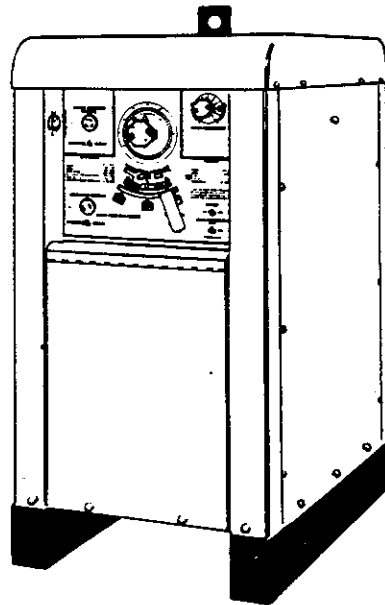


August 1973

FORM: OM-340

Effective with serial No. HD684370

MODEL	STOCK N
320P	901 013
330P	901 034
320A/BP	901 020
330A/BP	901 041
320A/B/SP	901 027
330A/B/SP	901 048



MODEL/STOCK NO.	SERIAL/STYLE NO.	DATE PURCHASED

# OWNER'S MANUAL



**MILLER ELECTRIC MFG. CO.**  
**APPLETON, WISCONSIN, USA 54911**



# ERRATA SHEET

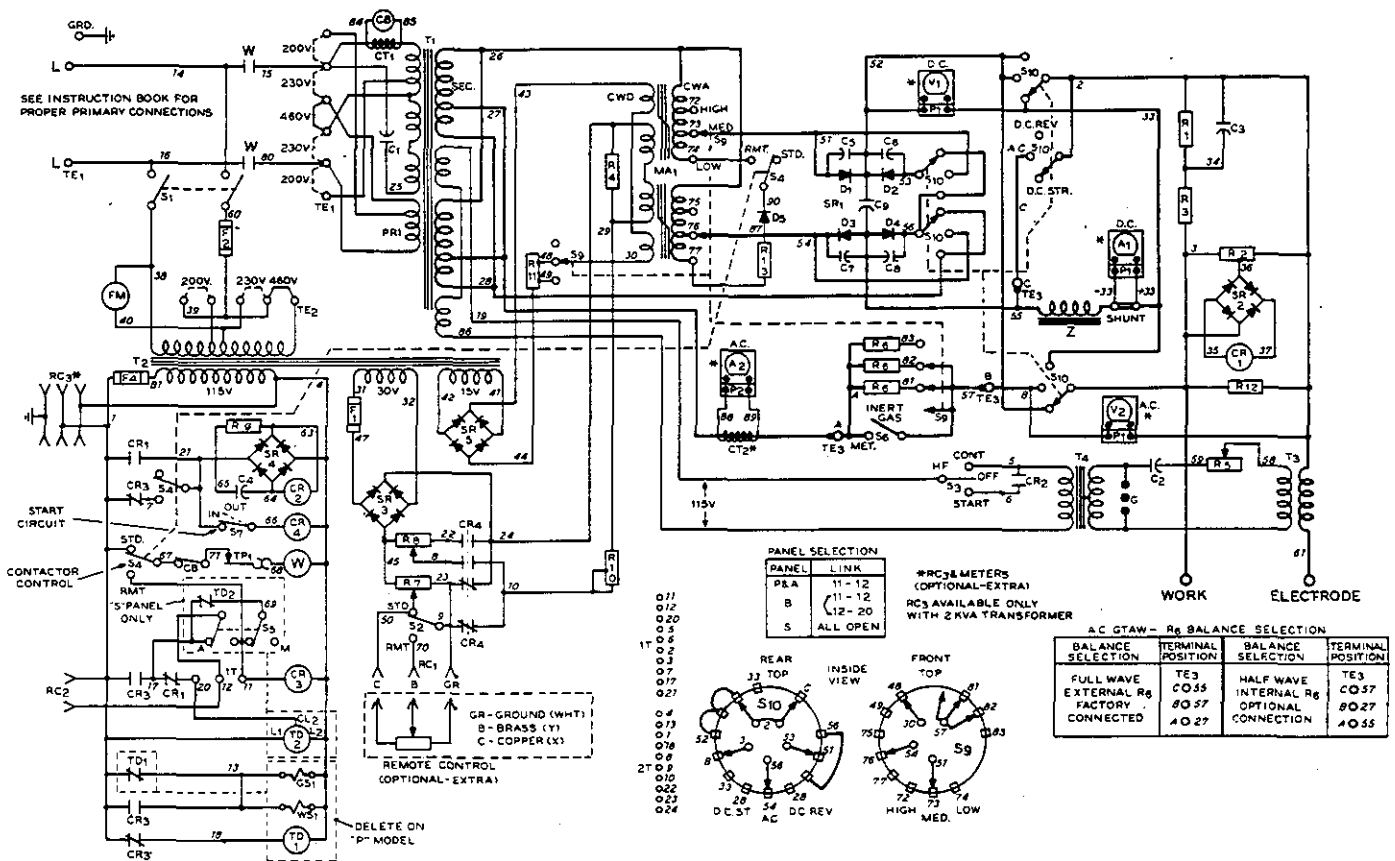
After this manual was printed, refinements in equipment design occurred. This sheet lists exceptions to data appearing later in this manual.

