

**Sears**

*owners  
manual*

**MODEL NO.  
113.201392**

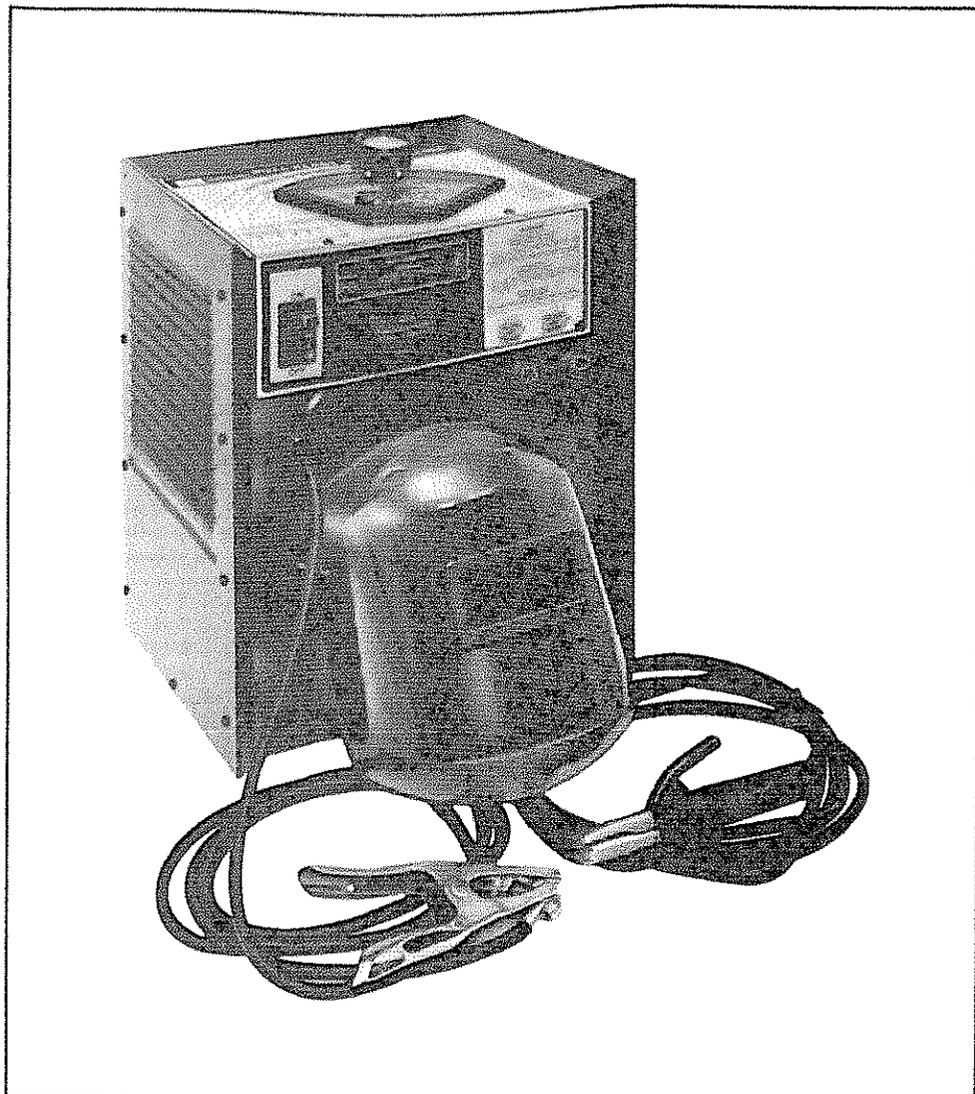
Serial  
Number \_\_\_\_\_

Model and serial  
number may be found  
at the rear  
of the cabinet.

You should record both  
model and serial number  
in a safe place for  
future use.

**CAUTION:**

Read  
**SAFETY  
INSTRUCTIONS**  
carefully



**Sears**

**CRAFTSMAN.**

**295 AMP  
DUAL RANGE  
ARC WELDER**

- *assembly*
- *operating*
- *repair parts*

**Sold by SEARS, ROEBUCK AND CO., Chicago, IL 60684 U.S.A.**

# SAFETY INSTRUCTIONS TO OPERATOR

For your own protection, read and observe all instructions included in this manual as well as the following specific safety precautions.

## 1. PROTECTION FROM ELECTRICAL SHOCK

- a. Do not let bare skin or wet clothing come between the following combinations

Electrode and Electrode Holder



80 volts exist between these parts when welder is on!!!

Wear dry hole-free, clothing, gloves and shoes to protect and insulate the body.

- b. Take special care to insulate yourself from ground using dry insulation (such as dry wood) of adequate size when welding in damp locations, on metal floors or gratings, and in positions (such as sitting or lying) where parts or large areas of your body can be in contact with possible grounds.
- c. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition.
- d. Do not use welding electrode as a cigarette lighter
- e. Connect the welder only to a source of electrical power meeting the requirements, including grounding, of the National Electrical Code (ANSI C1) and local codes
- f. Electrode coating may be electrically conductive—use welding gloves when changing electrodes.

## 2. EYE AND BODY PROTECTION

- a. Use helmet, filter, and cover plate complying with ANSI Z87.1 to protect your eyes and face from sparks and the rays of the arc when welding or observing open arc welding
- b. Always wear safety goggles with side shields complying with ANSI Z87.1 when in a welding area, or when near slag chipping operation
- c. Wear oil free protective garments, such as leather gloves, heavy shirt, cuffless trousers and high shoes
- d. Protect other near-by personnel with suitable non-flammable screening.
- e. Provide adequate ventilation in the welding area, particularly when welding on galvanized, lead or cadmium plated steel, and other metal which produce toxic fumes
- f. When working above floor level, protect yourself from a fall should you get a shock. Never wrap the electrode cable around any part of your body
- g. Do not weld in locations close to chlorinated hydrocarbon vapors coming from degreasing, cleaning, or spraying operations. The heat of the rays

of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

- h. Unprotected specators must be kept clear of the welding area due to the harmful nature of ultra-violet and infra-red arc rays, welding sparks, and welding fumes and gases

## 3. FLAMMABLE AND EXPLOSIVE MATERIALS

- a. Remove flammable and explosive material at least 35 feet from the welding arc to prevent welding sparks or molten metal from starting a fire. Keep a type ABC fire extinguisher within easy reach
- b. Welding on or near containers which hold combustibles can cause an explosion, even when they have been cleaned. For information purchase "Safe Practices for Welding and Cutting Containers that Have Held Combustibles" (A6.0-65) from the American Welding Society 2501 Northwest Seventh St., Miami, Florida 33125
- c. When not welding, place the electrode holder where it is insulated from the work clamp, work piece, or work table. Accidental grounding can cause overheating of the cables and welder, creating a fire hazard
- d. Never connect the work cable or clamp to any object but the work piece or metal work table. Connecting to other objects such as building ground can create a fire hazard

## 4. PREVENTATIVE MAINTENANCE

- a. Never apply power to the welder with any part of the "cabinet" removed. Position on-off switch in "Off" position and disconnect welder from the power supply before doing maintenance work inside the machine. Removal of the welder cabinet should be done only by a qualified service technician
- b. Before connecting the welder power cord to the receptacle, check the following
  1. Inspect the power cord and welding cables for cuts or burns and make sure blades and ground pin on the plug are straight
  2. Inspect "On-Off" switch lever for cracks or broken parts.
  3. Inspect electrode holder jaw insulators for cracks or broken parts
- c. Never weld anything on or to the welder cabinet, as a burn through may cause transformer failure
- d. For additional safety information, purchase copies of "Practice for Occupational and Educational Eye and Face Protection" (ANSI Z87.1), "Safety in Welding and Cutting" (ANSI Z49.1), and "Fire Protection in Use of Welding and Cutting Processes" (ANSI/NFPA No. 51B) from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

READ AND OBSERVE THE INSTRUCTIONS APPEARING ON THE WARNING LABELS FOUND ON THE INSIDE OF THE WELDING HELMET, SELECTOR PLATE, AND CABINET.

AMERICAN NATIONAL STANDARD SAFETY LABEL FOR PRE-WELDING LABELS

**WARNING** Protect yourself and others. Read and understand this label.

FUMES AND GASES can be dangerous to your health. ARC RAYS can injure eyes and burn skin. **ELECTRIC SHOCK** can kill.

- Read and understand the manufacturer's instructions and your employer's safety practices.
- Keep your head out of the fumes.
- Use enough ventilation/exhaust at the arc or both to keep fumes and gases from your breathing zone and the general area.
- Wear correct eye, ear and body protection.
- Do not touch live electrical parts.
- See American National Standard Z49.1 Safety in Welding and Cutting published by the American Welding Society, 2501 N. 7th St., Miami, Florida 33125. OSHA Safety and Health Standards 29 CFR 1910, available from U.S. Department of Labor, Washington, DC 20210.

DO NOT REMOVE THIS LABEL

**Sears CRAFTSMAN**

**CAUTION**

Use only for face and eye protection against injurious rays from arc welding and cutting. Use proper shade filter plate. Impact resistant eye protection (liner plate back-up plate or separate safety spectacles) should be worn when using this device. Impact resistant plates are NOT unbreakable. Pitted or scratched plates reduce vision and seriously reduce protection—replace immediately. Inspect frequently and immediately replace worn or damaged parts.

**Meets requirements of A.S.S.I. Z87.1**  
**DO NOT REMOVE THIS LABEL**

LENS SHADE NO **12**

**WARNING — FOR YOUR SAFETY**

REGARDING 80 VOLT POTENTIAL SHOCK AT ELECTRODE

REGARDING POTENTIAL SHOCK ON CABINET

REGARDING EYE INJURY

REGARDING FIRE

USE FOR MINIMUM LINE DRAW: 40 295 AMP RANGE

USE FOR MAXIMUM ARC STABILITY: 30 200 AMP RANGE

**WARNING · ARC WELDING CAN BE INJURIOUS TO OPERATOR AND PERSONS IN WORK AREA — READ AND UNDERSTAND OWNERS MANUAL BEFORE OPERATING WELDER**

**FULL ONE YEAR WARRANTY ON CRAFTSMAN ELECTRIC WELDER**

If this Craftsman Electric Welder fails to perform properly, due to a defect in material or workmanship, within one year from the date of purchase, Sears will repair it, free of charge.

Warranty service is available by simply returning the welder to the nearest Sears store or Service Center throughout the United States.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

SEARS, ROEBUCK AND CO  
BSC 41-3  
SEARS TOWER  
CHICAGO, IL 60684

**GETTING TO KNOW YOUR ARC WELDER**

MATERIAL THICKNESS GAUGE

ON-OFF SWITCH

WELDING HELMET

WORK CABLE AND WORK CLAMP

HEAT SELECTOR LOCKING KNOB

ELECTRODE DIAMETER GAUGE

DUAL RANGE OUTLET JACKS

ELECTRODE CABLE AND ELECTRODE HOLDER

**TABLE OF CONTENTS**

<b>OPERATING INSTRUCTIONS</b>			
Safety Instructions to Operator	2	Operating Controls	6
Warranty	3	Operating Instructions	7
Getting to Know Your Welder	3	Trouble Shooting	8
Unpacking and Checking Contents	4	<b>ARC WELD IT YOURSELF MANUAL</b>	1-1
Assembly	4	<b>WELDING ROD SPECIFICATIONS</b>	2-1
		<b>REPAIR PARTS</b>	2-6
			3

## SPECIFICATIONS

Welding Range . . . . . 30 – 295 amps  
 Primary Volts (AC) . . . . . 230  
 Amps Input (Max.) . . . . . 60  
 Fuse Required (Delayed Action Type) . . . . . 60  
 Phase . . . . . Single

Hertz . . . . . 60  
 Open Circuit Volts (Max.) . . . . . 80  
 Duty Cycle . . . . . 20% to 100%  
 Electrode Capacity . . . . . 1/16" thru 1/4"  
 Over-all Dimensions . . . . . 21" x 14" x 15"

# UNPACKING AND CHECKING CONTENTS

## SET-UP INSTRUCTIONS

This Craftsman welder is shipped complete in one carton. In order to facilitate packaging, certain items have been removed at the factory and must be assembled when received by the purchaser. Remove all items from the carton and identify item as shown in the exploded view.

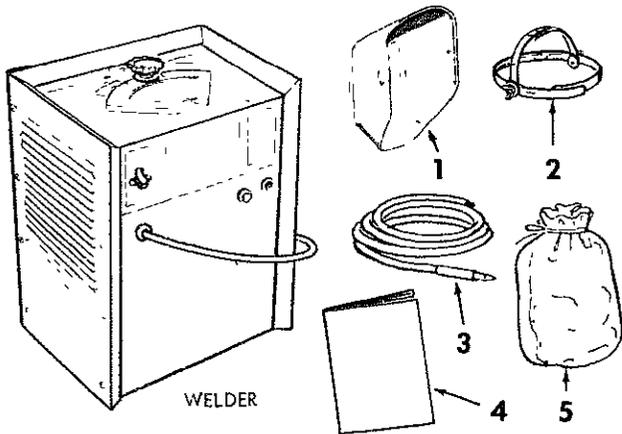


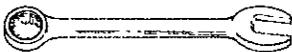
Illustration: These "Loose Parts" should be accounted for before discarding any packaging material.

## LOOSE PARTS LIST

Key No.	Part Name	Qty.
1	Welding Helmet (Partially assembled)	1
2	Helmet band assembly (Not Assembled)	1
3	Electrode cable assembly	1
4	Owners Manual	1
5	Loose Parts Bag – Containing the following items	
	Electrode Holder	1
	1/4" Hex "L" Wrench	1
	Work Clamp	1
	Electrical Outlet Box	1
	Screw, Pan Hd Ty "AB" No 10 x 1/2	2
	Outlet Box Cover	1
	Ground Terminal	1
	Screw, Pan Hd 10-32 x 1/2	1
	Lockwasher, No. 10	1
	Nut, Hex 10-32	1
	Connection Label	1

# ASSEMBLY

## TOOLS NEEDED



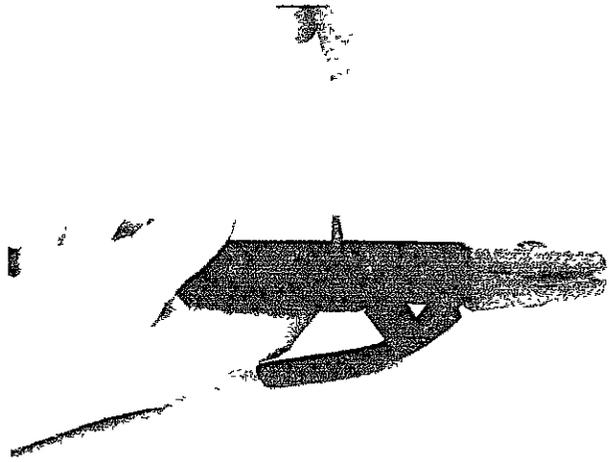
7/16-inch wrench



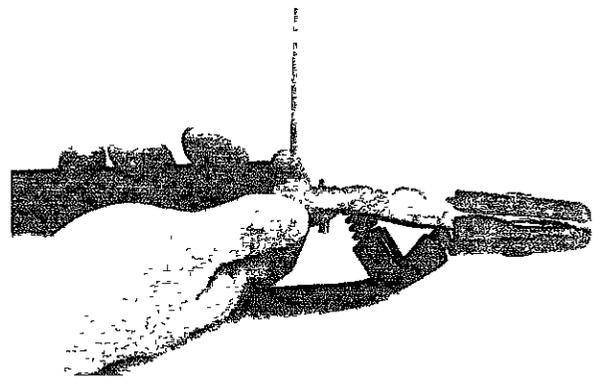
Screwdriver (medium)

## ATTACHING ELECTRODE HOLDER TO ELECTRODE CABLE

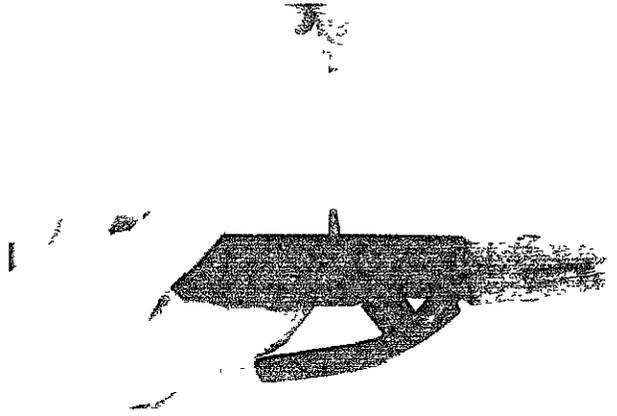
- Grasp the electrode holder and locate the slotted head, handle locking screw near the mid-point of the insulating handle. Loosen this screw approximately two turns, or until the handle can be slipped off the electrode holder. **DO NOT REMOVE THIS SCREW COMPLETELY.**
- Slide the handle off electrode holder and insert end of electrode cable assembly through the handle.  
The electrode cable is the one with insulation stripped from one end.



- Using the sockethead wrench (supplied) back out the Hex-head set screw, located near the end of electrode holder until the end of screw does not protrude into the wire socket in the end of holder.
- Make sure the wire strands on stripped end of electrode cable have not been "frayed". Twist together with fingers if necessary.
- Insert end of electrode cable into electrode holder and tighten the socket-head set screw very firmly using the 1/4" Hex "L" Wrench furnished.

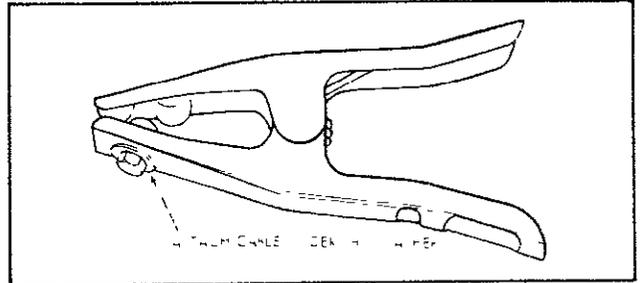


- Slide the handle back into place on electrode holder and position it until the hole in handle is directly over the head of handle locking screw. Tighten the screw clockwise  just enough to secure the handle on electrode holder.

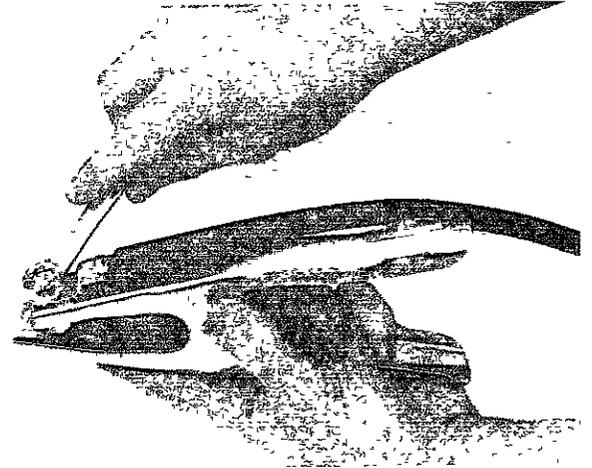


### ATTACHING THE WORK CLAMP TO THE WORK CABLE

- Attach the terminal on the end of the work cable to the work clamp.
- Do not use either of the holes in handle ends of work clamp.



