pull rather than push on the pipe wrench handle and maintain a proper stance with feet firm to hold balance.

Pipe Wrenches are designed to turn or hold pipe; never use a Pipe Wrench to bend, raise or lift a pipe.

Select a Pipe Wrench with sufficient capacity and leverage — never use a pipe extender or “cheater.”

Do not use a Pipe Wrench as a hammer, nor strike a Pipe Wrench with a hammer.

Inspect Pipe Wrenches periodically for worn or unsafe parts and replace them.

In tapping, be certain to use the correct tap size in the hole. It is recommended that the hole be of such size that the thread cut by the tap will be about 75 percent as deep as the thread on the tap.

Cast iron can be tapped dry but lubricant should be used with other metals.

Do not permit chips to clog flutes as this will prevent tap from turning.

Do not attempt to thread hardened steel as this will probably result in a chipped or otherwise damaged die.

Threading: Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.

When removing, rapid spinning of the threading stock is not recommended as this may damage the tool.

Pipe cutter wheels that are nicked or otherwise damaged should be replaced.

If there is not enough space to swing the single wheel pipe cutter completely around pipe, then a three or four-wheel cutter should be used.

Be certain the cutting wheel is suitable to cut type of pipe material. Thin wheel is suitable for cutting ordinary steel pipe, stout wheel is made to cut cast iron. Other wheels are available for stainless steel, plastic and other materials.

Never use a spiral reamer on a rotating pipe. The reamer may snag and cause serious bodily injury.

MEMBERS HAND TOOL INSTITUTE

A & E Manufacturing Company

5501 21st St.
Racine, WI 53401

A. & L. Handles, Inc.

244 Shoemaker Rd.
Pottstown, PA 19464

AT & G, Inc.

6 Pine Street
Lexa, AR 72355

Aircraft Specialties, Inc.

415 Howard St.
Lapeer, MI 48446

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The Cornwall & Patterson Co.

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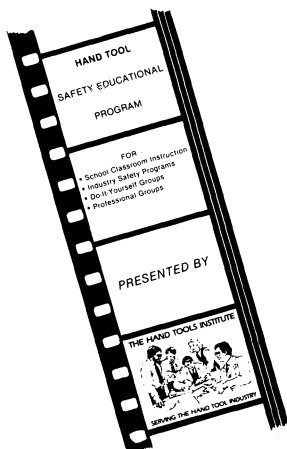
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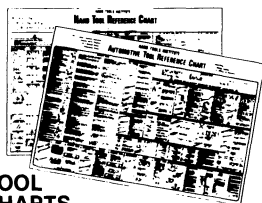
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