### NOTE

The data contained in this Errata Sheet applies to 300 ampere units effective with serial number HE745449 and on.

Item No.	Dia. Mkgs.	Part No. Listed In Parts List	Replaced with Part No.	Description	Quantity
299	S4	011 611	011 622	SWITCH, toggle 3PDT 15 amp 125 volts .....	1

**BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.**



**Circuit Diagram No. CB-901 034-1B**



September 1973

### CERTIFICATE

NAME OF EQUIPMENT: \_\_\_\_\_ MODEL NO. \_\_\_\_\_

SERIAL NO. \_\_\_\_\_ DATE \_\_\_\_\_

This equipment has been type-tested under standardized field test conditions as recommended by the Joint Industry Committee on High Frequency Stabilized Arc Welding Machines found to radiate less than 10 microvolts per meter at a distance of one mile, the maximum allowable limit established by the Federal Communications Commission for equipment of this type.

Installations using this equipment on the basis of these tests, may reasonably be expected to meet the radiation limitations established by the Federal Communications Commission, only when installed, operated and maintained as specified in the instruction book provided.

### USER'S CERTIFICATION

The welding equipment identified above has been installed in accordance with the specific instructions applicable to this model as outlined in the instruction book furnished. It is being used only for the purpose for which it was intended and is being maintained and operated in accordance with the manufacturer's instructions.

Date Installed \_\_\_\_\_ Signed \_\_\_\_\_



## TABLE OF CONTENTS

Paragraph No.

Page No.

### SECTION 1 – SAFETY RULES FOR OPERATION OF ARC WELDING MACHINE

1 - 1. General .....	1
1 - 2. Welding Cables .....	1
1 - 3. Electrode Holder .....	1
1 - 4. Code Conformance .....	1
1 - 5. Parallel Connections .....	1
1 - 6. Power Disconnect Switch .....	1
1 - 7. Polarity Switch .....	1
1 - 8. Range Switch .....	1
1 - 9. Exhaust Gases .....	1
1-10. Power Circuit Ground .....	2
1-12. Hollow Castings (Welding of) .....	2
1-13. Explosion Hazards .....	2
1-14. Ventilation .....	2
1-15. Solvents .....	3
1-16. Fire Hazards .....	3
1-17. Electrical Shock-Voltage .....	3
1-18. Electrical Shock-Dampness .....	3
1-19. Starting Under Load .....	3
1-20. Face Protection .....	3
1-21. Eye Protection .....	3
1-22. Clothing .....	4
1-23. Hot Metal Burns .....	4
1-24. Grinding and Chipping .....	4
1-25. Compressed Gas Cylinder .....	4

### SECTION 2 – INTRODUCTION

2 - 1. General .....	5
2 - 2. Receiving-Handling .....	5
2 - 3. Description .....	5
2 - 4. Safety .....	5

### SECTION 3 – INSTALLATION

3 - 1. Location .....	6
3 - 2. Primary Connections .....	6
3 - 3. Secondary Connections .....	7
3 - 4. Gas And Water Connections .....	7
3 - 5. Contactor Control Connections .....	7
3 - 6. Remote Amperage Control Connections .....	7

### SECTION 4 – FUNCTION OF CONTROLS

4 - 1. Current Control .....	8
4 - 2. Start Adjustment .....	8
4 - 3. Contactor Control Receptacle And Switch .....	9
4 - 4. High Frequency Switch .....	9
4 - 5. On-Off Power Switch .....	9
4 - 6. Primary Overload Circuit Breaker .....	9
4 - 7. Water-Gas Post-Flow Timer .....	9
4 - 8. High Frequency Intensity Control .....	9
4 - 9. Balancing Resistor Switch .....	10
4-10. Full Wave/Half Wave Balance .....	10
4-11. Panel Connection .....	11
4-12. Automatic-Manual Weld Switch .....	11
4-13. Spot Weld Timer .....	12
4-14. Duty Cycle .....	12
4-15. Volt-Ampere Curve .....	12