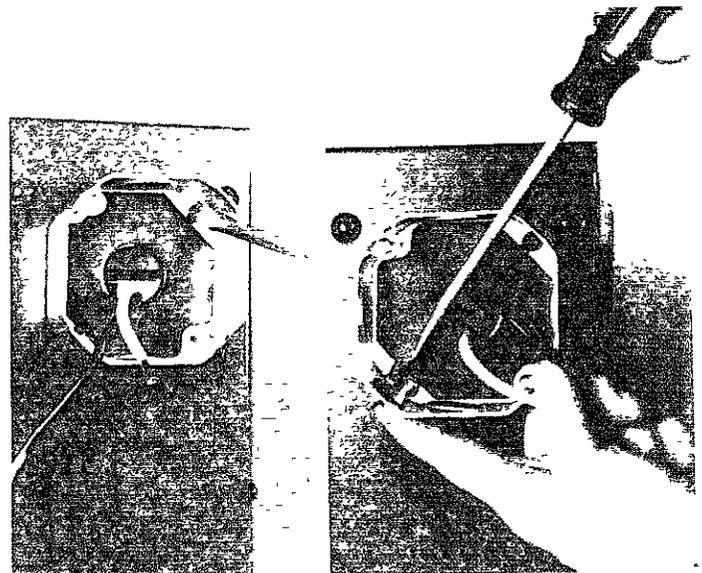
- Tighten the screw firmly enough to insure good contact and prevent the cable terminal from slipping on the clamp.



- Remove octagon shaped electrical box from Loose Parts Bag.

Attach the box to the rear of the welder cabinet with the two sheet metal screws provided. These screws must be tight.

Attach the ground terminal to the wall of the electrical box as shown using the 10-32 nut, screw and lockwasher provided. This connection must be tight.



## CONNECTING WELDER TO POWER SOURCE

**CAUTION:** Do not attempt to connect this welder to a regular household outlet. Make sure the power-line voltage and frequency agree with ratings shown on the selector plate attached to top of cabinet.

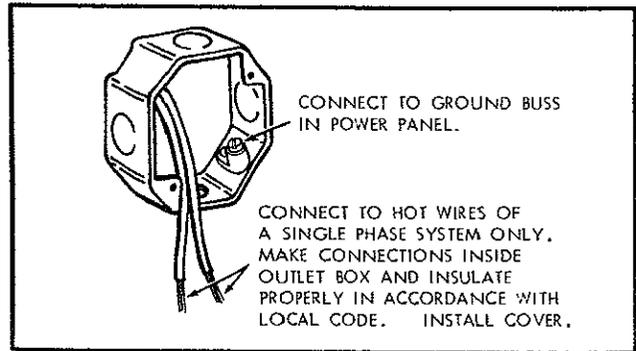
Electrical connections between the welder and 230-volt, single-phase, 60-cycle AC power source should be made by a qualified electrician. All wiring must comply with the National Electrical Code (ANSI C1) and The Local Electrical Code.

1. Install an individual (separate) line for the welder with a fuse block in the line. For best results, this circuit should be as short as possible. The size of the leads will depend upon their length as shown in the table below

### Supply Conductor (Incl. Extension Cords)

Up to 50 feet . . . . .	No. 8 AWG Copper
Over 50 feet . . . . .	No. 6 AWG Copper

**NOTE:** — These conductor sizes are for use with a welder having a rated input not more than 60 amps at 20% duty



cycle in accordance with Article 630 of the National Electrical Code (ANSI C1) and may not be adequate for other loads. Consult a qualified electrician before using for other loads.

2. Install 60 ampere fuses, of the delayed-action type such as "Fustat" or "Fusetron", in the fuse block
3. Connect 230-volt power lines and ground as shown.

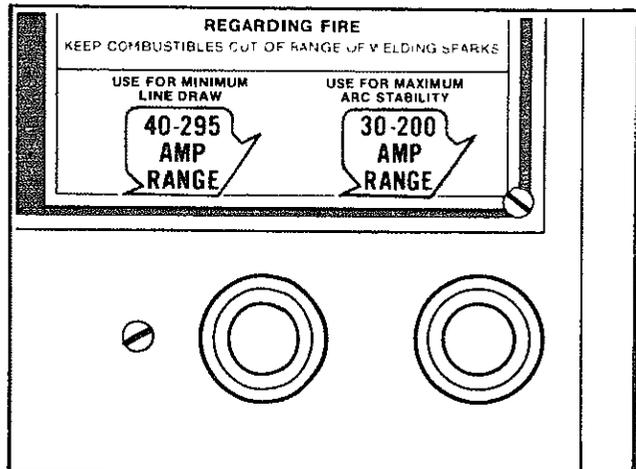
## OPERATING CONTROLS

The name "Dual Range" arc welder is derived from the fact that your new arc welder is equipped with two separate welding ranges.

The beginner or less-experienced welder will find the 30-200 amp range easier to use because it provides extra arc stability when welding with some of the "more difficult to weld with specialty rods" which are prone to pop-outs

The 40-295 amp range requires less line (input current) draw for any given amp setting and permits the use of the maximum amp settings with minimal effect on other electrical appliances, motors, and lights, on your electrical system.

Either range may be used, depending on operator preferences when the electrode diameter permits

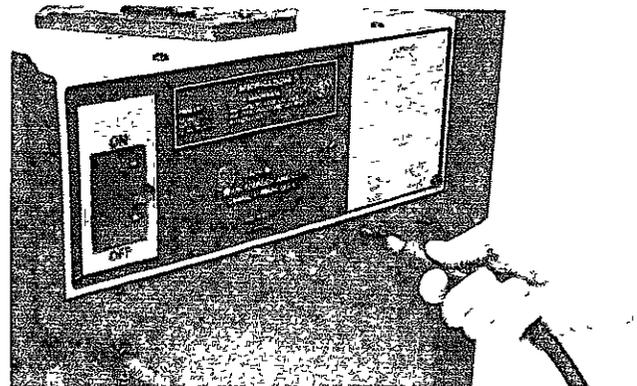


## CONNECTING ELECTRODE AND WORK CABLES

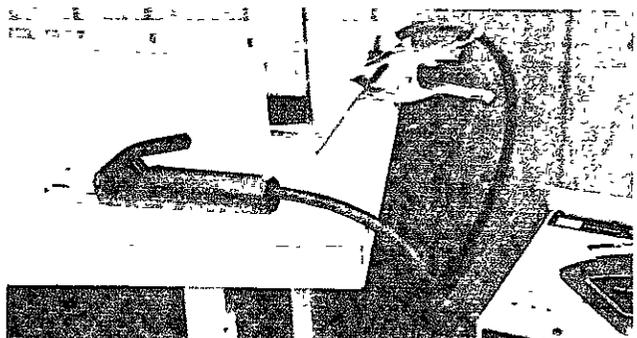
Insert the tapered plug on the end of the electrode cable into the proper outlet jack depending on amperage required or operator preference

To insure a good electrical connection always twist the electrode plug slightly while inserting. To remove the plug twist in the opposite direction while removing.

**NOTE:** If you extend the welding cables beyond those already supplied, they must be No 3 AWG or larger to avoid an undue drop in welding current. Do not extend cables over 50 feet



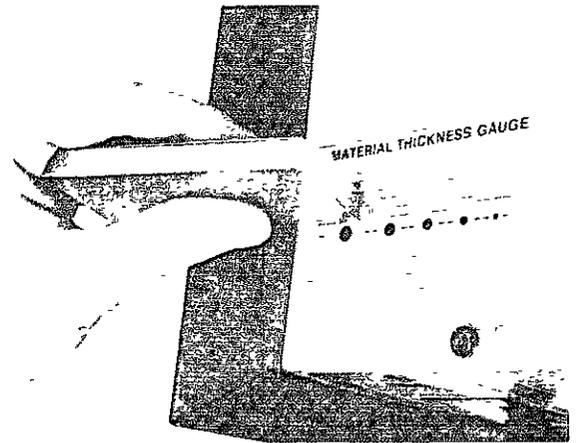
Connect the work clamp to the piece to be welded, (to complete the electrical circuit) or to the welding table itself provided it is metallic or will conduct electricity!



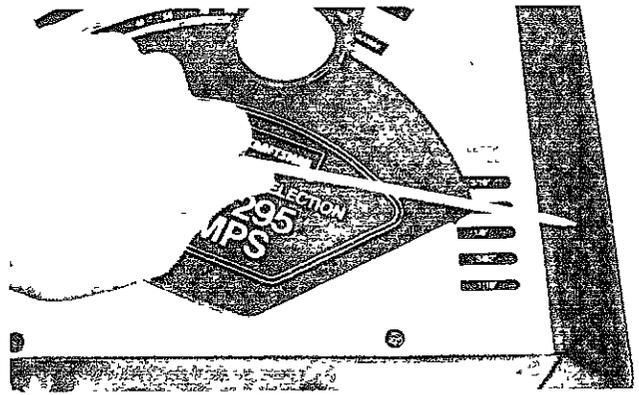
# OPERATING INSTRUCTIONS

We feel that welding with your new Craftsman dual range arc welder is as simple as A. B. C.

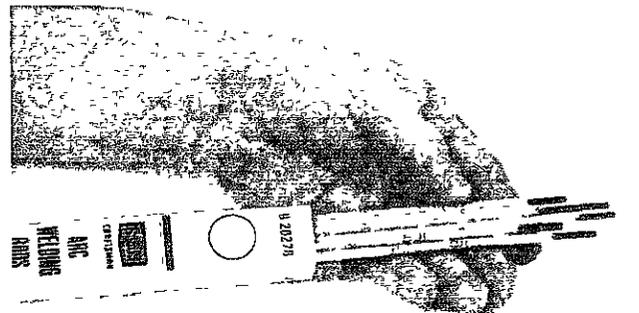
- A** Determine what diameter electrode should be used by gauging the piece to be welded on the material thickness gauge. The fractional number directly beneath the bar chart dictates what the proper electrode diameter is for given thicknesses of metals. You will note that a specific diameter of electrodes can be used on varying thicknesses of material. This is accomplished by adjusting the heat selector for more or less amperage.



- B** Next verify the electrode diameter, by placing the bare portion of the electrode into the electrode diameter gauge on the right side of the cabinet. Because electrodes are mass produced, there may be small burrs on the bare end of the electrode. Make sure the bare end of the rod is as clean as possible for accurate sizing.



- C** Finally, determine the type of electrode by the identification on the package or by the American Welding Society number stencilled on the coated portion of the electrode, bearing in mind the type of electrode you have chosen — E6013 or E7014, and also its' diameter (as previously determined). Locate that band on the amp scale. There are two E6013 bands and two E7014 bands, use the band which coordinates with the amp range you have selected.



Now loosen the heat selector knob and move the pointer until the fractional number matching your electrode diameter appears in the pointer window.

Tighten the heat selector knob.

Insert the electrode cable into the proper jack (depending on the range selected). Connect the work clamp to the work.

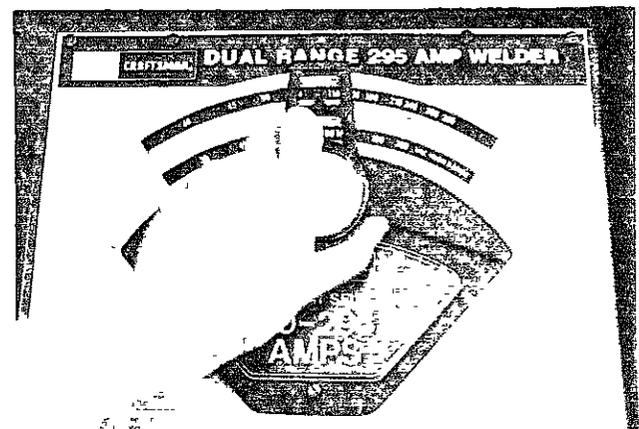
Wear Welding Helmet.

Turn the On-Off switch to the "ON" position and you are ready to weld.

Because metals vary in their make up and the technique of each operator is different, you may find it necessary to increase or decrease the amperage output accordingly.

**CAUTION.** Do not loosen and move heat selector while welding.

The duty cycle ratings bracketing the amperage scales are provided for your convenience and protection of your new welder. Duty cycle is the performance level of the welder based on a 10 minute time span. For example welding for 6



minutes out of 10 minutes is a 60% duty cycle. To avoid possible overheating of the welding transformer, which could shorten the life of your welder, Do Not exceed the duty cycles listed on the name plate.

# TROUBLE SHOOTING

**WARNING: REMOVAL OF THE WELDER CABINET TOP FOR ANY REASON MUST BE DONE BY A QUALIFIED SERVICE TECHNICIAN.**

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
Fan and welder do not operate, or continually blow fuses.	<ol style="list-style-type: none"> <li>1. Improperly fused or protected.</li> <li>2. Blown fuse, or open circuit breaker.</li> <li>3. "ON-OFF" switch not "ON".</li> </ol>	<ol style="list-style-type: none"> <li>1. Use 60 ampere fuses of the delayed action type such as "Fusetron" or "Fustat" or 60 ampere 240 volt circuit breaker.</li> <li>2. Replace fuse, or reset the circuit breaker</li> <li>3 Turn switch "ON".</li> </ol>
Welding current low or weak.	<ol style="list-style-type: none"> <li>1. Low line voltage.</li> <li>2. Welding current setting too low.</li> <li>3. Poor connections.</li> </ol>	<ol style="list-style-type: none"> <li>1. Have a voltage check performed by the local power company.</li> <li>2. Check current recommended for the electrode being used.</li> <li>3 Check electrode holder, work and electrode cable connections.</li> </ol>
Can't hold an arc.	<ol style="list-style-type: none"> <li>1. Using a D,C, welding rod</li> <li>2. Low hydrogen rod.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use AC or AC-DC rods</li> <li>2. Use rod of 3/16-inch maximum diameter, or smaller on 30-200 amp range or lower</li> </ol>

## SERVICE TIPS

### FAN MOTOR:

No provision has been made for lubricating the fan motor, as extra large oil reservoirs provide lubrication for the life of the motor.

### SELECTOR PLUGS OR CONTACTS:

**WARNING: BE POSITIVE YOU HAVE DISCONNECTED THE POWER SUPPLY TO THE WELDER. DO NOT REMOVE CABINET TOP OR SELECTOR PLATE.**

If for any reason the selector plugs or mating contacts become burned or pitted, they should be cleaned with a fine grade of emerycloth or dressed very lightly with a fine file.

Sears

**CRAFTSMAN.**

# ARC WELD IT YOURSELF



**A COMPREHENSIVE  
GUIDE FOR YOUR  
NEW CRAFTSMAN  
ARC WELDER AND  
WHAT IT WILL DO**

**CONTAINS:**

**INFORMATION ABOUT**

- **VARIOUS TYPES OF RODS**
- **USEFUL ACCESSORIES**
- **TIPS ON CUTTING, WELDING  
AND BRAZING**

**MAKE** *Sears* **YOUR WELDING  
HEADQUARTERS**

# ARC WELD IT YOURSELF

## TABLE OF CONTENTS

	Page
Your Welder and What It Will Do .....	1-3
How the Craftsman Contact Rod Simplifies Welding	1-3
What Happens When You Weld? .....	1-3
Read Before Welding .....	1-4
Learn By Doing .....	1-5
Position Welding .....	1-11
Cast-Iron Welding .....	1-14
Hard Surfacing Worn Cutting Edges .....	1-15
The Twin Carbon Arc Torch .....	1-16
Cutting and Other Miscellaneous Operations ...	1-17
Inert-Gas Metal-Arc Welding .....	1-19

*Read this Manual carefully for additional welding information.*

**SEARS, ROEBUCK AND COMPANY  
AND SIMPSONS-SEARS LIMITED**

# YOUR WELDER *and what it will do . . .*

Your CRAFTSMAN Arc Welder is a sturdily constructed and thoroughly tested machine engineered to give many years of efficient trouble-free service. It is listed by Underwriters' Laboratories, incorporated, which means that it passes all requirements of safety, fire hazard and temperature rise limits as specified in their Standard for Transfer-Type Arc-Welding Equipment.

Simply rest the electrode on the work. Maintaining constant arc length is effortless as the cone depth automatically provides the correct spacing between electrode and work for proper arc length and also prevents electrode freezing. Drag the electrode at the appropriate speed for the weld desired.

**THE OLD**      **THE EASY WAY**

Special coating containing powdered iron forms a shell around wire core. Core burns back from outside coating to keep proper gap. Easiest arc welding method known.

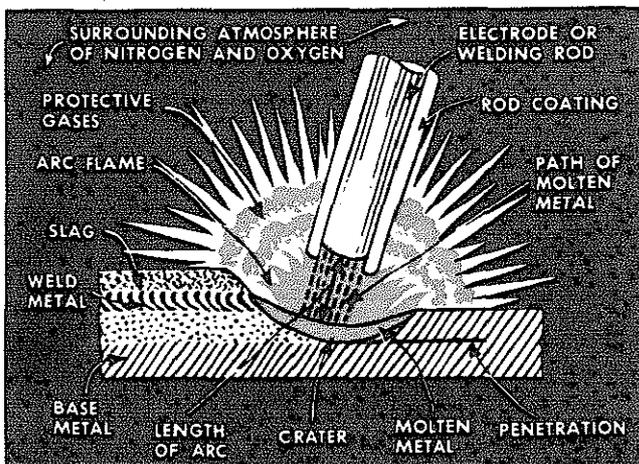
## HOW THE CRAFTSMAN ELECTRODE SIMPLIFIES WELDING

Craftsman Contact Electrode is self-starting--plus automatic restarting . . . The electrode starts on contact.

Craftsman Contact Electrode is self-cleaning . . . Under normal conditions the slag removes itself as the weld cools. Spatter is almost non-existent. Craftsman Contact Electrode has an exceptionally good appearance . . . With fine ripple, unusually clean, smooth appearance, and reduced slag inclusions.

Craftsman Contact Electrode deposits more metal faster . . . Because the powdered iron in the flux goes into the weld.

# WHAT HAPPENS WHEN YOU WELD?



Arc Welding is the process of fusing two or more pieces of metal together to form one piece. It is accomplished by heating adjacent metal surfaces to the melting point with an electric arc, then adding a sufficient amount of molten metal to provide reinforcement and fill any vacant space between the parts being joined, as shown in the accompanying illustrations.

The arc is created when an electric current, regulated by a welding transformer, flows across an air gap between an electrode and the work being welded. The intense heat generated by the arc is ideally suited for welding, as it can be directed to affect only the part of the metal to be welded. Uniform heat from the arc, is acquired by keeping its length the same for a given rod size and current setting.

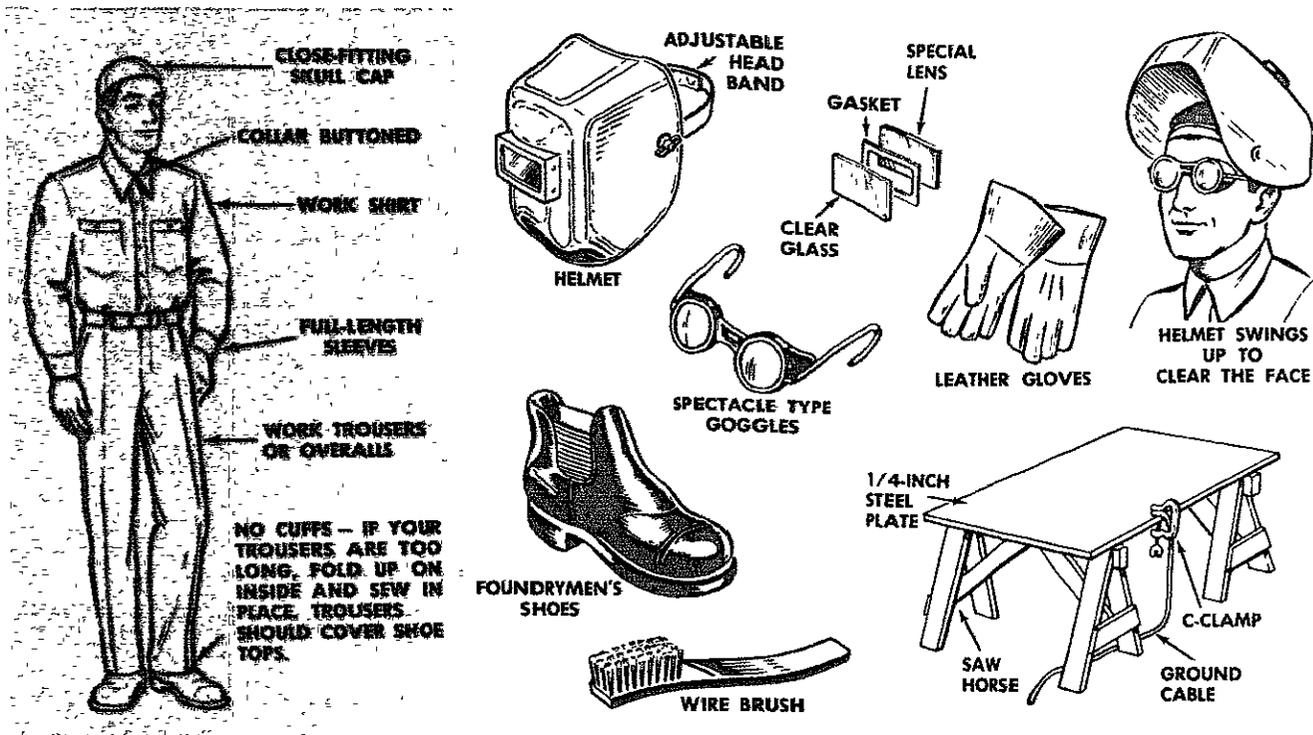
At the instant an arc is "struck", a portion of the base metal directly beneath it, is melted, resulting in a small pool of molten metal, some of which is forced out by the blast of the arc and deposited along the weld path. The depth of the crater thus formed, is the distance the weld will extend into the base metal and is referred to as the penetration of the weld.

Some of the electrode (which consists of a metal rod surrounded by a flux coating) is melted simultaneously with the base metal and is carried by the arc to the liquid pool. This added metal combines with the base metal to form the deposited weld.

During this operation a part of the flux coating burns off and forms a gaseous smoke screen that completely envelops the arc, protecting the molten metal from harmful effects of oxygen and nitrogen in the surrounding atmosphere. The remainder of the flux coating that melts is carried to the molten pool where it mixes with the metal to combine with various impurities. It then floats to the surfaces to form a coating of slag which covers the deposited weld metal, protecting it from the atmosphere and retarding its cooling.

- 1 Both edges of the metal are heated by the arc, until —
- 2 they melt and flow together forming one piece, instantly —
- 3 more molten metal and flux is added from the rod, which —
- 4 fills the crater and covers the top of the weld with slag. —
- 5 This process continues the entire length of the weld.

# READ BEFORE WELDING



*When operating a welder, certain precautions must be taken to prevent minor injuries to yourself and others. Although injuries may not be serious or permanent, knowing how to use the protective equipment to safeguard against them is the first step in learning to weld.*

The effects of heat and light given off by the arc, while electric welding, may be compared to that of the sun's rays. Even greater precautions are necessary for electric arc welding. Before starting a weld, caution anyone in the immediate vicinity against looking at the arc. In case of accidental eye injury, contact a physician immediately.

To protect the face and eyes a heat-resisting, fibreglass helmet is used. The special lens, which allows the user to view the arc safely, is inserted into the framed opening of the helmet. The clear glass, which should be replaced from time to time, protects the expensive special lens from breakage and weld spatter. The helmet is held firmly in place on the head with an adjustable head band, thereby leaving both hands free. A close-fitting skull cap should be worn with the helmet. As the helmet is used only when actually welding, a tilting arrangement permits it to be swung up clear of the face. When the welding is resumed a slight nod of the head tips the helmet down over the face. To protect the eyes further while cleaning the weld, goggles should be worn by the welder and others working around him. Animals are also affected by the rays and should be kept at a safe distance.

To safeguard the hands against heat and weld spatter, gauntlet-type leather gloves should be worn. A leather jacket will give better protection against the shower of

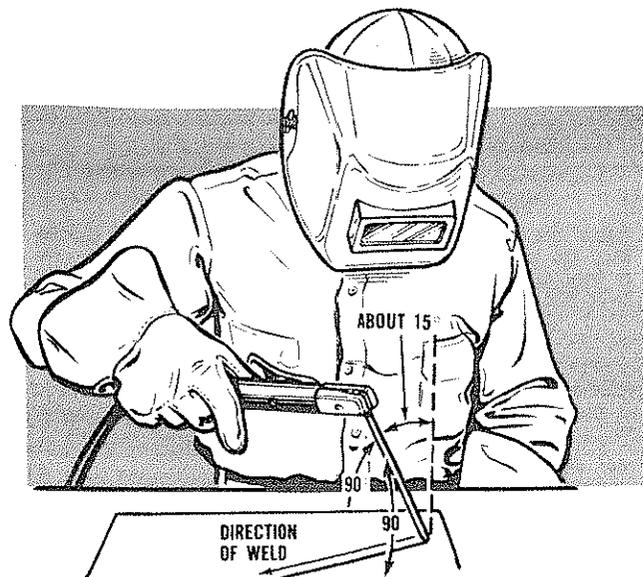
sparks than ordinary clothing. High top shoes (not oxfords) should be worn. If a great deal of welding is to be done, foundrymen's shoes are best.

Precautions must also be taken to protect property and equipment against fire. A large fire extinguisher should be within easy reach. The welding area should have a concrete or cinder floor, kept dry and clear of inflammable rubbish. Sometimes, it is necessary to weld close to a fuel tank. If practical, remove the part to be welded. If not, drain the tank and completely fill it with water.

Few tools, in addition to those supplied with the welding machine, are needed and most of them can be found in the average shop. Two sawhorses supporting a 1/4-inch steel plate makes an excellent welding table. A permanent bench, using the same steel plate, can be made of angle iron or pipe. A chipping hammer is used to clean slag off a weld and pliers will be useful for handling hot metal. A wire brush is used to clean the work before welding and remove small pieces of slag after chipping.

Small pieces of mild-steel scrap iron, reasonably free of rust and paint, should be used for practice welding. Angle iron, bar stock or plate steel are good examples. Do not use scrap cast iron, high carbon or hardened steel as these metals require special electrodes and welding techniques. These should be set aside for future practice after completing elementary practice lessons.

## LEARN BY DOING



Experience has proven that short periods of practice at regular intervals are the best way to teach yourself how to weld. As learning to weld is simply a process of trial and error, all practice work should be done on scrap metal that can be discarded. Do not attempt to make repairs on valuable equipment until you have satisfied yourself that your practice welds are of good appearance and free of slag or gas inclusions. Remember, what you fail to learn while practicing, must be learned through a series of mistakes and rewelds later on.

A comfortable body position is important when learning, as tensed muscles will result in fatigue and lack of control. Sit on a low stool and grasp the electrode holder in one hand with the cable drawn across the lap. Allow enough slack to move the holder freely and yet keep the weight and drag of a long length of cable from becoming tiring.

The ground connection is as much a part of the welding circuit as the cable and electrode holder. A poor ground connection can render the best welding equipment inefficient. When using a table with a steel top, fasten the lug of the ground cable to it securely with a bolt or C-clamp, so that any piece of iron placed on the table top will be properly grounded. If a steel table is not used, connect the ground cable directly to the work with a ground clamp or bolt.

Select a fairly large piece of steel plate approximately 1/4-inch thick and clamp it to the table top to prevent it from lifting, should the electrode stick or "freeze" when

first attempting to weld. Insert a small, mild-steel welding electrode in the electrode holder and connect the welding cables to produce the heat specified by the CONTROL panel. Connect the ground cable to the work and set the indicator in the current range recommended for the diameter of rod used.

Any method of bringing the tip of the rod in contact with the work, then quickly raising it until there is approximately a 1/8-inch gap between the rod and the work, will start an arc. The easiest way for a beginner to strike an arc is to scratch the tip of the rod a short distance on the surface of the work, as you would a match, then lift it (quickly) the required 1/8-inch (fig. 1). Another method is to strike the work a hard blow with the tip of the rod and allow it to bounce up to form the arc gap. The important thing is to strike the arc quickly and not allow the rod to remain in contact with the work.

A common mistake often made by a beginner is to point the rod toward the work and, after lowering the helmet, feel slowly about until the tip of the rod touches the work. This always results in sticking or "freezing" of the rod which produces a direct short circuit. When this occurs the rod can be loosened by bending it from side to side while pulling on the holder (fig. 2). If this fails, turn the welder off. The electrode must be released in a matter of seconds to avoid unnecessary heating of the welder or damage to the flux coating on the rod.

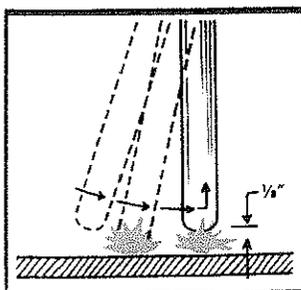


Figure 1

To strike an arc, scratch the end of the rod on the plate and then quickly raise approximately 1/8-inch.

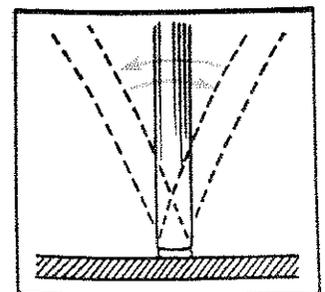


Figure 2

Should the rod stick or "freeze" bend it from side to side while pulling upward on the rod holder.

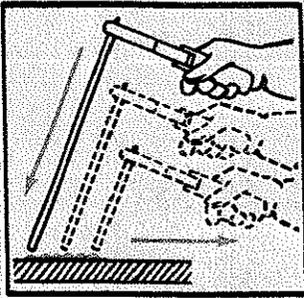


Figure 3

To lay a weld bead only two movements are used, downward and in the direction the weld is to be laid.

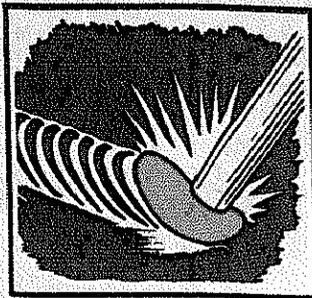


Figure 4

Watch the weld puddle to keep the slag from flowing in front of it, causing inclusions and gas pockets.

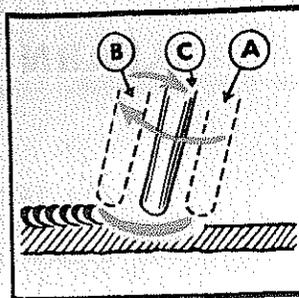


Figure 5

Fill the crater, when starting a new rod, by striking the arc at A then moving to B and back to C position.

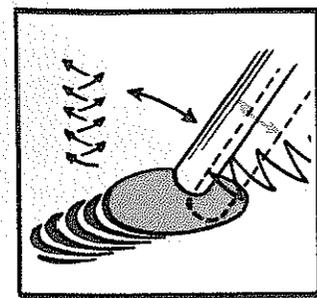


Figure 6

To widen the bead, work the rod from side to side slightly, with a slow, zigzagging crescent-shaped motion.

If difficulty is experienced after repeated attempts to maintain an arc, check the ground connection for proper contact with the work. If this does not help, increase the welding current. Also check the rod size, as larger rods require higher current settings.

Practice striking and maintaining an arc for a few seconds, then snap it out by rapidly pulling the rod away from the work. Repeat this operation until the arc can be started and the gap maintained as uniformly as possible. In a short time you will find the arc length can be controlled by the crackling or "frying" sound which may be recognized by gradually shortening the arc until it sputters irregularly as though it were going to "choke out" and stick—then slowly lengthening the arc by pulling the rod away from the work until it snaps out. Somewhere between these two extremes the steady crackling sound of a proper arc length will be heard.

To lay a weld bead, only two movements are used, a steady downward feeding of the rod to maintain the correct arc length and a slow travel in the direction in which the weld is to be laid (fig. 3). Watch the weld puddle and arc length, and move the rod steadily in a straight line as the back end of the crater fills up (fig. 4). The slight angle of the rod will keep the flux or slag flowing over the deposited weld metal to form a protective coating. If the rod is moved too slowly the slag will flow in front of the puddle and be trapped in the weld, producing inclusions and gas pockets.

Lay a bead approximately four inches long. After allowing it to cool slightly, remove the slag coating, which covers the top of the weld, by scraping along each edge of the weld with a cold-chisel followed by wire brushing until it is bright and clean. Inspect the surface of the weld carefully before starting another. The surface of a good weld is rippled uniformly, which results from a steady rate of travel and uniform arc length.

If the scrap plate used is small, it will become very hot after laying a few beads. This will alter welding conditions which could be very confusing to a beginner. Have several scrap pieces handy so each may be allowed to cool before laying a second bead.

When starting with a new rod, chip slag from the crater and strike the arc at the forward end as shown at "A" in figure 5. Then move the rod to "B" and back to "C," at about twice the normal rate of travel to give the rod and base metal time to heat up for proper fusion.

After laying a number of beads, try "working" the rod from side to side slightly (fig. 6). This movement should be slow and not wider than the diameter of the rod being used. Experiment with different current settings, rod sizes and rates of travel. Compare results with welds shown in the diagrams (fig. 9).

Too low a current setting tends to deposit the bead on top of the plate with very little penetration. The arc sound will be an intermittent crackle with irregular sputtering. Too high a current setting (for the size of the rod being used) will provide sufficient penetration but the bead will be thin and undercut in places. The arc makes a hissing sound and the rod becomes red hot before it is half used.

If travel is too slow it will pile up a wide, heavy bead with good penetration but with overlap of the weld metal on sides without fusion. A large area surrounding the weld is heated to a high temperature which produces distortion, even on a simple weld. If the rod is moved too fast the small bead will result with little more than melted base metal. An extremely long arc causes the rod to melt off in globules, with little or no penetration, and a very irregular weld surface. The arc produces a hissing sound.

A good weld laid with correct current setting, speed and arc length will produce a surface that is rippled uniformly, with the same width throughout its length, and well formed crater. The cross-sectional view shows it to have good penetration and no undercut or overlap.

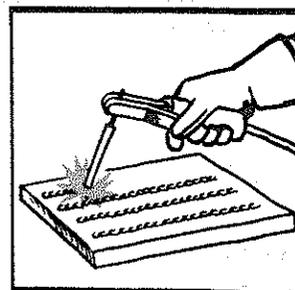


Figure 7

Lay the weld beads about one inch apart. Remove the slag and examine each weld before starting the next.

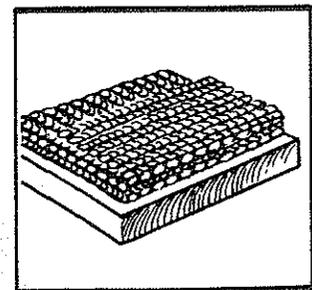


Figure 8

A pad of weld metal is built up by running a series of beads in layers at right angles to each other.

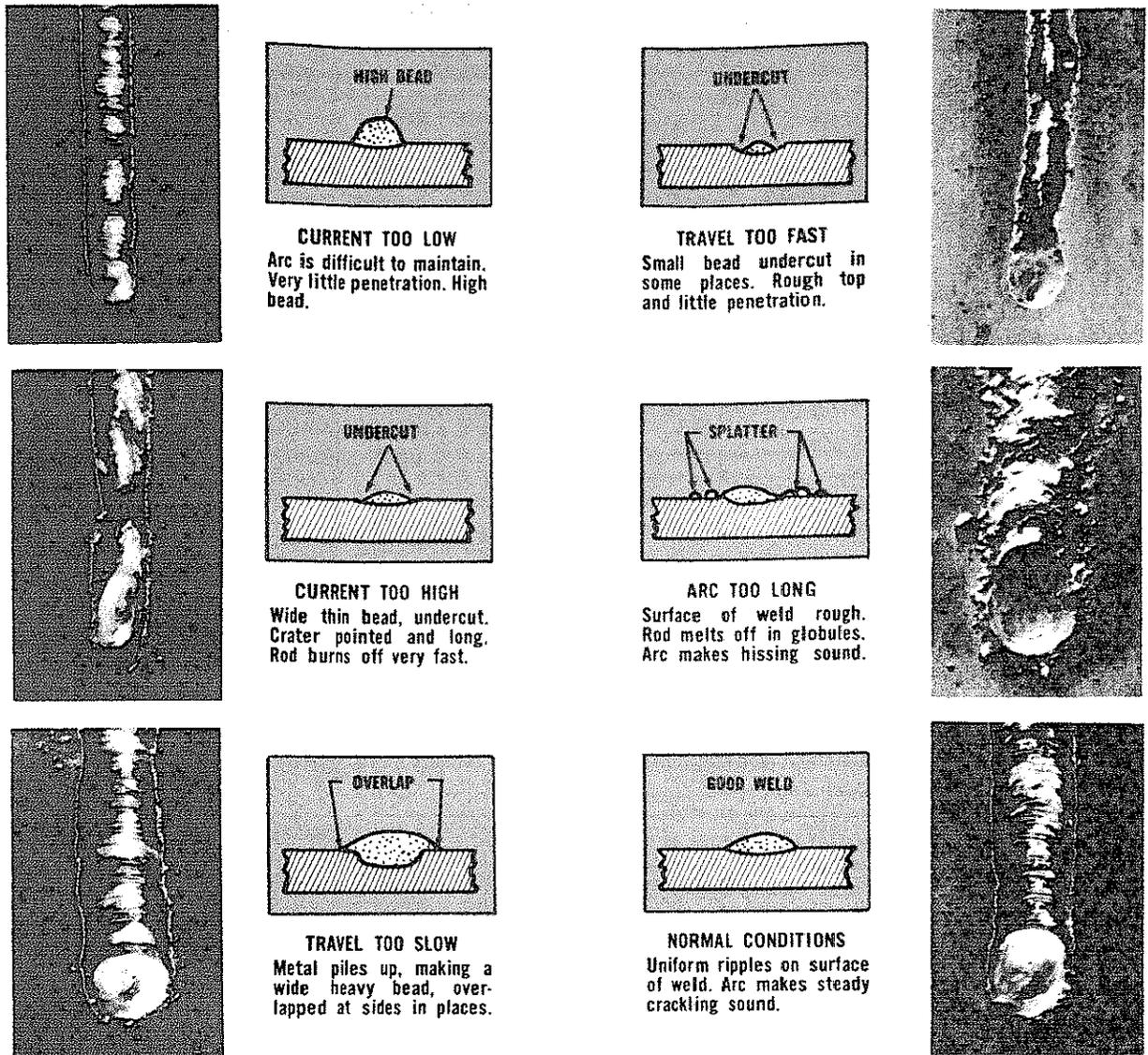


Figure 9

Practice laying beads approximately one inch apart until a good weld can be produced with all the different rod sizes the welder will handle (fig. 7). After becoming proficient in running a bead, build up a pad of weld metal. Clean each bead before laying the next and make sure they are fused together (fig. 8). Run the second layer at right angles to the first and the third at right angles to the second, etc., until a pad approximately 1/2-inch thick has been built up. This type of welding is used to build up round or flat surfaces or reinforce parts that are rusted thin.