## **SECTION 5 – SEQUENCE OF OPERATION**

5 - 1. Shielded Metal-Arc Welding .....	13
5 - 2. Gas Tungsten-Arc Welding .....	13
5 - 3. Gas Tungsten-Arc Spot Welding .....	13

## **SECTION 6 – MAINTENANCE**

6 - 1. Rectifier .....	14
6 - 2. Fan Motor .....	14
6 - 3. Rectifier .....	14
6 - 4. Spark Gap .....	14
6 - 5. Control Circuit Fusing .....	14
6 - 6. Thermal Protection .....	15

## **SECTION 7 – TROUBLESHOOTING**

### **SECTION 8 – CERTIFICATION FOR HIGH FREQUENCY ARC WELDING EQUIPMENT**

8 - 1. General .....	21
8 - 2. General Information .....	21
8 - 3. Power Service .....	21
8 - 4. Welding Machine .....	21
8 - 5. Welding Leads .....	22
8 - 6. Wiring In The Vicinity Of The Welding Area .....	22
8 - 7. Grounds .....	22
8 - 8. Metal Building .....	22
8 - 9. Individual Installation Certification .....	23
8-10. Check List .....	23

## **PARTS LIST**



# SECTION 1- SAFETY RULES FOR OPERATION OF ARC WELDING MACHINE

## 1 - 1. GENERAL

These rules apply to ac and dc welding generators, ac transformer and ac/dc welding machines, and dc transformer rectifier welding machines.

In arc-welding operations, where electrically energized parts are exposed, observe the following safety rules to insure maximum personal safety and protect nearby persons.

Failure to observe these safety precautions may expose not only you, but fellow workers as well, to serious injuries. Once these rules are learned and kept in mind, proceed with maximum assurance.

## 1 - 2. WELDING CABLES

DON'T overload cables, (Figure 1-1)

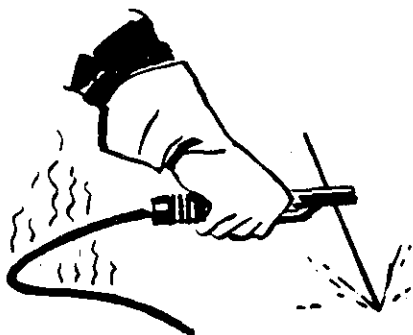


Figure 1-1. Don't overload cables

NEVER use welding cables at currents in excess of their rated capacity. It will cause overheating and rapid deterioration of the insulation. It is also uneconomical.

DON'T use worn or poorly connected cables. (Figure 1-2)

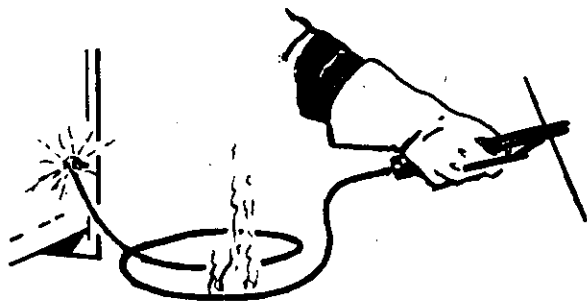


Figure 1-2. Don't use worn or poorly connected cables

Inspect the cables frequently. Immediately repair all breaks in the insulation with rubber and friction tapes. Tighten all cable connections and adequately insulate any joints where a connector may have an exposed conductive part. In addition to the potential hazard to life, a hazard occurs when exposed sections of cable come in contact with grounded metallic objects, causing an arc. Unprotected eyes may be injured and fire may result if combustible materials such as oil or grease are in the vicinity. The efficiency and quality of welding will be improved by elimination of these dangerous grounds, and by keeping connections tight.

## 1 - 3. ELECTRODE HOLDER

DON'T use electrode holders with defective jaws. (Figure 1-3)

Keep the jaws of the electrode holder tight and the gripping surfaces in good condition to provide close contact with the electrodes. Defective jaws will permit the electrode to wobble, making control of the welding operations difficult.

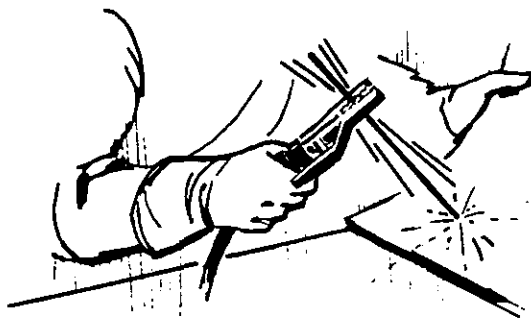


Figure 1-3. Don't use Electrode Holder with defective jaws

DON'T use electrode holder with loose cable connections.