To avoid distortion when building up the end of a shaft, run the beads parallel to the axis and lay each successive bead on the opposite side as shown by the numbered steps in figure 10. Cover the entire shaft with weld metal for the desired length. If the place to be welded is not at the end of the shaft, weld around it and turn the shaft slowly to keep the weld puddle in the flat position (fig. 11). Clean off the slag after each bead, then machine the shaft to proper size.

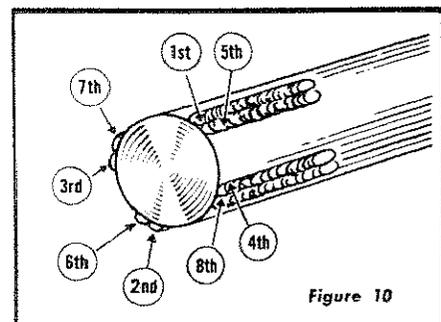


Figure 10

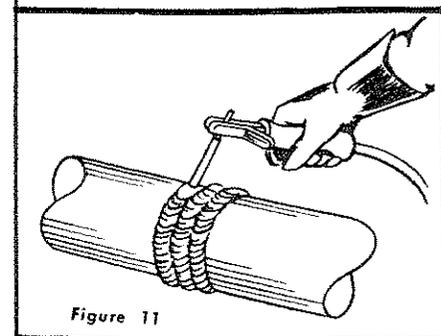
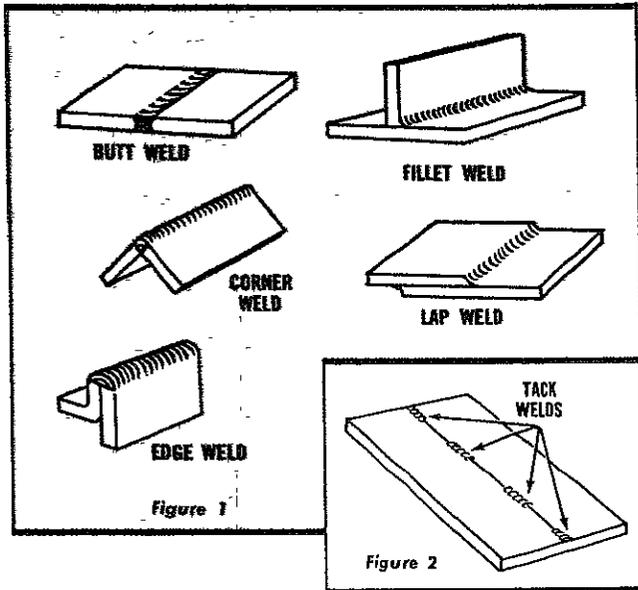


Figure 11

# FLAT WELDING



Flat welding includes all types of joints in which the weld is horizontal, and the electrode is fed down as in the practice welds of previous pages. The five types of joints in figure 1 can be welded in the flat position.

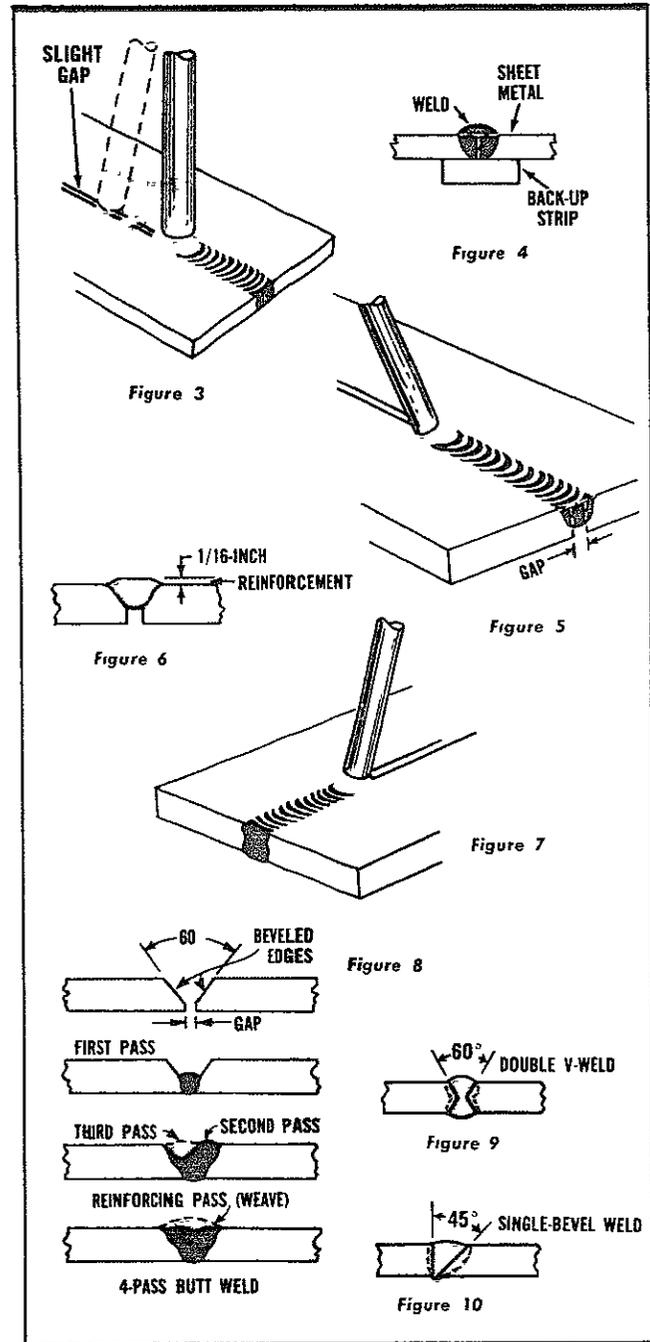
Butt welds on light material should be practiced first on scrap stock. Use 16-gauge mild steel sheet metal (approximately 1/16-inch thick) and 5/64-inch rods with the welder set at approximately 30 to 50 amperes. Butt edges of metal together and tack-weld approximately every three inches (fig. 2). (Tack welds are small beads 1/4 to 3/8-inches in length.) Place bars of scrap iron under ends of the work to provide an air space above the table. Simply move the rod in a straight line directly above the edges to be joined

If the weld burns through in places, reduce the welding current or increase the rate of travel. Some difficulty may be experienced in starting the arc at these low current settings.

However, once the arc is started, there will be sufficient heat to make a sound weld. After laying a bead, turn the work over and inspect the underside which should also have a small uniform bead. To prevent burning through where the edges are not butted tightly together, move the rod back and forth with short quick strokes in the direction of the weld to bridge the gap and give the metal in the crater a chance to solidify (fig. 3).

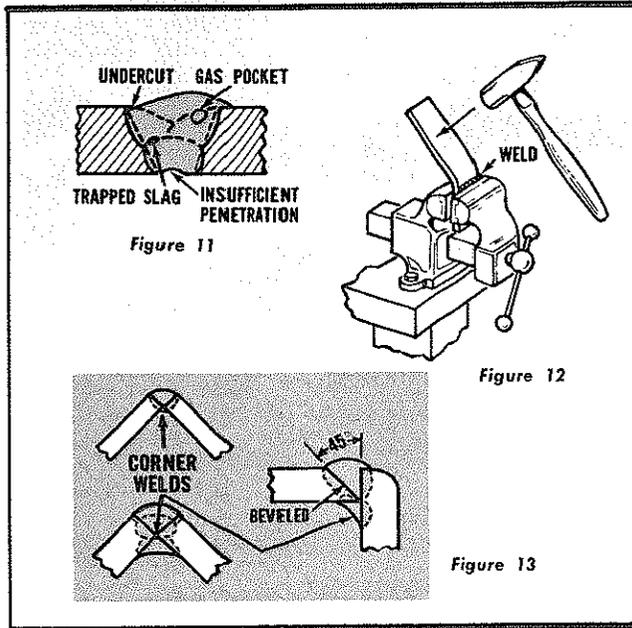
Butt welds on sheet metal lighter than 18 gauge should not be attempted by the beginner without the use of a back-up strip (fig. 4). This consists of a bar of copper clamped tightly against the underside of the seam to absorb the heat of the arc and prevent the weld from burning through. To assure complete penetration with butt welds on 8-gauge metal or heavier, a 1/16 to 3/32-inch gap should be allowed between them (fig. 5). Insert a wedge or screwdriver between the plates when tack-welding to maintain the gap, then turn the piece over, so the tack welds are on the underside

Use enough current to melt edges of plates to a depth of at least one-half their thickness. Clean off the slag and inspect it for smoothness, penetration and height of reinforcement. A good weld should have a reinforcement slightly more than flush with the surface (fig. 6). Turn the plate



over and weld a similar bead on the other side (fig. 7). A higher welding current can be used on this side as there is no danger of burning through and fusion with the first bead will be assured

Although butt welds can be made on steel plates up to 3/8-inch thick, with a 295-ampere machine using 1/4-inch rod, the same results can be obtained with the 180 and 230-ampere machines if edges of plates are beveled (fig. 8). Metal of almost any thickness can be welded in this manner by depositing a number of beads, one on top of the other until the groove is completely filled. If the plate can be welded from both sides, always use a double bevel (fig. 9). If only one plate is beveled, the angle should be at 45 degrees (fig. 10).

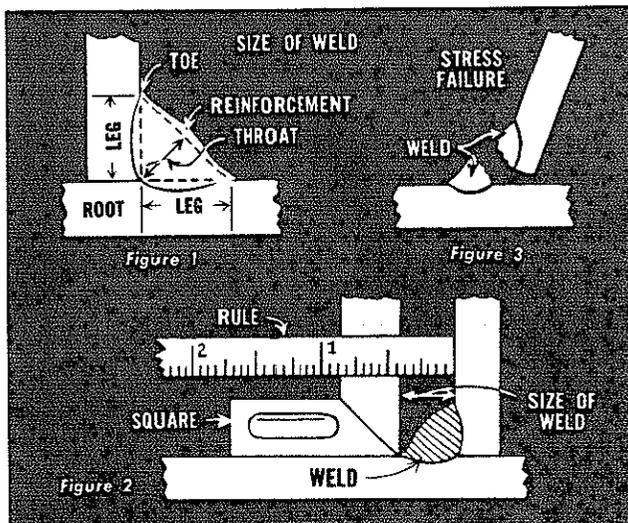


Run the first pass on beveled plates with a 5/32-inch rod and use as high a current as you can handle to obtain a small bead on the underside. If this is not done, insufficient penetration will result, as shown in figure 11. Be sure to clean each pass before laying on the next. All beads are laid by moving the rod in a straight line with no weaving or side-to-side movement. On the last or reinforcing pass, a weaving motion must be used to obtain a wide weld that will completely cover preceding beads. For the beginner, the side-to-side movement (with a slight hesitation at each end) will produce a smooth top without undercut or overlap.

Select several practice welds of different thicknesses and cut them into 1-1/2-inch strips. Clamp each strip in a vise and bend it at the weld (fig. 12). If it breaks through the weld, study it to find the cause of failure.

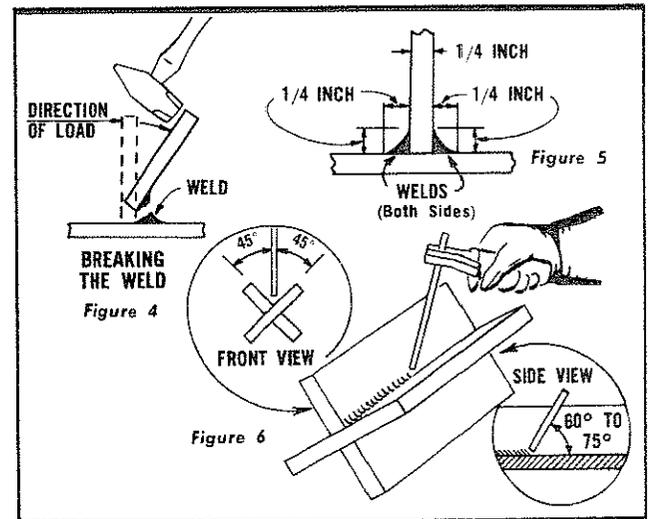
Corner welds are made on light sheet metal by running a single bead along the top, after tack-welding at three-inch intervals to prevent warping (fig. 13). If numerous gaps are present, a back-up strip may be used. On heavier metal two passes may be necessary and, if the design permits, a smaller pass can be laid on the underside. Beveling may be used to advantage on the thicker metals.

## FILLET WELDS



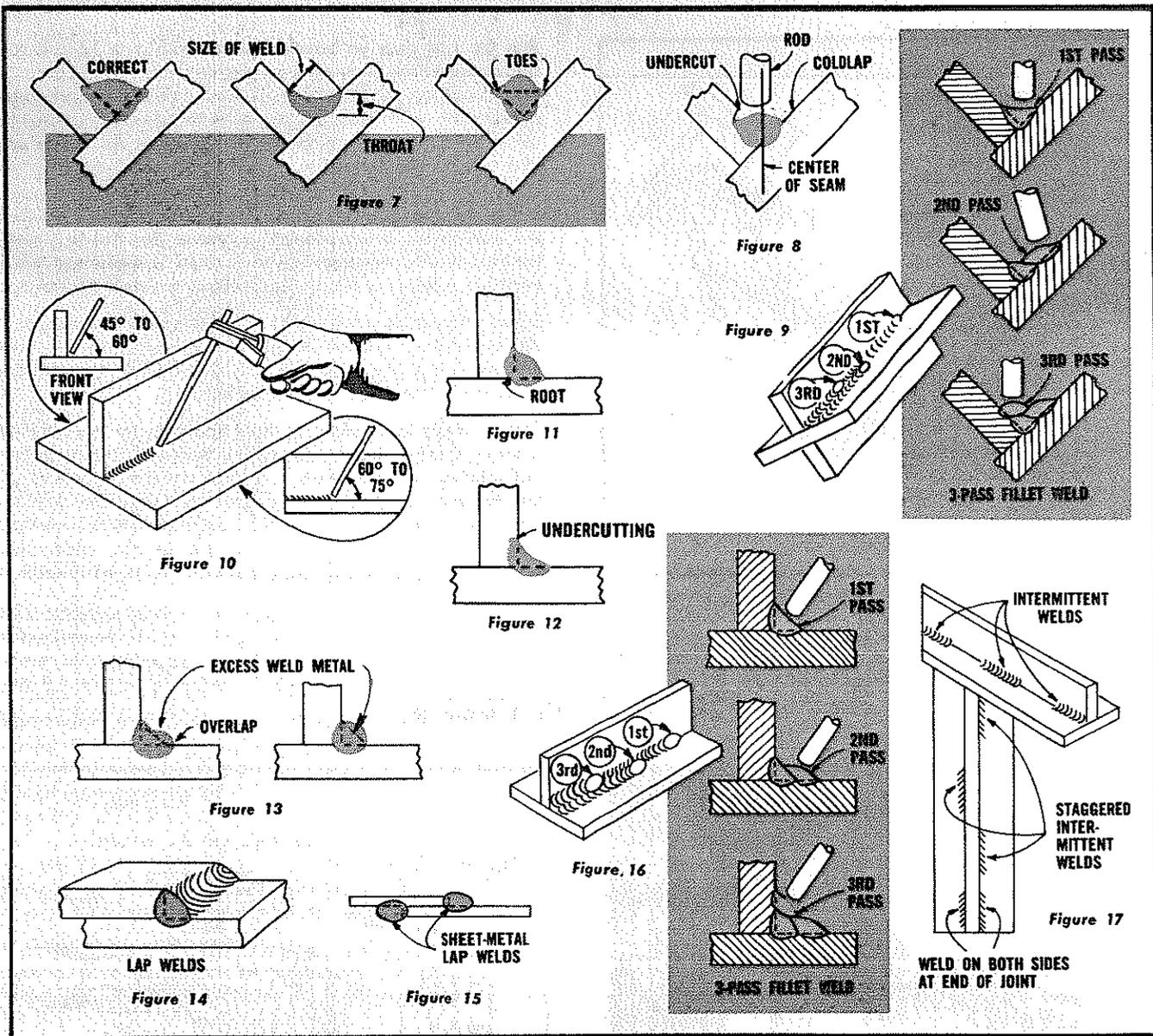
Fillet welds are used to join two pieces of metal with sides or edges at right angles to each other. The size of such a weld is based on the leg length of the largest isosceles right triangle that can be inscribed within the cross sectional area, as shown by the dotted-line triangle (fig. 1). The size of a fillet weld may also be measured with a square and ruler, subtracting 1/32-inch from all dimensions under 3/16-inch and 1/16-inch from all over 1/4-inch (fig. 2). For example, a 1/4-inch fillet weld should measure 5/16-inch. This will offset any inaccuracy due to the slight radius at the toe of the weld and allow for concavity of the bead.

When a fillet weld is stressed to its maximum capacity, failure will usually occur through the throat section (fig. 3). Therefore, the strength is determined by the throat dimension multiplied by the length of the weld. Finished welds of



this type should always be at least four times their size in length; that is, a 1/4-inch fillet weld should never be less than one inch long. The direction in which the load is applied to a weld greatly affects its strength, which can be clearly demonstrated by breaking the weld (fig. 4). A joint so loaded should always be welded on both sides with fillets equal to the plate thickness (fig. 5). If this cannot be done, bevel the plate to assure complete penetration and position the work at a 45-degree angle if possible.

For practice, tack-weld three pieces of scrap iron together to form a cross (fig. 6). Use a 5/32-inch rod with high current and hold it as indicated in the front and side views. Move the rod at a steady even pace along the seam without any side-to-side movement and deposit one inch of weld for each inch of rod melted. The surface contour of a good weld



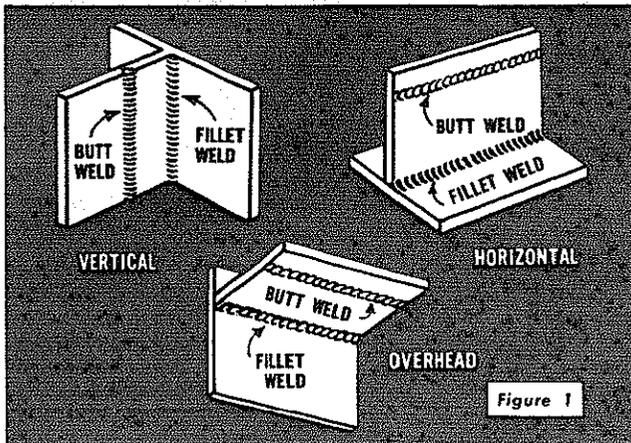
should be nearly flat with a slight radius at the sides or toes. Avoid excessive concave or convex surfaces of the fillet (fig. 7). Undercuts and cold-laps are caused by not holding the rod in the center of the seam (fig. 8). If the desired fillet weld cannot be made with a single pass, several passes are used to build it up to required size (fig. 9). Slag must be cleaned from each pass before depositing the next. Fillet welds over 1/2-inch in size are rarely used because joints requiring more strength can be made more economically by beveling and groove-welding, followed by a small concave fillet weld to provide a radius in the corner.

Horizontal fillet welding is used when the side or edge of one member of the joint is in the vertical position particularly for small single-pass welds where the work cannot be tilted. For practice, tack-weld two pieces of scrap together to form a tee-joint (fig. 10). Use a 5/32-inch rod held at angles indicated, and direct the arc into the corner of the joint. The arc length should be somewhat shorter than for flat fillet welding. To assure penetration at the root, use the highest welding current that can be handled (fig. 11). Good penetration is of prime importance and appearance

will come with experience. If the arc is advanced too fast, or held too close to the vertical plate, undercutting may result (fig. 12). Too slow travel will cause overlapping and an extremely close arc or low current will produce a bead with a convex surface (fig. 13). To check the penetration and soundness of the bead, break some of the welds for inspection, as shown in figure 4.

When making a lap weld, care should be taken not to melt too much of the upper corner on the top plate (fig. 14). Some melting will take place, but proper advance of the rod will cause the weld metal to build up and blend into the top surface. On sheet metal, hold the 3/32-inch rod almost perpendicular and move the arc rapidly. Welds of this type should be wider than they are high, somewhat like a flat bead (fig. 15). A slight discoloration on the underside of the lower sheet indicates good penetration. On heavy metal, a 3/8-inch fillet weld can be laid in one pass with a 1/4-inch rod using a 295-ampere machine. However, with smaller machines, the same weld or larger can be made by building up with a number of passes (fig. 16). When welding long narrow pieces, stagger the welds in short intermittent beads, first on one side then on the other side, to minimize distortion (fig. 17).

# POSITION WELDING



In order to derive the greatest benefits from your welder, you should practice until you can make a welded joint in almost any conceivable position. The ability to do this is especially useful when making repairs on machinery as the amount of welding in most cases is small and does not warrant disassembling the parts to weld them in the flat position. Welds of this type have been classified into three groups according to their location and are referred to as vertical, horizontal and overhead welds (fig. 1). Of the three positions, vertical welding will be used the most and should be practiced first. Skill gained in this type of weld will make horizontal and overhead welding easier.

## VERTICAL WELDING

The two methods of welding in the vertical position are commonly known as "vertical-down" and "vertical-up" welding (fig. 2). In the former the bead is started at the top and welded in a straight line downward. In the latter the bead is started at the bottom and welded up, usually with a weaving motion.

The chief difficulty encountered with any position weld is keeping the molten metal in the puddle from falling out. To prevent this the arc must be held as short as possible and the weld puddle kept fairly small so it will solidify rapidly.

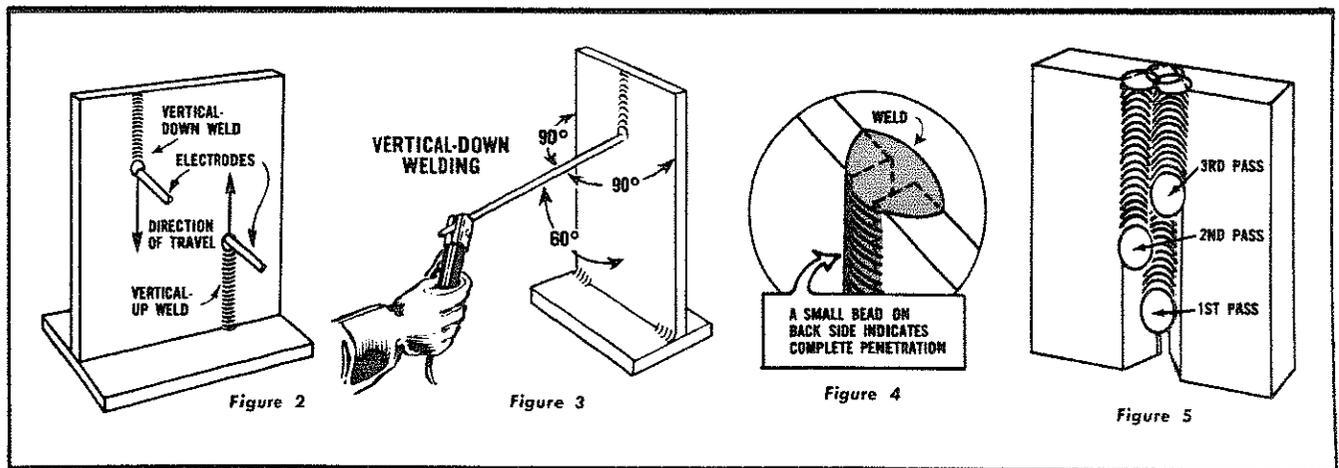
Vertical-down welding is the easiest to perform and is used on material up to 1/8-inch thick. Before attempting a vertical

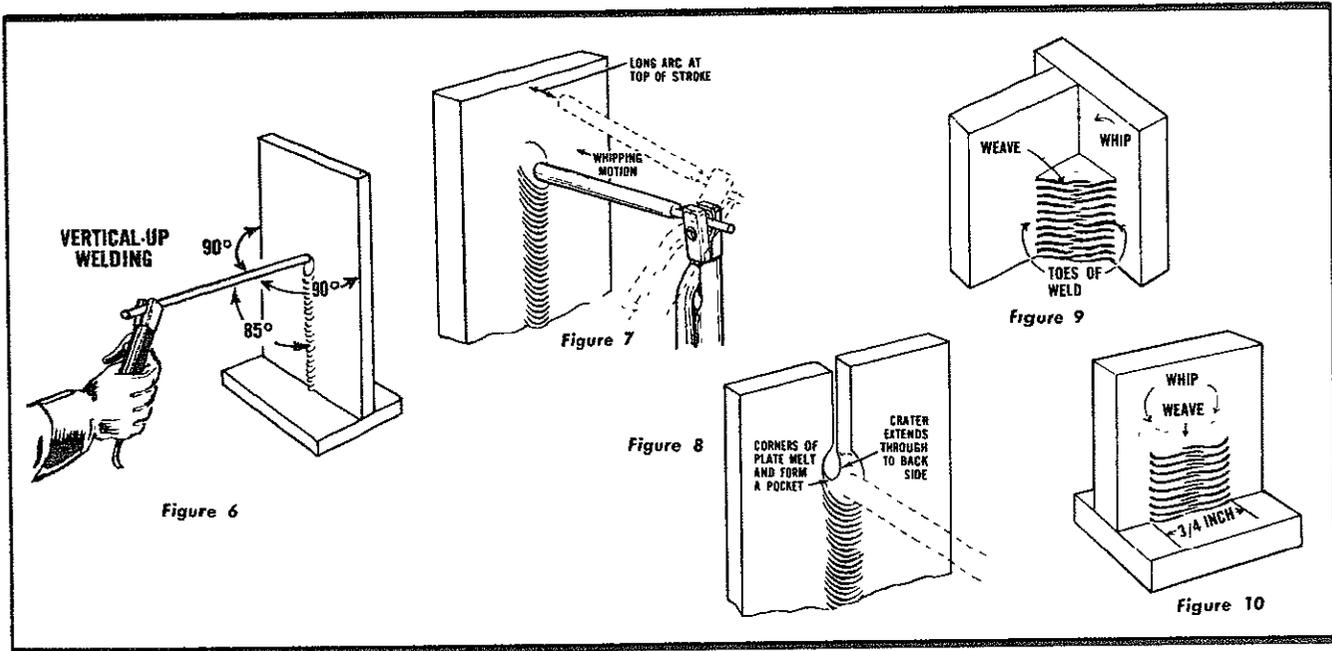
weld, run a few practice beads to get the "feel" of the arc. Tack-weld a piece of scrap iron to an old practice plate so it is positioned vertically (fig. 3). Use 1/8-inch rods for the first welds and a current of about 75 to 115 amperes. Experiment with various amperage settings until you are using the highest current you can handle. Hold the rod at right angles to the plate laterally, with the tip pointed up at the angle shown in figure 3. Start the weld at the top of the plate and move the rod in a straight line downward. The correct rate of travel can be determined by gradually reducing the speed until molten metal in the puddle can no longer be kept in place. Then, increase the speed slightly while watching the puddle, arc length and angle of the rod. A short arc provides better control of the molten metal. Follow the same procedure with 3/32 and 5/32-inch rods. It will be noted that the larger the rod the more difficult it is to control the puddle. For this reason smaller diameter rods are always used for position welding.

Lap or tee-joints are made by simply directing the arc into the corner of the joint as in flat welding and moving the rod down the seam at a steady pace. Butt welds may require more practice, as there is a tendency to burn through on light gauge material. If this occurs, continue until the seam is completed and patch the hole by chipping the slag and wire brushing until clean. Then, with slightly lower current, strike an arc on the weld directly above the hole and quickly bring the rod down to the lower rim of the hole to deposit a small amount of metal. Raise the rod for an instant to let the metal solidify and repeat until the hole is welded. Hold a long arc when raising, so there will be no metal deposited except when the rod is lowered. Any hesitation in the rate of travel will cause a "burn through." If this happens repeatedly, lower the welding current.

Leave a slight gap between pieces for butt welds on material over 3/32-inch thick. Inspect the back side after welding for small bead along the seam, indicating complete penetration (fig. 4). Butt joints on material around 3/16-inch thick should be welded on both sides.

Vertical-down welds may be made on heavier material by laying in a number of passes (fig. 5), however, this practice is not recommended as it takes longer than a heavier single-pass weld made by the vertical-up method.





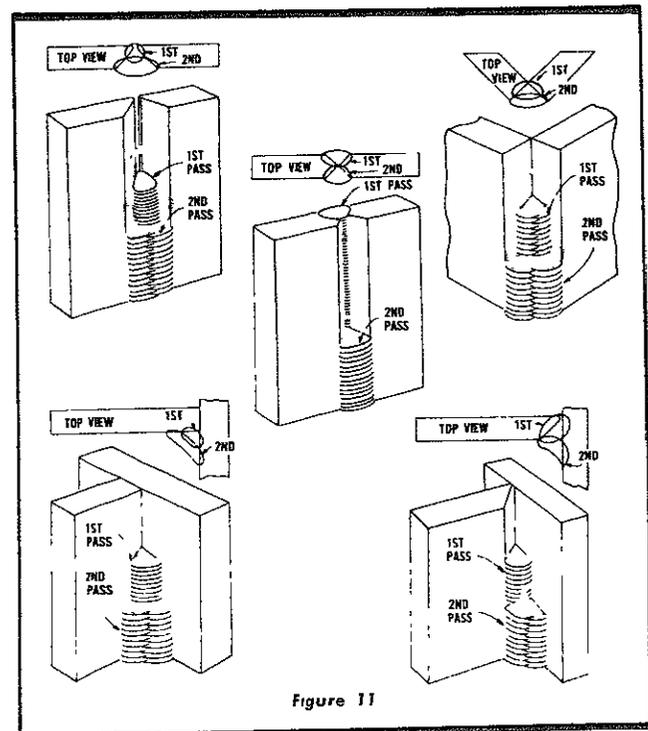
Use 1/8 and 5/32-inch rods for all vertical-up welds and start by running practice beads from bottom to top of a 3/16 or 1/4-inch plate, tack-welded in a vertical position. Hold the rod as shown in figure 6, noting that the angle of the rod is not as steep as for vertical-down welding, but tilted just slightly (approximately five degrees) so the tip of the electrode points upward. Strike and hold a short arc until a small amount of metal is deposited, then quickly raise the rod upward with a wrist movement to increase the length of the arc at the top of the stroke (fig. 7). As soon as the metal deposited in the crater has solidified, bring the rod down and deposit more metal. Keep repeating this whipping motion, while gradually moving the rod upward and toward the plate as the electrode burns off. The length of the stroke will depend upon the amount of metal deposited and the welding current used. Keep the rod in constant motion once it has left the crater. The purpose of a long arc is to prevent any metal from being deposited except when the rod is held at the crater. If globules of molten metal drop from the tip of the rod when the arc is lengthened, either the current is too high or the rod has remained away from the crater too long. Care should be taken not to break the arc at the top of the stroke. Do not deposit too much metal at one time as this will cause the weld to sag and result in a high narrow bead undercut along the sides. Better penetration can be had by the vertical-up method. This can be demonstrated by joining two pieces of 3/16-inch metal with a butt weld, using the whipping motion. Leave a gap between the plates and use a 5/32-inch rod with a fairly high current, determined by experimenting. The whipping motion will melt the corners of the plate and form a pocket in which to deposit the weld metal (fig. 8).

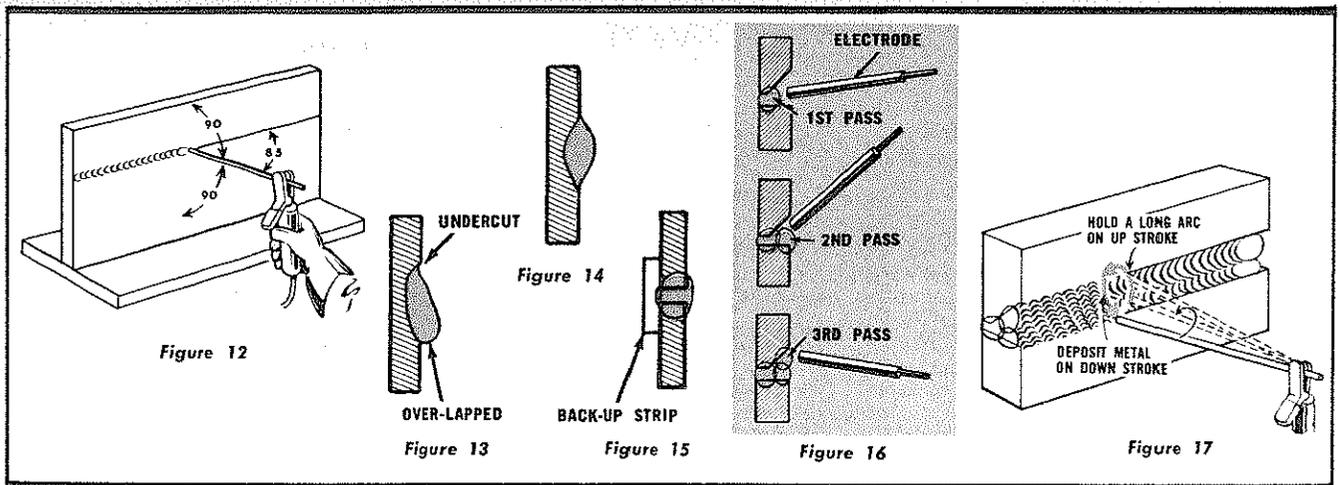
Burn the rod in deep so the crater extends through to the back side. After completing the weld, inspect the back side for the small bead, which indicates 100-percent penetration. Butt welds on heavier materials should be welded on both sides.

On materials up to 1/4-inch thick, use the whipping motion on small single-pass fillet welds for lap and tee-joints. Larger single-pass fillet welds can be made by the whipping motion with a slight side-to-side weave added and combined with the up and down movement to make a triangular shaped

weave (fig. 9). This will produce a "shelf" upon which additional metal is deposited intermittently as the welding progresses. There should be a slight pause in the weaving motion at the toes of the weld to avoid making a bead that is too convex. Materials 1/4-inch and thicker must be beveled on one or both sides, depending upon the joint.

Practice making a wide bead using a side-to-side weaving motion with a very slight whipping action at each end to give the metal at each end a chance to solidify and avoid undercutting along the sides of the weld (fig. 10). This type of bead is used on welds that require more than one pass and is called the finish bead or "wash" pass. Hold a short arc, making the bead approximately 3/4-inch wide and fairly light. Multiple vertical welds may be made as shown in the series of diagrams, figure 11.





## HORIZONTAL WELDING

Horizontal welding refers to one type of butt weld between two plates in a vertical plane. For practice, set up a plate as for vertical welding and run straight beads across from left to right (fig. 12). Use the same current settings as for vertical-down welding and hold the rod as indicated with a short arc. Move the rod in a straight line and deposit a light bead. The rate of travel will depend upon the current used. Too slow a travel will cause the bead to sag (fig. 13). Practice with 3/32, 1/8 and 5/32-inch rods until a well formed bead can be made with each size rod (fig. 14).

Sheet metal up to 1/16-inch thick can be butt welded from

one side. If the seam has numerous gaps, use a back-up strip, allowing a slight gap between edges of 1/8-inch thick metal and weld from both sides (fig. 15). All metal 3/16-inch thick and over should be beveled and welded with a number of passes (fig. 16). Thoroughly clean each bead before laying the next and use higher current than for single-pass welding.

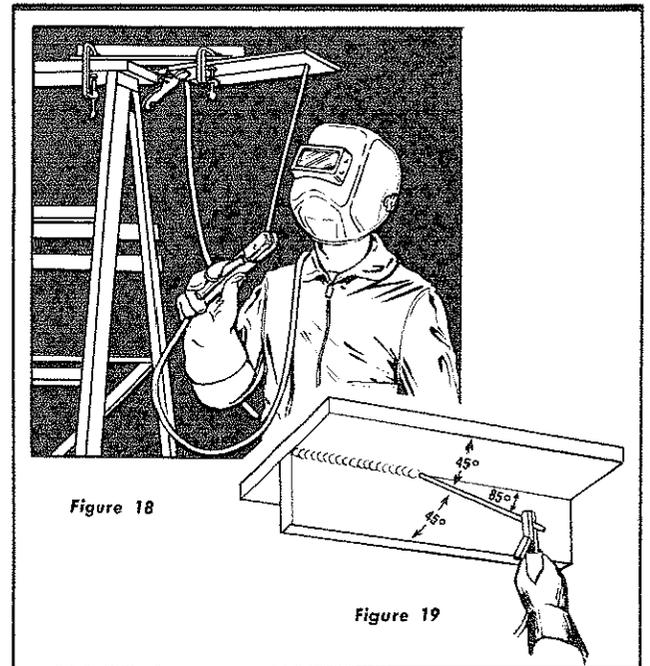
The appearance of a multiple-pass horizontal weld can be improved by vertical down beads laid closely together. Use a swift circular motion to the right; slowly downward while welding (fig. 17).