Keep the connections of the electrode lead to the holder tight at all times.

Use only fully insulated electrode holders (and without protruding screwheads.)

Never touch two electrode holders from two separate welding machines at the same time.

## 1 - 4. CODE CONFORMANCE

The machine and its equipment must be installed and maintained in accordance with the National Electrical Code and local requirements.

## 1 - 5. PARALLEL CONNECTIONS

See diagrams in the instruction manual applying to the welding machine used.

## 1 - 6. POWER DISCONNECT SWITCH

If the welding machine does not include a power disconnect switch, install one at or near the machine.

## 1 - 7. POLARITY SWITCH

DON'T operate the polarity switch under load.

The polarity switch (when supplied) is provided for changing the electrode lead from positive (reverse polarity) to negative (straight polarity). Never move it while under the load of a welding current. Operate this switch only while the machine is idling and the welding circuit is open. The potential dangers of opening the circuit while carrying high current are:

1. An arc will form between the contact surfaces of the switch and severely burn them.
2. The person throwing the switch may receive a severe burn from this arcing.

## 1 - 8. RANGE SWITCH

DON'T operate the range switch under load.

The range switch (when supplied) is provided for obtaining required current settings. It must never be operated while the machine is under the load of welding current. Operate the range switch only while the machine is idling and the welding circuit is open. The potential danger of switching the circuit while carrying high current is the formation of an arc between the contact surface which will severely burn them. Repeated occurrences of this arcing will eventually prevent operation of the contacts.

## 1 - 9. EXHAUST GASES

DON'T use gas engine units in confined spaces without venting the exhaust gases. (Figure 1-4)

If gasoline or other fuel driven welding machines are operated indoors, provide means to pipe the exhaust gases to the outside air to avoid carbon monoxide poisoning.

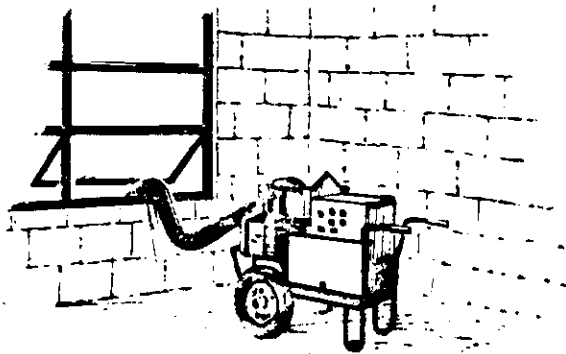


Figure 1-4. Vent exhaust gases

## 1-10. POWER CIRCUIT GROUND

DON'T use welding machine without grounding frame or case. (Figure 1-5)

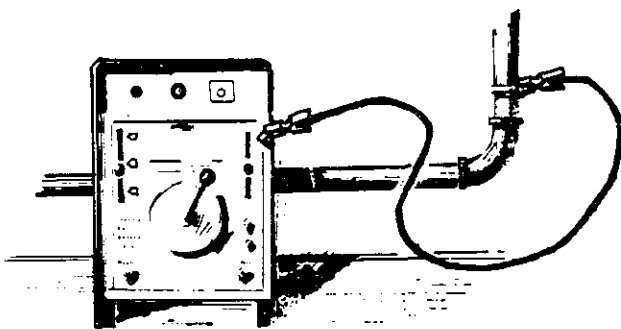


Figure 1-5. Ground frame or case

Ground the ground cable of every power circuit to prevent accidental shock by stray current. The potential danger is that development of a stray current may give a fatal shock should a person, for example, place one hand on the welding machine and the other on the switch box, or other grounded equipment. Do not ground to pipelines carrying gases or flammable liquids and conduits carrying electrical conductors. Be sure conductors can safely carry the ground current. When connecting the welding machine, properly ground the machine frame or case.

## 1-11. CONTAINERS WHICH HELD COMBUSTIBLES

DON'T weld on containers which have held combustible or flammable materials or materials which, when heated, give off flammable or toxic vapors without proper cleaning, purging, or inerting.

Welding containers which have held flammable or combustible materials may be extremely dangerous. To prevent a fire or explosion of the container, follow the recommendations of the American Welding Society Pamphlet A6.0 "Welding or Cutting Containers Which Have Held Combustibles".

DON'T depend on your eyes or nose to decide if it is safe to weld on a closed container.

Find out what was in the container or use an explosimeter. A very small amount of residual flammable gas or liquid can cause a serious explosion.

NEVER use oxygen to ventilate a container.