## OVERHEAD WELDING

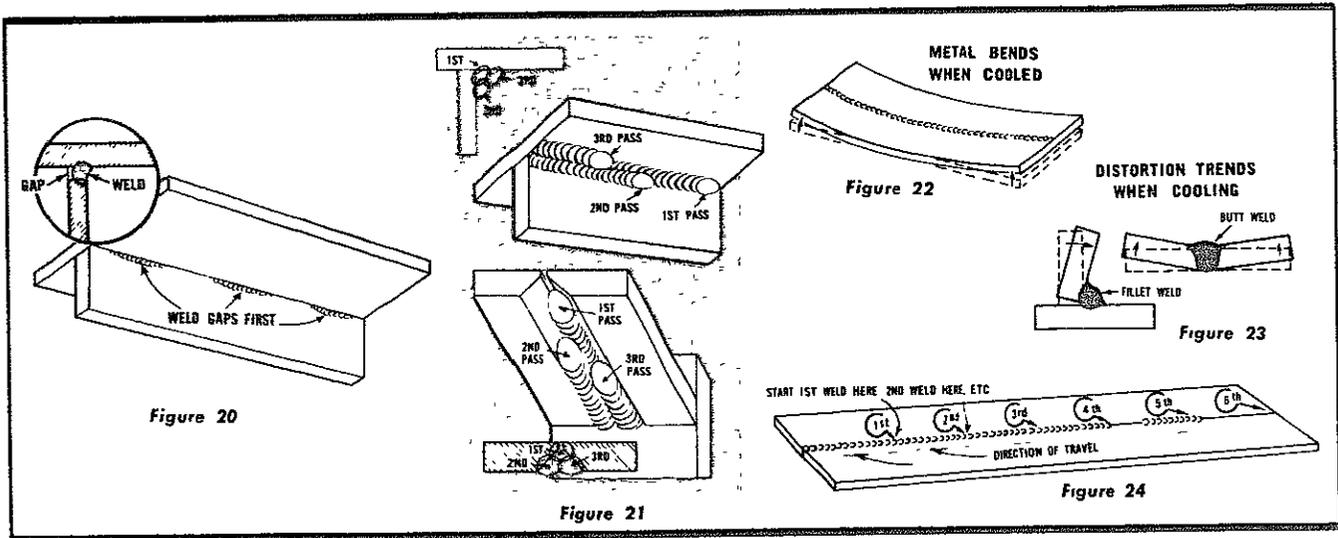
Although overhead welding is generally considered difficult, do not become discouraged, as it is being done every day by people who have taught themselves. Once the art of maintaining a short arc has been mastered, the rest will be easy.

Since there will be a shower of sparks, wear a leather jacket and keep the practice plate slightly higher than the top of your head when standing. To keep sparks out of your glove, grasp the electrode holder as indicated in figure 18 and hold the rod in a nearly vertical position with a slight tilt to the right. Drape the cable over your shoulder so its weight will not interfere with the use of the electrode. Use 1/8-inch rods and a current setting the same as for vertical welding, and move the rod in a straight line without any weaving or whipping motions. A reasonably fast rate of travel must be used to prevent the bead from sagging and undercutting along the edges. Vary the rate of travel and notice its effect on the size and appearance of the weld. When you feel you can run a satisfactory bead, try the side-to-side weaving motion and deposit a thin weld approximately 3/4-inch wide. The movement must be somewhat faster than for other positions to keep the bead from sagging. (This method of weaving is used only for the last pass on heavy welds where improved appearance is necessary.)

The whipping motion is used where a gap exists between the plates as it provides better penetration with higher welding current. For practice work, set up two plates approximately 1/8-inch thick, allowing a gap between them. Burn in deep for good penetration with 1/8 and 5/32-inch rods, varying the plate size and gap distances.



Fillet welds for lap or tee-joints are most common in the overhead position. Tack-weld two pieces of scrap iron together to form a tee-joint, and clamp in the overhead position so one plate is held vertically (fig. 19). Hold the rod at angles indicated and deposit a light bead from left to right without weaving or whipping movements. A slightly higher current than used for overhead butt welds will be necessary to get good penetration at the root of the weld.



To simulate actual conditions tack-weld a piece with an irregular edge to another piece leaving numerous gaps along the joint. Use the whipping motion and deposit a fairly heavy bead, slowing down the rate of travel where the gaps are widest to build up a weld of uniform size throughout its length. If the gaps are rather wide, fill them first, clean off the slag and lay in a fillet weld the entire length of the joint (fig 20)

When you can lay single-pass butts and fillet welds you will be able to make an overhead weld of any size, as it is simply a matter of fusing a number of straight beads together, one on top the other (fig. 21).

Weld appearance can be improved by grinding with a properly guarded abrasive wheel mounted on the end of a flexible shaft.

## EXPANSION AND CONTRACTION

Metals expand when heated; contract when cooled. In arc welding, the deposited metal and edges being joined are molten and the metal surrounding the weld is heated sufficiently to cause expansion. When the deposited metal solidifies, it becomes a part of the plates; but, being unrestricted in its expansion in the molten state, it tends to contract more than the heated surrounding metal. If the

surrounding metal is free to move (not clamped or tacked) it cannot resist these forces and bends (fig 22)

The weld also contracts in width, as well as in length, tending to pull the plates together, resulting in locked-up stresses (fig. 23). This is not too serious when welding mild steel up to 1/2-inch thick, as the ductility and elongation of the metal will permit it to deform slightly to compensate for these forces, and prevent cracking. On sheet metal and light structural members, long continuous welds may cause considerable bending and result in a badly distorted weldment. Fortunately most of this can be avoided by studying the effects of expansion and contraction, as related to the job before welding and working out a procedure to follow. For example: first assemble the job with tack welds, and install temporary braces tack-welded to support parts that might bend. The braces can be removed after the job is completed. Lay the beads so the stresses will counteract or neutralize one another, by running a short pass first on one side then on the other, etc. Often the neutralizing weld is at the other end of the job. Do not concentrate too many welds in one place but space them to distribute the heat and stresses throughout the entire structure. Use intermittent welds whenever possible. If continuous welds are necessary to make a water-tight compartment, use the back-step method as shown in figure 24, fusing each bead together at the end.

## CAST IRON WELDING

Previous experience in handling the arc, plus good judgment regarding expansion and contraction, will enable you to weld gray cast iron successfully in a short time. Two types of electrodes are used, namely: non-machinable for use in cases where the weld does not have to be machined, and machinable which deposits a file-soft weld that can be drilled or machined to close tolerances. Non-machinable rods are used for most repair jobs such as cracked motor blocks, water jackets, pump and gear housings, etc. If the weld must be made across a machined surface that need not be refinished to a close tolerance, the face of the weld may be ground flush with an abrasive wheel.

As cast iron is very brittle, care must be taken to control expansion and contraction, and thus avoid cracking of the

weld or the casting. Because of low tensile strength and lack of ductility it cannot bend, stretch or distort itself to conform to the contraction of the weld metal. In some cases it may be necessary to pre-heat the entire casting before welding. However, as most cast iron welding jobs can be done without pre-heating, this method will be considered first.

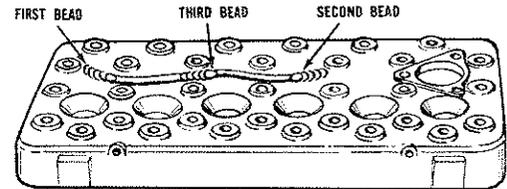
The part must be free of rust, grease, paint or dirt, cleaned by wire brushing, grinding or washing with solvent. The crack should be beveled for penetration. If the parts are broken apart completely, they may be ground on an abrasive wheel to a single or double bevel, depending upon the thickness of parts and whether or not the joint can be welded from both sides. Do not bevel to a sharp edge along the entire crack. Instead, allow approximately 1/16-inch

of the fractured surface to line up the two pieces. Tack-weld or clamp parts in position. If the crack has not separated the casting, a vee-groove can be chipped out with a diamond-point chisel. Chip an inch or so beyond the visible ends of the crack as it may extend under the surface. On cracked water jackets, where only a seal is required, the depth of the groove need only be one-half the thickness of the casting.

Keep the casting as cool as possible and do not expect to complete a weld in cast iron as rapidly as in the same length in mild steel. Use a smaller rod and a slightly higher current than for the same thickness of steel. Lay a short bead, about an inch long, at one end of the crack and peen it immediately with a cross-peen hammer or blunt chisel to spread the weld metal and relieve locked-up stresses. Do not strike the edges of the casting. Place the second bead at the opposite end of the crack and the next in the center, etc (fig. 1). Allow enough time between welding to permit your bare hand to be held on it. Never use water or a blast of air to cool the casting. Although cracks may not show up immediately, the locked-up stresses due to uneven cooling will cause the casting to fail after it is back in service. Wire

brush each bead before depositing the next. Then continue to fill the groove with short weld beads as before, working rapidly when depositing and peening the bead. Allow plenty of time for cooling. Examine the casting for cracks that may develop during cooling periods. If any of the beads crack, chip them out and re-weld. If cracking persists, preheat the entire casting slowly to a dull red heat with an oxyacetylene torch or blow-torch. When the preheated method is used, the welding can be continuous. After completing the weld, cover the casting with warm dry sand or slaked lime so it will cool slowly.

Malleable iron is ordinary gray cast iron that has been heat treated to give it a tough ductile outer skin. The method of welding is the same as for cast iron.



## HARD FACING WORN CUTTING EDGES

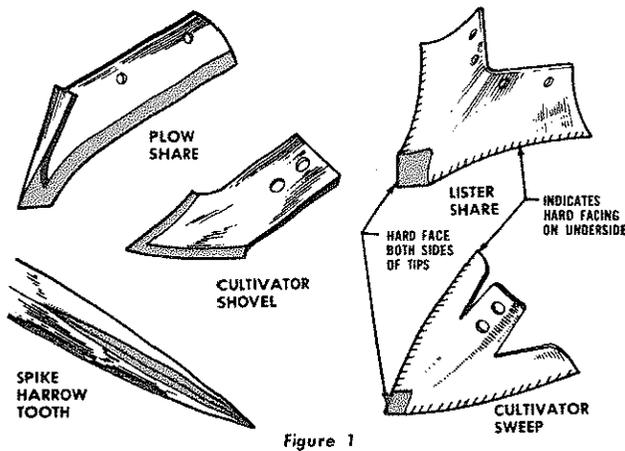
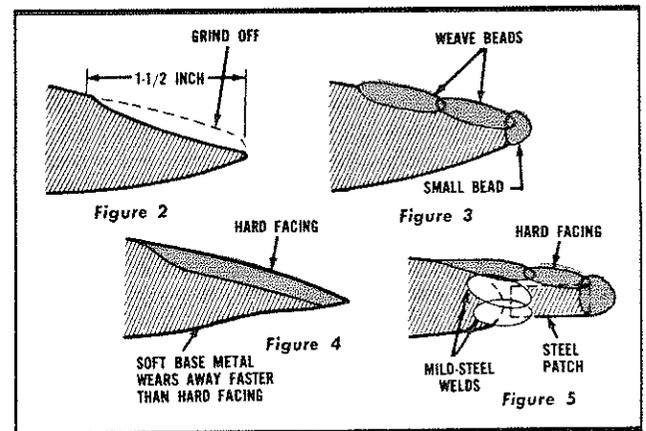


Figure 1

Excavating equipment, earth-cutting farm machinery or others such as plow shares, lister shares, cultivator shovels, sweeps, subsoilers, spike harrow teeth, tractor treads, excavating buckets, or any surface subject to abrasive action will last much longer and require less sharpening when their cutting edges are hard faced with hard surfacing electrodes. The arc welding process consists of depositing a layer of abrasion resisting weld metal on the worn cutting edges as indicated in red on the parts shown in figure 1.

Prepare the part for welding by cleaning the surface to be welded by grinding it approximately 1-1/2 inches back from the edge (fig. 2). Position the part so weld metal can be deposited in the flat position. If the material is 1/4-inch thick or less, use a 1/8-inch rod and as low a current as possible that will still permit the metal to flow out smooth and fairly thin (1/16 to 1/8-inch thick). Weave the rod from side-to-side in a crescent-shaped movement and deposit a bead about 3/4 to 1-inch wide. Several passes (laid side-by-side) may be necessary where the worn surfaces are quite wide. In some cases a small straight bead



must be deposited along the edge to build it up (fig. 3). Make beads heaviest where the wear will be greatest, but avoid excessive build-up as the metal cannot be filed or machined. If shaping is required, heat the weld metal and forge it. Smoothing and sharpening can be accomplished by grinding.

For plow and lister shares, cultivator shovels and similar cutting points, deposit the weld metal on one side only which will result in a self-sharpening edge (fig. 4). The softer base metal on the other side will wear away first and leave a knife-like edge of hard facing material. Parts that must wear uniformly on both sides should be hard faced on both sides. The condition of the worn part must also be taken into consideration. If the part requires a number of passes to bring it up to the desired thickness, use mild-steel welding rods first; then cover with deposited metal from hard surfacing rods. If the edge is entirely worn away, a steel patch (cut to fit) may be welded in place with mild-steel electrodes, then hard faced (fig. 5). To prevent distortion when hard facing small parts, peen the deposited weld metal before it cools.

# THE TWIN-CARBON ARC TORCH

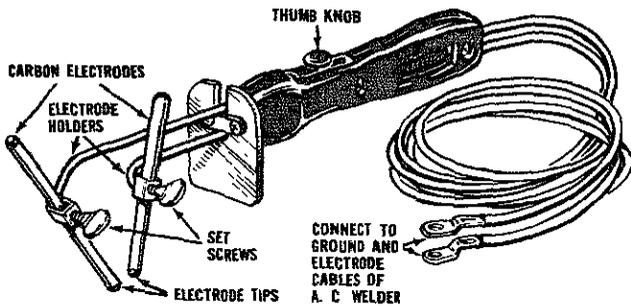


Figure 1

Work ordinarily done with a gas welding torch is possible with the twin-carbon arc torch connected to an A.C. welder. The carbon-arc flame is similar to the flame of a gas welding torch in that it provides heat by radiation, rather than by direct arc between work and electrode. This flame heat greatly widens the scope of work possible with the arc welder for brazing, soldering, welding of non-ferrous metals and localized heating for bending, forging and hardening.

The arc torch (fig. 1) consists of an insulated handle with two projecting carbon electrode holders, one of which is adjustable to permit striking and breaking an arc at the carbon tips. A thumb knob on the handle performs the adjustment and operates a shut-off switch built into the handle. There are no valves or gauges that require fine adjustment as with an oxyacetylene torch. The same protective equipment used for ordinary arc welding is used when operating the carbon-arc torch.

A wide selection of flame heats may be had by varying the current and size of the carbon electrodes. Although the actual temperature of the arc remains the same for any current setting, the volume of transferable heat increases with an increase in amperage. However, amperages in excess of those given below will only cause short carbon life.

1/4-in. carbons . . . . .	30 to 40 amperes
5/16-in. carbons . . . . .	40 to 65 amperes
3/8-in. carbons . . . . .	65 to 90 amperes

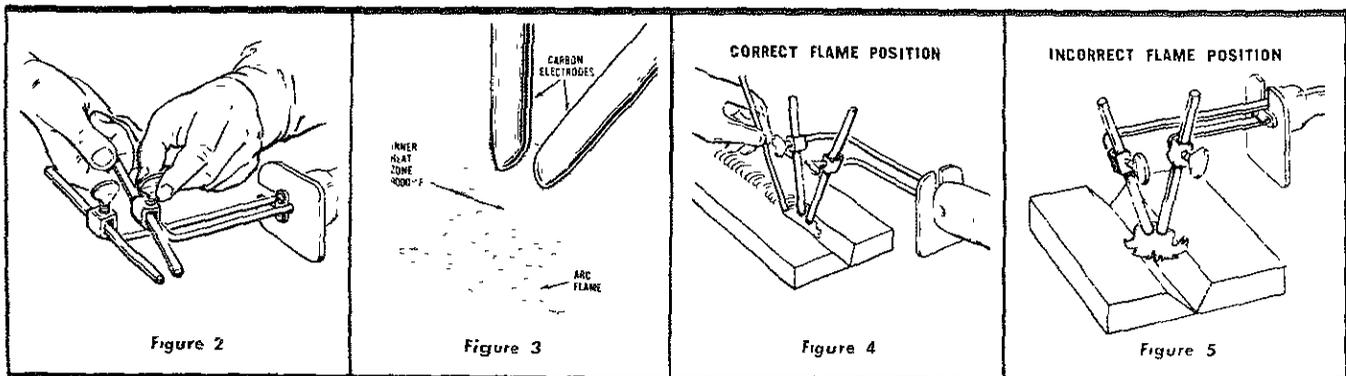
To prepare the torch for use, connect its two cables to the ground and electrode cables of the welding machine. Grounding of the work is not necessary as the operation of the arc flame is entirely independent. With the thumb knob on the handle in the "off" position, insert two 3/8-inch carbon electrodes in the holders and clamp in place at approximately one-half their length (fig. 2). Do not clamp them on or near the ends opposite from the arc as this will cause overheating of the carbons. When tightening the clamping screws, be careful not to apply too much pressure on the carbons, as they are very brittle and break easily. Use only enough pressure to hold them firmly in place. If the tips of the carbons do not line up with each other, an adjustment may be made by turning the longest of the electrode holders slightly, too much turning will loosen it, and make it necessary to disassemble the torch to again tighten it properly.

Do not make any turning adjustments with the sliding holder as this would spoil the contact tension in the switch.

To strike the arc, turn on the welding machine and set it for approximately 70 amperes. Lower the welding helmet and hold the torch up to silhouette it against the light of a window. Slowly move the thumb knob forward until contact is made between the tips of the carbons. This will start the arc. Then immediately move the knob back to increase the gap between the carbons. The actual distance can be determined with a little practice. When the carbons are too close the arc flame will have a sharp crackling noise. As the distance between the carbons is increased, the crackling will change to a soft purring sound which indicates the best arc flame. There are two heat zones and the small inner zone is by far the hottest, having an estimated temperature of 9000 degrees Fahrenheit (fig. 3).

The shape of the flame greatly influences the way in which it must be used. For example, on beveled work the torch should be held parallel to the groove so the flame will reach the bottom (fig. 4). If held at right angles to the groove, the flame straddles the groove and the heat will not reach the bottom (fig. 5). Filler rods, as for gas welding, must be used on joints of this type.

The soft, bushy flame is pressureless and has no tendency to blow the molten metal. This is a distinct advantage when welding thin sheet metal. Joints on light material should be



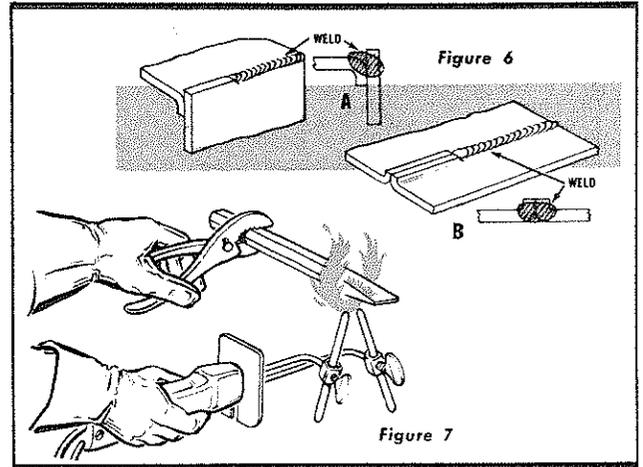
bent and edges fused together by melting down the excess metal to form a bead (fig. 6). No filler rods are required. The carbon-arc torch is ideally suited for brazing and soldering small tubing.

Cast and malleable iron can be brazed with excellent results. A bronze filler rod and common brazing flux are used. Rust, paint or grease must be cleaned from the area to be brazed. If it is a butt joint, such as a crack in a casting, grind or chip out a beveled groove as for arc welding. Apply the heat from the arc flame gradually by passing it over the metal surrounding the joint. When the casting has become warm, concentrate the arc flame at the joint. The important thing to remember when brazing cast iron is never to heat the edges of the joint to the melting point. The temperature of the work should not exceed the melting point of the filler rod. The carbons are held as close to the work as possible without causing the metal to bubble. Hold the filler rod in the left hand and heat the end of it slightly by passing it through the arc flame. Then dip the heated end in brazing flux. Raise the torch slightly and deposit some of the flux at the part of the joint being heated. When the surface of the heated metal takes on a shiny or wet appearance, the filler rod can be applied.

Do not put the rod directly in the flame, but hold it on the work and let the heat of the edge of the flame and the work melt the rod. Deposit only enough metal to fill the part of the joint that has been coated with flux. As the metal is being deposited, move the torch along the joint slowly, applying flux to the rod and joint as required.

Copper and copper-base alloys such as bronze and brass may also be brazed, but as their melting temperatures are so close to the melting point of the filler rod, the process in many cases becomes one of welding rather than brazing. A bronze filler rod and common brazing flux are used.

Most non-ferrous metals can be welded by manipulating the torch and filler rod in the same manner as for brazing, with the exception that the edges of the joint are heated to the melting point before depositing the filler metal. If the work is a copper alloy, use common brazing flux. If it is an



aluminum alloy, use aluminum flux. The filler rod should be of the same analysis as the work. If regular welding rod is not available, strips of the parent metal may be used. A back-up strip should be used when welding thin material.

Small diameter carbons and low amperage setting are used for soldering. The torch is held so the work is just within the visible edge of the flame. Apply the soldering flux and play the flame over the work until it is just hot enough to melt the solder. If the joint is to be sweat-soldered, tin the surfaces to be joined, then press them together and reheat, adding more solder at the edges of the joint.

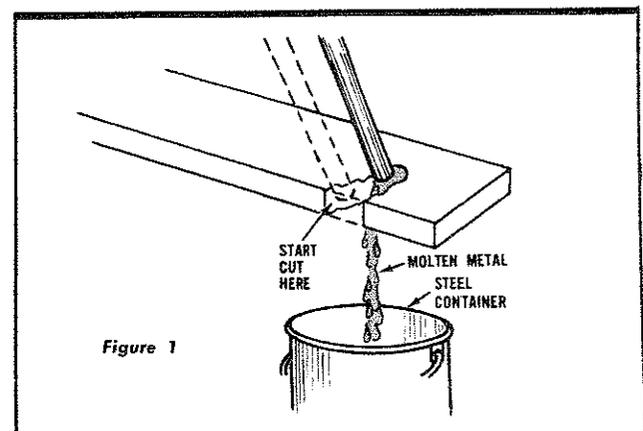
One of the most practical uses of the arc torch is heating metal for bending, forging, etc. Set the torch for a wide, enveloping-type flame and apply the heat to the bottom of the work (fig. 7). Since a red heat is not visible through the dark welding glass, the helmet must be raised periodically so the work can be inspected to avoid overheating. To protect the eyes from the rays of the arc, hold the torch to one side and above your head. The carbon-arc torch is not recommended for welding mild-steel. However, it may be used for brazing mild-steel if the metal is too thin for regular metallic-arc welding.

## CUTTING

and other miscellaneous operations

### CUTTING WITH THE ELECTRIC ARC

Arc cutting is simply the continuation of a "burn through" such as you probably experienced when practicing with light sheet-metal welding. When this action is accelerated by using extremely high currents, it becomes an efficient method of cutting metals. Although the edges of the cut surfaces are not as smooth as when cut with a saw or oxyacetylene torch, there are many cases where such precision is not required. Ordinary mild-steel welding rods may be used. The current will vary with the type and thickness of the material. In general, high currents increase the speed of cutting but also increase the rod burn-off rate and width of the cut.



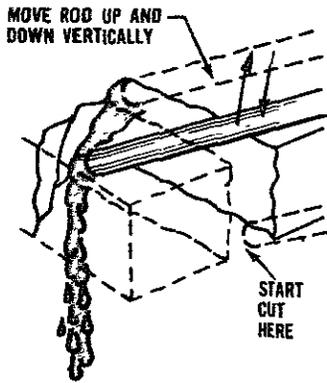


Figure 2

To make a trial cut, place a bar of steel approximately 1/4-inch thick on the table so that one end projects over the edge. Use a 3/32-inch rod and a current setting of around 140 amperes. Hold the rod as shown in figure 1 and strike an arc on the top corner at the edge of the bar where the cut is to be made. Feed the rod into the molten puddle and keep the crater burning through as the rod is moved across the bar. To catch the molten metal, place a metal container on the floor directly under the cut.

When cutting metal heavier than 1/4-inch, the arc is started at the bottom corner and worked up and down vertically as shown in figure 2, advancing the bottom of the cut slightly ahead of the top of the cut to permit molten metal to run out more easily. If a smooth edge is desired, the pieces can be ground on an abrasive wheel. Electrodes designed especially for cutting may also be used.

## REMOVING SEAMS

In addition to cutting, the electric welding arc can be used for beveling the edges of material to be welded, gouging out cracked welds for rewelding or removing tack-welds. The surface of the metal being worked upon should be approximately in the vertical position, or tipped slightly toward the arc (fig. 3). Start at the bottom of the seam to be gouged out and work upward. The rate of speed will depend upon the depth of the groove and the amount of metal removed.

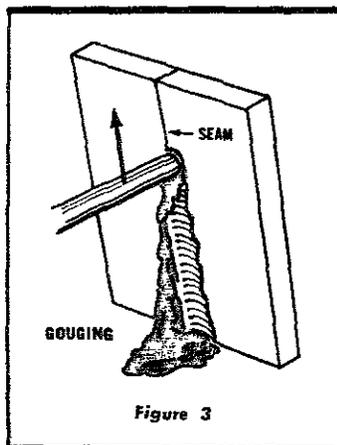


Figure 3

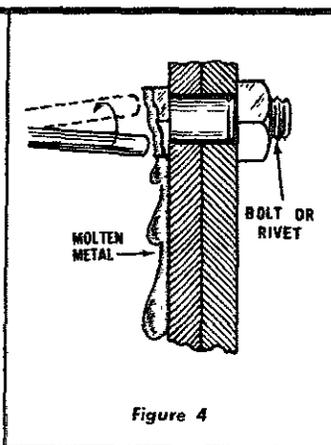


Figure 4

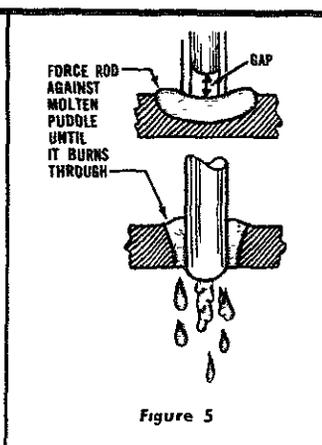


Figure 5

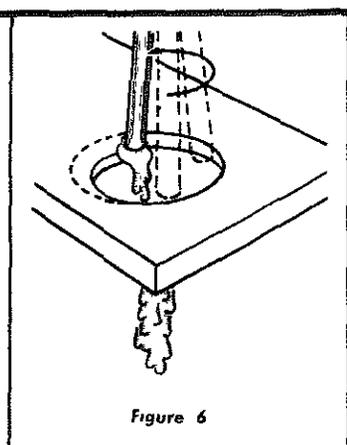


Figure 6

## BOLT AND RIVET CUTTING

Removing rusty bolts or rivets is an easy job with an electric arc welder. The arc is struck on the head or nut of the bolt and worked around in a slight circular movement until the head is completely melted off (fig. 4). A punch is then used to drive out the remaining part. The bolt or rivet can be removed by heating the head almost to the melting point, then quickly shearing it off with a cold chisel. Care must be taken not to cause the bolt to become welded to the metal.

## HOLE PIERCING

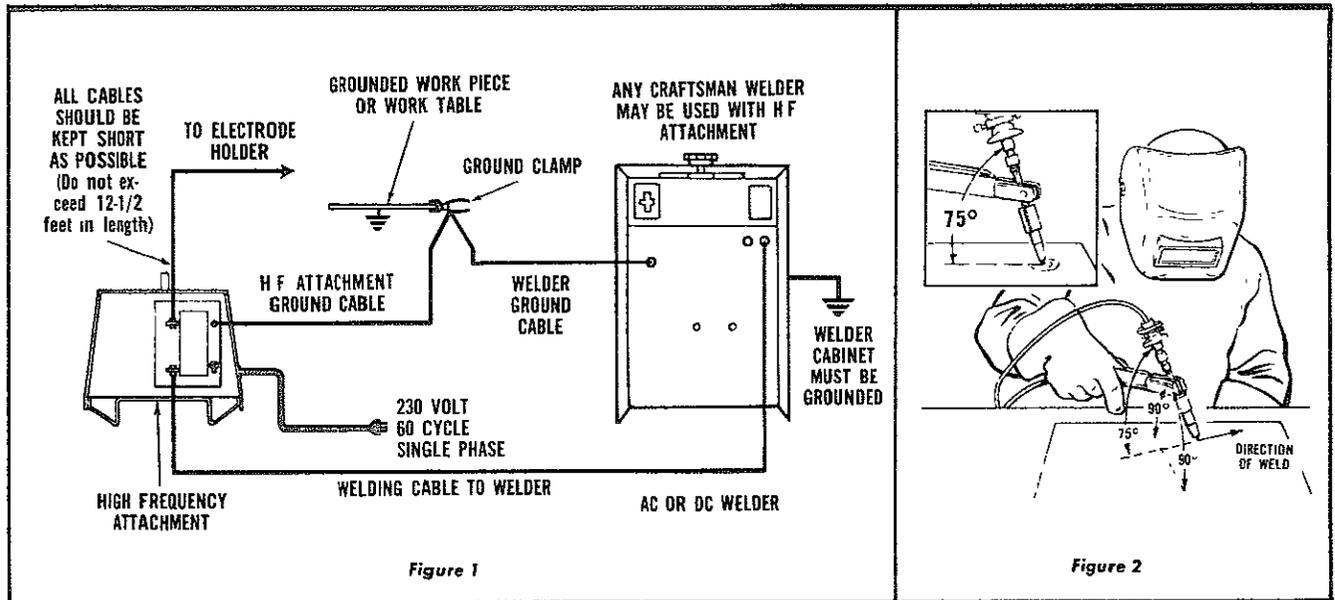
Another useful application of the welding arc is piercing holes in metal. Coated metallic electrodes are best for this purpose because of their small size and insulation afforded by the coating. The process is extremely fast and a surprisingly clean circular hole can be made. For practice, place a piece of scrap iron 1/4-inch thick (or less) on the table and allow it to project over the edge as for arc cutting. Use a 3/32-inch rod and the same current as for cutting. At the place where the hole is to be pierced, strike an arc and hold it until a molten puddle is formed. Then push the electrode down against the molten puddle and force it through the plate. It is possible to hold the electrode against the melted plate because the metal core melts off faster than the coating. The coating (not the rod) touches the molten metal (fig. 5). The gap maintained by the protruding coating prevents the metal core of the electrode from sticking or freezing to the plate.

If a larger diameter hole is desired, first pierce a hole as described. Then, holding a fairly long arc, melt the edges of the hole away by moving the rod around it (fig. 6). Holes of almost any diameter can be made. To pierce a hole through material thicker than 1/4-inch, work from the underside.

## HEATING

The carbon arc provides a convenient method for localized heating of all metals. Simply strike an arc on the part to be heated and "play" it across the surface until the required temperature is reached.

# INERT-GAS METAL-ARC WELDING (Nonconsumable)



## HIGH FREQUENCY ATTACHMENT

The Craftsman, High-Frequency Attachment may be used with any Craftsman welder or other single-phase, transformer-type welder of high quality construction having an AC, or AC/DC power output Tungsten inert gas (T.I.G.) welding has many useful and advantageous applications as described in the following paragraphs. In order to use the T.I.G. process with an AC welder, a high-frequency attachment must be provided. Figure 1 shows a typical hookup using this high-frequency attachment with a Craftsman welder. When not using the T.I.G. welding process, the high-frequency attachment also permits easy "arc" starting and greatly improved results with many hard-to-weld rods (low hydrogen rods) as well as making the welding operation much easier to perform.

The use of a high-frequency attachment makes possible the establishment of an arc without touching the electrode to the work. Once the arc has been established, it is stabilized by the high-frequency output. This is essential in the T.I.G. process in order to avoid contaminating the tungsten electrode or the work.

## PRINCIPLES OF OPERATION

The necessary heat for inert-gas welding (nonconsumable) is produced by an electric arc maintained between the non-consumable electrode and the work-piece. The electrode used for carrying the current is usually a tungsten or tungsten alloy rod. The heated weld zone, the molten metal and the nonconsumable electrode are shielded from the oxidizing effects of the atmosphere by a blanket of inert gas fed through the T.I.G. torch and the weld is made by applying the arc heat until the abutting edges of the work-pieces are melted, adding filler rod if necessary. The resultant pool of molten metal, upon solidifying, joins the edges of the members together. The process may also be used for adding metal to surfaces, locally-melting and spot-joining parts.

A thorough cleaning of the surface to be welded is required.

All oil, grease, paint, rust, dirt or other contaminants must be removed either by mechanical means or by the use of vapor or liquid cleaners. Files, chisels and stainless wire brushes may be used. Grinding is not recommended. Liquid cleaners such as naphtha, mineral spirits, alcohol, acetone and methyl-ethyl-ketone can be used. All surfaces must be wiped dry with a clean cloth. Cleaners should not be used after a joint is assembled prior to welding.

Striking the arc may be accomplished as follows:

1. Touching the electrode to the work momentarily and quickly withdrawing it a short distance. (DC power source)
2. Use of an apparatus which will cause a spark to jump without touching the electrode to the work. (AC power source with high-frequency unit attachment)

The high-frequency arc stabilizer provides for this latter method of starting the arc. Such devices are not required with DC, consequently it is usually necessary to touch the electrode to the work to start the arc.

For manual welding, once the arc is started, the electrode holder is held with the electrode positioned at an angle of about 75 degrees to the surface of the weld puddle as shown in figure 2. To start the welding, the holder is usually moved in a small circle until a pool of molten metal of suitable size is obtained. Once adequate fusion is achieved at any one point, a weld is made by gradually moving the electrode along the parts to be welded to melt the adjoining edges progressively, adding filler rod as required. Solidification of the melted metal follows progression of the arc along the joint and completes the welding cycle.

Material thickness, joint design and weld characteristics desired will determine whether or not filler metal should be added to the joints. When filler metal is added during manual welding, it is applied by hand feeding the filler rod (from the side) into the pool of molten metal in the region of the arc. Filler rod is added in essentially the same manner when welding by the oxyacetylene method.

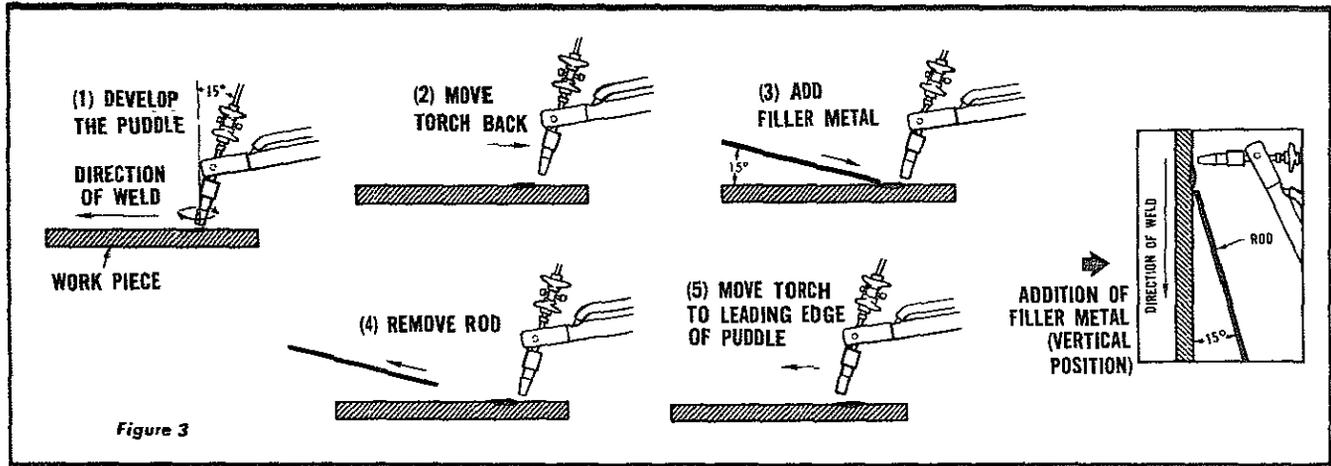


Figure 3

The filler rod is usually held at an angle of approximately 15 degrees to the work and slowly fed into the weld puddle. One of the most commonly used techniques for feeding filler rod is shown in figure 3. Another method, used most often in multiple-pass welding of vee joints, is to press the filler rod into the vee groove in line with the weld and melt it along with joint edges. Still another method, used frequently in making large welds, is to feed filler metal continuously into the weld puddle by oscillating the filler rod and arc from one side of the weld to the other. The filler rod moves in one direction while the arc moves in the opposite direction, but the filler rod is at all times in close proximity to the arc and feeding into the weld puddle.

Joints may be welded by the T.I.G. process include all standard types, such as square abutting edge, vee butt, tee and lap connections. It is seldom necessary to bevel edges of material 1/8-inch or less, although heavier materials are usually beveled. Whenever joints are beveled, filler material must always be added.

The accompanying table provides a guide to the type of current recommended for welding some typical materials. Electrodes used for the T.I.G. (nonconsumable) process may be pure tungsten or tungsten alloy. Pure tungsten electrodes were formerly used exclusively. At this time, however, many

electrodes are alloyed with small percentages of thorium or zirconium. Such electrodes have the advantage of greater current-carrying capacity for a given diameter, a more stable arc at low current values, and longer life with less deposit of tungsten in the welds.

### TYPES OF GAS TO USE

Either argon, helium, or a mixture of the two can be used with the T.I.G. process. Argon is used most frequently because:

1. It provides general suitability with a wide variety of metals.
2. It maintains a stabilizing influence on the welding arc
3. It costs less (due to the lower flow rates required).

Helium is generally used when welding heavy metal sections because it provides greater weld penetration. Mixtures of argon and helium are useful when a balance of these characteristics is desired.

Argon is generally supplied in K-cylinders, having a capacity of approximately 238 cubic feet at a pressure of 2200 psi, or in T-cylinders, having a capacity of approximately 330 cubic feet at a pressure of 2640 psi. Purity of commercial argon ranges between 99.95% and 99.99%.