When you know the container held a gas or liquid which will readily dissolve in water:

1. Flush out with water several times and then fill with water as far as work permits, positioning container to permit introduction of as much water as possible.
2. Before welding be sure there is a vent or opening to provide for release of air pressure.

When you know the container held a gas or liquid which will not readily dissolve in water:

1. Clean out thoroughly with steam or a cleansing agent and purge all air or inert with a gas such as carbon dioxide or nitrogen before repairing. Carbon dioxide is heavier than air and will tend to remain in the container if the opening is at the top.
2. Use steam to clean out light material.
3. Use a strong caustic soda solution to clean out heavy oils or grease.
4. Be sure to purge all air or inert with a gas, such as nitrogen or carbon dioxide, no matter how well you have cleaned. There may still be traces of oil, grease, or other readily oxidizable material under the seams.

Be careful when cleaning with steam or caustic soda wear goggles and gloves.

DON'T clean where there is poor ventilation.

Ventilation is necessary to carry away harmful or explosive vapors.

DON'T clean where there are open flames.

When scraping or hammering to remove heavy sludge or scale, use a spark resistive tool and keep it wet to avoid sparks.

Keep your head and arms as far away from your work as possible.

## 1-12. HOLLOW CASTINGS

DON'T weld on hollow (cored) castings that have not been properly vented. The casting may explode. (Figure 1-6)



Figure 1-6. Don't weld on hollow (cored) castings

## 1-13. EXPLOSION HAZARDS

NEVER weld in or near explosive atmospheres. Such atmospheres can be created by flammable gas leaks or by vapors from flammable liquids (gasoline, alcohol, etc.) or by combustible dusts.

## 1-14. VENTILATION

DON'T weld in confined spaces without adequate ventilation.

When welding in confined spaces, provide ventilation in accordance with United States of American Standard Z49.1, 1967. Always provide adequate ventilation by blowers, air lines, or other acceptable means. Never use compressed oxygen. The depletion of the oxygen supply, the heat of welding, and the fumes given off may cause severe discomfort or a serious illness.

When toxic fumes from lead or cadmium bearing materials or any other substances are present in harmful concentrations, always use an air supplied respirator.

## 1-15. SOLVENTS

Do not weld where chlorinated hydrocarbon vapors from degreasing, cleaning, or spraying may reach or be drawn into air surrounding the welding operation. The heat of the arc can decompose solvent vapors to form phosgene, a highly toxic gas and other irritating decomposition products.

Do not weld where ultraviolet light from the electric arc can penetrate air containing even minute amounts of vapors from solvents such as trichloroethylene or perchloroethylene. Ultraviolet light can decompose the vapors to form phosgene, a highly toxic gas and other irritating products.

## 1-16. FIRE HAZARDS

**DON'T** weld near flammable or combustible materials.

Fires can be caused by the arc, by contact with the heated metal, by slag, or sparks. Keep combustibles at least 35 feet from the arc or suitably protected. If welding must be done in a particular area, move the combustibles away. If they cannot be moved, cover them completely with fire resistive screens. Cover cracks or openings in floors or walls; sweep floor free of combustibles and wet down, if wood, being sure welder wears insulation shoe coverings. Avoid welding on partition walls in contact with combustibles. Heated metal on the other side of partition wall being welded upon can ignite combustibles in contact with the partition. Where other than a minor fire might develop, have a fire watcher stand-by with suitable fire extinguishing equipment for at least one-half hour after the welding is completed.

## 1-17. ELECTRICAL SHOCK-VOLTAGE

**OPEN** power circuits before checking machines.

Before working on the wiring, switches, controls, etc., open the power line disconnect switch. In most welding shops the power supply used for arc welding machines is 230 or 460 volts. Open circuit voltages are usually less than 100 volts and welding or arc voltage drops are still lower. However, all of these voltages are capable of developing a harmful or fatal current to the body.

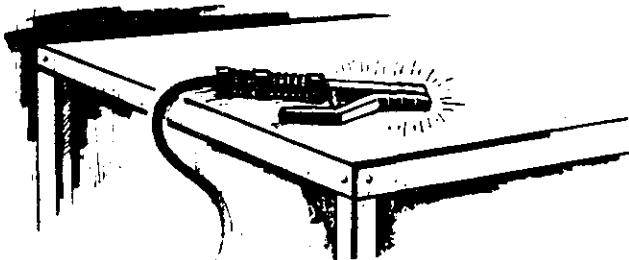
**DON'T** touch electrically "hot" parts.

**NEVER** touch any exposed or non-insulated part of the cables, cable connectors, clamps, electrode holders, electrodes, or the power supply equipment to prevent harmful or fatal electric shock or burns.

## 1-18. ELECTRICAL SHOCK-DAMPNESS

**NEVER** work in a damp area without suitable insulation against shock. Keep hands, feet, and clothing dry at all times.

To prevent harmful body shocks, keep hands, feet and clothing dry. Never stand or lie in puddles of water, damp ground, or against grounded metal when welding without suitable insulation against shock. Always find a dry board or rubber mat to stand on when water, moisture, or perspiration cannot be avoided. Dampness between the body and an energized or grounded metallic part lowers the resistance to the passage of current to the body which may produce a harmful or fatal shock. Salt in perspiration or sea water dangerously lowers contact resistances.



**Figure 1-7. Don't leave electrode in contact with grounded metallic surface.**

## 1-19. STARTING UNDER LOAD

**DON'T** leave an uninsulated electrode holder, or a "live"

electrode on the table top or in contact with a grounded metallic surface. (Figure 1-7)

When it is not in use, never place an electrode holder in contact with the tabletop or other metallic surface in contact with welding ground. Provide an insulated hook or holder for the electrode holder. A potential danger is that a holder in contact with the ground circuit provides a dead short circuit on the welding machine. If the machine should be started up, this short circuit would cause an excessive load on the machine and may damage the insulation.

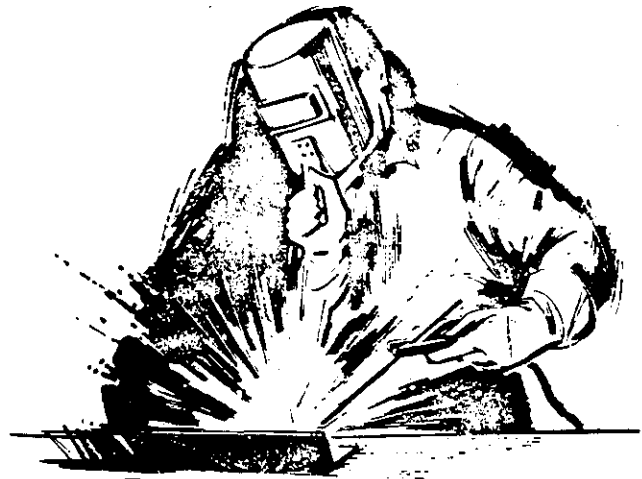
## 1-20. FACE PROTECTION

**DON'T** use cracked or defective helmets or shields.

Keep the helmet, hand shields, or face shield in good condition. If cracks occur in the fibre material, replace the shield, since the leakage of arc rays may cause serious burns.

## 1-21. EYE PROTECTION

**NEVER** under any circumstances, look at an electric arc without eye protection.



**Figure 1-8. Use eye protection at all times**

### CAUTION

Make sure that flash goggles are used under the welding helmet at all times, particularly while gas shielded-arc welding.

In some type of arc welding, such as gas shielded-arc welding, ultra-violet and infra-red radiation from the arc is particularly intense and requires constant attention to avoid arc flashes to the welder when striking an arc and to avoid exposure to other welders.

**NEVER** strike an arc without ascertaining that nearby persons either have the necessary protective equipment or are looking in the opposite direction.

For welding operations in open areas, provide portable, non-reflecting screens to shield persons nearby from the rays of the arc. Eye burns from the arc, through not generally permanent injuries, are exceedingly painful. Such burns frequently referred to as "flashes", feel like hot sand in the eye. If the eye is focused on the arc without filter-glass protection, infra-red radiation can cause retinal scarring and impaired vision. For eye burns consult your first aid station or doctor.

**NEVER** use cracked, ill-fitting, or defective plates.

The filter glass plate provided in the helmets and shields must be of reputable manufacture conforming to the latest American National Standards Institute, Standard Z2.1. Replace cracked or ill-fitting filter plates promptly.

**NEVER** use filter plates without a protecting cover glass.

Keep a clean cover glass in front of the filter plate for the protection thereof. Frequent renewal of these cover glasses is necessary, since they become covered with spatter, reducing vision.

## 1-22. CLOTHING

NEVER use poor, inadequate, or worn-out clothing. Wear heavy shoes, tightly laced. Keep clothing dry.

Proper and dry, oil-free clothing is essential for the welder's protection. Clothing must not only keep off the spatter and molten particles, but must also obstruct the rays of the arc and, when necessary, insulate the body from harmful electrical currents.