### Current Selection for Inert-gas (nonconsumable) welding

Material	Alternating Current*			Direct Current						
	Stabilized			Straight Polarity			Reverse Polarity			
	Excellent	Good	Not Recommended	Excellent	Good	Not Recommended	Excellent	Good	Not Recommended	
Magnesium up to 1/8-in thick	✓					✓		✓		
Magnesium above 1/8-in thick	✓					✓		✓		
Magnesium castings	✓					✓		✓		
Aluminum up to 3/32-in thick	✓					✓		✓		
Aluminum over 3/32-in thick	✓					✓		✓		
Aluminum castings	✓					✓		✓		
Stainless steel	✓					✓		✓		
Brass alloys		✓				✓		✓		
Silicon copper		✓				✓		✓		
Silver		✓				✓		✓		
High-chromium, nickel-base, high temperature alloys		✓				✓		✓		
Silver cladding		✓				✓		✓		
Hard facing	✓					✓		✓		
Cast iron		✓				✓		✓		
Low-carbon steel, 0.015 to 0.030 in †		✓				✓		✓		
Low carbon steel 0.030 to 0.125 in		✓				✓		✓		
High-carbon steel, 0.015 to 0.030 in		✓				✓		✓		
High-carbon steel, 0.030 in and up		✓				✓		✓		
Deoxidized copper‡		✓				✓		✓		

\* Where alternating current is recommended as a second choice, use about 25% higher current than that recommended for DCSP  
 † Do not use alternating current on tightly jugged parts  
 ‡ Use brazing flux or silicon bronze flux for 1/4 inch and thicker

# WELDING ROD SPECIFICATIONS

## AWS E-6011 MILD STEEL AC-DC

**GENERAL APPLICATIONS:** Farm Equipment • Sheet Metal • Car and Truck • Body and Fender • Pipe • Tanks • Maintenance • Jigs and Fixtures • Cabinets • General Repairs • Structural Steel

### SIZES AND HEATS (AMPS)

Diameter . . . .	1/16"	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"
Flat	20-55	20-80	75-130	100-175	150-225	175-250	200-375
Vertical	20-55	20-65	75-115	100-150	150-200		
Overhead	20-55	20-65	75-115	100-150			

### SPECIFICATIONS

**MEETS THESE REQUIREMENTS** 
 American Welding Society . . . . . Class: E-6011  
 Military . . . . . MIL-E-15599C  
 American Bureau of Shipping . . . . . Class: E-6011

Physical Properties of Deposited Metal:	As Welded	Stress Relieved
Tensile Strength . . . . .	70,000 to 75,000 psi	65,000 to 70,000 psi
Yield Point . . . . .	60,000 to 65,000 psi	55,000 to 60,000 psi
% Elongation in 2-inches . . . . .	23% to 25%	30% to 35%
Reduction in Area . . . . .	50% to 55%	65% to 75%

### DESCRIPTION

The AWS E-6011 is an AC-DC (reverse polarity) electrode with a special coating that provides strong fluxing action for high quality welds, even in dirty, rust covered, galvanized or plated steels. An extremely stable, spray type penetrating arc, is produced that is easy to start and restart after interruption. It is a versatile electrode, producing welds far beyond the requirements of its A.W.S. classification. It adapts to a wide variety of jobs due to the wide range of amperage settings at which top quality results are obtained.

**Features:** Deeper Penetration – Fast-Freeze Puddle – Greater Arc Stability.

**WELDING PROCEDURE:** Weld with AC or DC (reverse polarity). Strike the arc by brushing rod tip lightly at the point where weld is to be made. After the arc is established and weld material is deposited, concentrate on holding a short arc that is just long enough to keep the electrode from touching the molten metal. In the flat position, use a slight oscillating motion as you advance. In vertical position, on sheet steel start at the top of the seam and weld down. This provides a more rapid speed of travel, lower penetration, and minimum warpage. When welding overhead use a straight stringer bead or a circular motion. Keep the molten pool as small as possible. Use small electrodes overhead, none larger than 5/32 diameter.

# WELDING ROD SPECIFICATIONS

---

## AWS E-6013 MILD STEEL AC-DC

multi-purpose all position

**GENERAL APPLICATIONS:** Farm Equipment • Car and Truck • Sheet Metal • Pipe • Tanks • Boilers • Structural Steel • Maintenance Repairs • General Repair Work

### SIZES AND HEATS (AMPS)

Diameter	5/64"	3/32"	1/8"	5/32"	3/16"	1/4"
Flat	20-55	20-75	75-130	100-175	150-225	200-375
Vertical	20-55	20-65	75-115	100-150	150-200	
Overhead	20-55	20-65	75-115	100-150		

### SPECIFICATIONS

**MEETS THESE REQUIREMENTS** American Welding Society . . . . . Class E-6013  
 Military . . . . . MIL-E-15599C  
 & MIL-E-6843A  
 American Bureau of Shipping . . . . . Class E-6013

Physical Properties of Deposited Metal	As Welded	Stress Relieved
Tensile Strength . . . . .	75,000 to 80,000 psi	65,000 to 70,000 psi
Yield Point . . . . .	62,000 to 67,000 psi	50,000 to 60,000 psi
% Elongation in 2-inches . . . . .	20% to 29%	27% to 35%
Reduction in Area . . . . .	40% to 55%	60% to 70%

### DESCRIPTION

The AWS, E-6013 is a general purpose mild steel electrode for use with AC or DC. It produces a very stable, easily handled arc throughout a wide amperage range. The moderately penetrating and easily directed arc provides excellent results in all positions (flat, vertical or overhead) and is ideal for single pass horizontal fillet welds. Spatter loss is low, as the weld metal solidifies quickly producing a closely rippled deposit with good appearance.

Even though it is designed for production welding in mild steel fabrication, this rod is excellent for multi-purpose use where sound durable welds are required.

The arc is easily started, even at low amperage settings for light gauge steel, yet is stable at the high amperages needed for higher welding speeds, and for heavier sections

Use with AC or DC (see recommended amperages) Hold a short arc, just long enough to keep the electrode from touching the molten metal. In flat position single pass fillets or butt welds may be made with or without weaving. Weld from bottom up on vertical welding of heavy sections. Welding down on light material or fillets produces excellent results. Use 5/32-inch or smaller electrodes for overhead work, making either stringer or weaving beads.

# WELDING ROD SPECIFICATIONS

---

## HARD SURFACING AC-DC

medium chrome-carbon electrode

**GENERAL APPLICATIONS** Tractor Grouzers and Rollers • Scraper Blades • Agricultural Implements • Plow Shares • Hitches • Power Shovel • Dipper Teeth and Drive Sprockets • Coal Cutters • Conveyor Rolls • Mining Buckets • Rock Crushers • etc

### SIZES AND HEATS (AMPS)

Diameter	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"
Amperes	55-85	100-130	130-150	175-200	175-250	225-275

### SPECIFICATIONS

MEETS THESE REQUIREMENTS Military . . . . . MIL-E-19141C

**Physical Properties of Deposited Metal**

As Welded Condition (Rockwell "C" 46-50)	450-500 Brinell Hardness
After Cold Working (Rockwell "C" 50-54)	500-550 Brinell Hardness

### DESCRIPTION

The Medium Chrome-Carbon rod is a hard-surfacing alloy steel electrode with a coating of powdered metals and flux. When welding, this special coating combines in the arc with the steel core wire to give an extremely hard weld-metal deposit. Deposited weld metal requires no heat treatment for maximum strength, ductility, and wear resistance. Annealing or heat treating will not soften the metal deposit, which is not machinable, but may be hot forged to any desired shape. Deposited metal has a very fine grain and is free of slag and porosity. The metal is tough and highly resistant to wear and impact.

The rod is designed for use with either AC or DC (either polarity). Hold a medium short arc and deposit the metal with a weaving motion. Excellent welding results are obtained in either the vertical or flat position.

**WELDING PROCEDURE:** Grind the surface to clean and remove shallow cracks, rust, or other foreign material. Cracks too deep to be removed by grinding should be gouged out with a cutting torch or cutting rod. Use the "drag" technique to deposit weld metal, to thin edges when desirable or weave a wider bead, or use a "free" arc.

# WELDING ROD SPECIFICATIONS

---

## AWS E-7014 CONTACT AC-DC

for welding of mild steel

**GENERAL APPLICATIONS:** Sheet Metal Fabrication and Repairs • Machinery Fabrication • Construction Equipment Repairs • Storage Tanks • Shipbuilding Fabricating Structural Shapes and Heavy Equipment • Equipment and Heavy Pipe Welding.

### SIZES AND HEATS (AMPS)

Diameter . . . .	1/16"	3/32"	1/8"	5/32"	3/16"	1/4"
Length	12"	14"	14"	14"	18"	18"
Amperes	70-90	90-110	130-165	190-210	200-250	250-350

### SPECIFICATIONS

**MEETS  
THESE  
REQUIREMENTS**

American Welding Society . . . . . Class E-7014  
 American Bureau of Shipping . . . . . Class E-7014

Physical Properties of Deposited Metal	As Welded
Tensile Strength . . . . .	72,000 psi to 76,000 psi
Yield Point . . . . .	60,000 psi to 69,000 psi
% Elongation in 2-inches . . . . .	17% to 28%

### DESCRIPTION

The AWS E-7014 is an excellent electrode for the inexperienced or experienced welder. Starts on contact with smooth surge-free arc, also restrikes instantly. This Craftsman electrode has powdered iron in the coating which makes welding easier and faster. The slag is easy to remove in most cases self-peeling as the weld cools

Ideal for fixture welding where weld appearance and lack of spatter is important. The amount of slag permits use in all welding positions

**WELDING PROCEDURES:** Weld materials should be clean. Best results are obtained when fit-up is good Either AC or DC current may be used. When arc is established, deposit metal holding a short arc or place electrode in contact with work.

# WELDING ROD SPECIFICATIONS

## MACHINABLE CAST IRON AC-DC

machineable welds on all cast irons

**GENERAL APPLICATIONS:** Cylinder Blocks • Crankcases • Valve Seats • Defective Castings • Gears • Sprockets • Casting Repairs in General • Garages • Farms • Shops

### SIZES AND HEATS (AMPS)

Diameter	3/32"	1/8"	5/32"	3/16"
Amperes	48-85	75-130	100-150	130-175

### DESCRIPTION

This electrode uses a nickel core wire, and produces a fully machinable weld without pre-heating the casting. Cast irons can be joined to steel, nickel alloys and copper.

This electrode operates with AC or DC (reverse polarity). It has very stable arc characteristics.

It is recommended for automotive repairs, such as cylinder blocks, crank cases, valve seats and other cast iron parts. In maintenance and repairs it is used on gears, sprockets, and many farm machinery parts.

**WELDING PROCEDURE:** Remove all dirt and grease from work piece before starting to weld. A cutting electrode may be used to burn a groove along the break where the weld is to be made. This cutting electrode removes the grease and scale, and then seals in any oil soaked into the cast iron.

Use the lowest amperage that gives good fusion. During cooling, peen hammer the weld to relieve strain and stress.

## CUTTING ROD AC-DC

quick, inexpensive, easy cuts through all metals

**GENERAL APPLICATIONS:** Cutting • Piercing • Gouging • Scarfing • Beveling • etc.

### SIZES AND HEATS (AMPS)

Diameter . . . . .	3/32"	1/8"	5/32"	3/16"
Amperes – AC	80-150	75-130	100-150	130-175
Amperes – DC	150-250	–	–	–

### DESCRIPTION

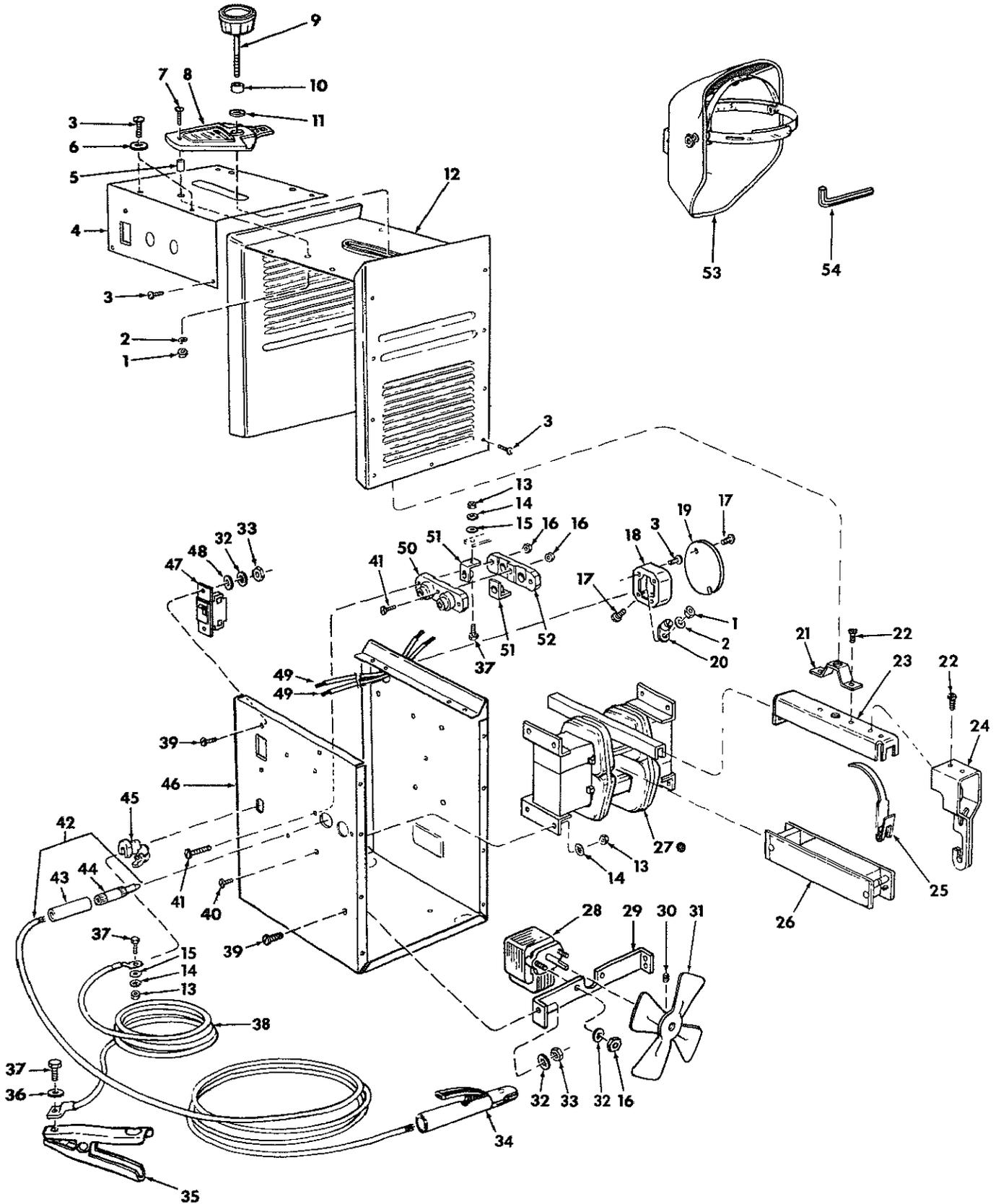
For piercing, gouging, cutting, and scarfing.

Excellent for removing old welds in preparation to rewelding. Also used for beveling cracks in castings or removing sharp edges prior to welding. Needs no oxygen or special equipment to cut carbon steels, stainless steel, manganese steel, cast iron, etc. Recommended for the owners of all arc welders. AC or DC.

**WELDING PROCEDURE:** Place electrode in holders so that it's positioned like a lance in the direction of travel. The angle between the electrode and work metal should not exceed 15°. Strike arc at starting point. Push electrode along the line of cut, forcing the molten metal ahead and away. If deeper gouge is required, repeat procedure until the desired depth has been reached.

# REPAIR PARTS

PARTS LIST FOR CRAFTSMAN 295 AMP ARC WELDER MODEL 113.201392



## PARTS LIST FOR CRAFTSMAN 295 AMP ARC WELDER MODEL 113.201392

**Always Order by Part Number – not by Key Number**

Key No.	Part No.	Description
1	STD 541110	*Nut, Hex 10-32
2	STD 551210	*Lockwasher, No. 10 Internal
3	STD 611005	*Screw, Type AB Pan Hd. No. 10 x 1/2
4	61339	Plate, Selector
5	61276	Spacer
6	STD 551008	*Washer, 3/16 x 3/8 x 1/32
7	STD 511110	*Screw, Pan Hd. 10-32 x 7/8
8	61300	Pointer
9	61278	Knob
10	61279	Bushing, 3/8 x 1
11	60325	*Washer, 3/8 x 1-3/8 x 3/64
12	61280	Cabinet, Top
13	STD 541025	*Nut, Hex 1/4-20
14	STD 551225	*Lockwasher, 1/4 Internal
15	STD 551025	*Washer, 17/64 x 47/64 x 1/16
16	STD 541006	*Nut, Hex 6-32
17	STD 511105	*Screw, Pan Hd. 10-32 x 1/2
18	37525	Ring, Outlet Box External
19	37526	Cover, Outlet Box
20	30298	Terminal, Ground
21	61335	Bracket, Guide
22	STD 601103	*Screw, Type T Pan Hd. 10-32 x 3/8
23	61332	Slide, Shunt
24	61333	Guide, Shunt
25	61334	Spring
26	61385	Core Assembly, Moving
27	•	Transformer Assembly
28	61314	Motor
29	61302	Bracket, Fan

Key No.	Part No.	Description
30	STD 501102	*Screw, Socket Set 10-32 x 1/4
31	61315	Blade Assembly, Fan
32	STD 551208	*Lockwasher, No. 8 Ext. Tooth
33	STD 541008	*Nut, Hex 8-32
34	61264	+Holder, Electrode
35	61190	+Clamp, Work (Includes Key No. 36 & 37)
36	STD 551025	*Washer, 17/64 x 47/64 x 1/16
37	STD 522507	*Screw, Hex Hd. 1/4-20 x 3/4
38	61342	Cable Assembly, Work
39	STD 510805	*Screw, Pan Hd. 8-32 x 9/16
40	STD 512507	*Screw, Sl. Tr. Hd. 1/4-20 x 5/8
41	STD 510607	*Screw, M. Pan Hd. 6-32 x 3/4
42	61310	Cable Assembly, Electrode
43	30332	Insulator, Plug
44	61171	Plug, Selector
45	61086	Relief, Strain
46	61338	Cabinet, Bottom
47	61269	Switch
48	STD 551010	*Washer, 13/64 x 3/4 x 1/32
49	61311	Lead, Primary
50	61115	Block No. 2, Contact Mounting
51	61116	Contact, Selector Plug
52	61117	Block No. 1, Contact Mounting
53	61265	+Helmet
54	37435	Wrench, Hex 1/4
—	61307	Bag Assembly, Loose Parts
—	61341	Owners Manual (not illustrated)

\*Standard Hardware Item — May be Purchased Locally.

+Stock Item — May be secured through the hardware department of most Sears Retail Stores or Catalog Order Houses.

•Transformer not replaceable.



*owners  
manual*

**SERVICE**

**MODEL NO.  
113.201392**

**HOW TO ORDER  
REPAIR PARTS**

**295 AMP DUAL RANGE  
ARC WELDER**

Now that you have purchased your 295 amp arc welder, should a need ever exist for repair parts or service, simply contact any Sears Service Center and most Sears, Roebuck and Co. stores. Be sure to provide all pertinent facts when you call or visit.

The model number of your 295 amp arc welder will be found on a plate attached to your welder, at the rear of the cabinet.

WHEN ORDERING REPAIR PARTS, ALWAYS GIVE THE FOLLOWING INFORMATION:

PART NUMBER	PART DESCRIPTION
MODEL NUMBER 113.201392	NAME OF ITEM 295 AMP ARC WELDER

All parts listed may be ordered from any Sears Service Center and most Sears stores. If the parts you need are not stocked locally, your order will be electronically transmitted to a Sears Repair Parts Distribution Center for handling.

**Sold by SEARS, ROEBUCK AND CO., Chicago, IL 60684 U.S.A.**