Wear leather or asbestos gloves at all times to protect the hands and wrists. Dark colored shirts are preferred to light ones because light ones reflect arc rays to exposed parts of the body. In the case of gas shielded-arc welding, light colors are more reflective and may cause eye burns due to the intense ultra-violet rays given off by the process. Avoid cotton fabrics when gas shielded-arc welding.

An arc burn on the skin resembles a sunburn, except that it is usually more severe. Clothing can be made flame resistant by treatment with a solution of 3/4 pound of sodium stannate in 1 gallon of water, then wrung out and dipped in a solution of 1/4 pound ammonium sulphate per gallon of water. Don't wash clothing so prepared in water, but dry clean.

When welding operations are to be performed in vertical and overhead positions, leather sleevelets, aprons, and in some cases leggings and ear plugs should be used to prevent severe burns from spatter and molten metal.

## 1-23. HOT METAL BURNS

NEVER pick up hot objects. (Figure 1-9)

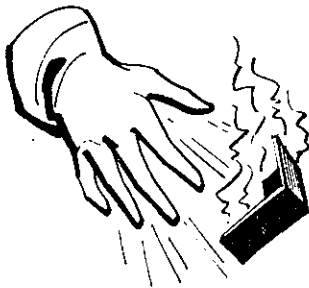


Figure 1-9. Never pick up hot objects

NEVER pick up pieces of metal which have just been welded or heated, or the stub ends of electrodes which have been discarded.

## 1-24. GRINDING AND CHIPPING

NEVER do any chipping or grinding without protective goggles. (Figure 1-10)



Figure 1-10. Never do any chipping or grinding without protective goggles.

Whenever it is necessary to grind or chip metal, wear protective goggles specifically designed for this purpose. Serious eye injuries may result from failure to wear protective goggles.

## 1-25. COMPRESSED GAS CYLINDERS

NEVER strike an arc on a compressed gas cylinder. Always observe the following precautions in regards to compressed gas cylinders:

1. Avoid accidental contact of the electrodes, electrode holder, or other electrically energized parts with a compressed gas cylinder or any other pressure vessel. Serious accidents or fires may result.
2. Use I.C.C. or D.O.T. cylinders. They are manufactured and maintained in accordance with D.O.T. requirements and are safe so long as they are properly handled. Don't drop cylinders.
3. Identify gas content by the name marked on the cylinder. If the cylinder is unmarked, do not use it. Return it to the supplier. Do not rely on a color code.
4. Never use a cylinder or its contents for other than intended purposes.
5. Keep oil and grease away from oxygen cylinders and cylinder valves.
6. Keep cylinders away from exposure to sparks, hot slag, open flame and all possible sources of ignition or excessive heat.
7. Be careful that cylinders are not placed so as to become a part of an electrical circuit. Avoid third rails, wires and electric welding circuits.
8. When transporting cylinders by crane, use cradle platform or other suitable support.
9. Never lift the cylinders by slings, by the caps or by electric magnets.
10. Never use cylinders as supports or rollers.
11. Never try to mix any gases in a cylinder.
12. Never try to refill a cylinder.
13. Mark or tag empty cylinders "Empty" or "MT".
14. Send "Emptys" back to the supplier promptly.
15. Keep "Emptys" and "Fulls" separate.
16. Never tamper with or alter cylinder numbers or other markings. This is not only foolish but may be illegal.
17. Do not tamper with or change fittings on cylinders.
18. If valves cannot be opened by hand, do not use hammer or wrench. Notify supplier.
19. Protect cylinder valves from bumps, falls, falling objects, and from weather. Keep them covered with cylinder caps when moving cylinders.
20. Keep valves closed on empty cylinders.
21. See that your cylinders are clear of passageways and active work areas and that they are secured against falling.
22. If adapter is required between cylinder and regulator, always use a standard adapter. These may be obtained from your supplier. Where right and left hand threads are used on adapter, use two wrenches to insure leak proof connections.
23. Do not store cylinders in unventilated areas.

## SECTION 2 - INTRODUCTION

Model					Open Circuit Voltage AC & DC	Amperes Input At Rated Load Output 60 Hz Single Phase Amperes				kw	Overall Cabinet Size (Inches)	Weight (Pounds)	
	AC Gas Tungsten-Arc	AC Shielded Metal-Arc	DC Gas Tungsten-Arc	DC Shielded Metal-Arc		208V	230V	460V	kva			Net	Ship
200 Ampere	5-45 12-125 85-300	6-45 10-155 90-330	5-50 10-160 120-300	5-40 10-130 70-260	80	80	72	36	16.5	14	Height - 47-1/2 Width - 22-1/4 Depth - 33-1/8	785	805
300 Ampere	5-48 20-230 190-435	5-48 20-245 200-470	5-60 20-250 230-460	5-45 16-200 150-350	80	115	104	52	23.9	21.8	Height - 47-1/2 Width - 22-1/4 Depth - 33-1/8	870	890

Figure 2-1. Specifications

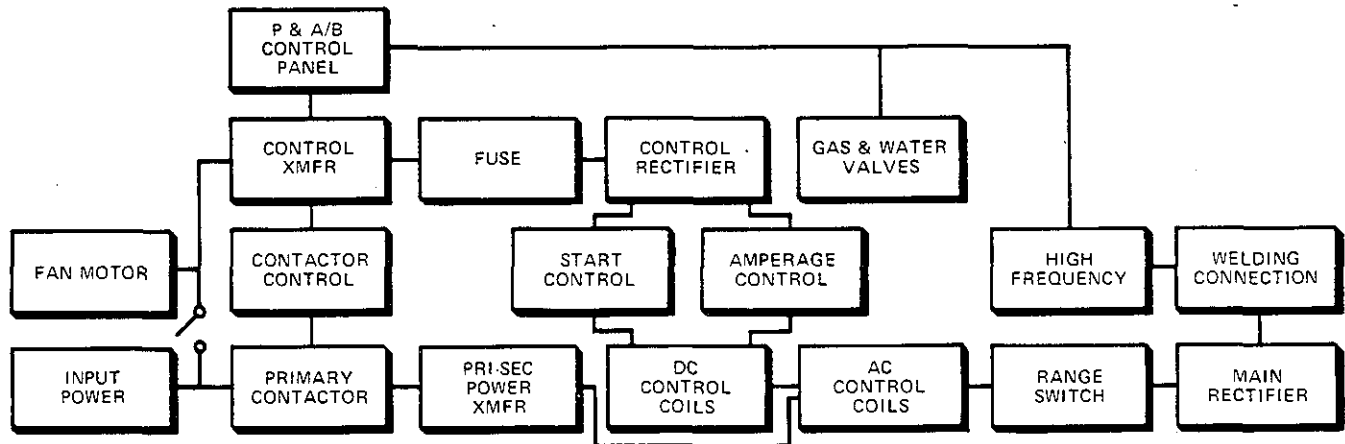


Figure 2-2. Block Diagram

TS-901 013-1

### 2-1. GENERAL

This manual has been prepared especially for use in familiarizing personnel with the design, installation, operation, maintenance, and troubleshooting of this equipment. All information presented herein should be given careful consideration to assure optimum performance of this equipment.

### 2-2. RECEIVING-HANDLING

Prior to installing this equipment, clean all packing material from around the unit and carefully inspect for any damage that may have occurred during shipment. Any claims for loss or damage that may have occurred in transit must be filed by the purchaser with the carrier. A copy of the bill of lading and freight bill will be furnished by the carrier on request if occasion to file claim arises.

When requesting information concerning this equipment, it is essential that Model Designation and/or Stock Number and Serial (or Style) Number of the equipment be supplied.

### 2-3. DESCRIPTION

These single phase input welding power sources are designed to be used for ac or dc Shielded Metal-Arc and Gas Tungsten-Arc Welding. This series of welding power sources come in either a 200 or 300 ampere version and either version can be equipped in three different ways: basic; basic with gas and water control; and basic with gas and water control, and spot weld time capability.

#### A. Basic Model

The basic model is provided with a Range Switch for selecting one of three coarse amperage ranges of either ac, dc straight, or dc reverse polarity weld current. The Fine Current Control on this unit provides the capability of selecting the exact desired weld current within the coarse range selected. Facilities are also provided for connecting a remote fine current control. Facilities are also provided for on-off control of the open circuit voltage through utilization of the con-

tactor control receptacle and switch. A Start Control is provided for determining the amount of weld current present at the initiation of the weld. High frequency is also built into the welding power source for ease in arc starting when performing Gas Tungsten-Arc Welding.

#### B. Water And Gas Control Model

The water and gas control model incorporates all the features of the basic model plus the addition of a gas valve, water valve, and post-flow timer.

#### C. Spot Time Model

The spot timer model incorporates all the features of the basic and water and gas control models plus the addition of a spot weld timer.

### 2-4. SAFETY

Before the equipment is put into operation, the safety section at the front of this manual should be read completely. This will help avoid possible injury due to misuse or improper welding applications.

The following definitions apply to CAUTION, IMPORTANT, and NOTE blocks found throughout this manual:

#### CAUTION

Installation, operating, and maintenance procedures, practices, etc., which will result in personnel injury or loss of life if not carefully followed.

### IMPORTANT

Installation, operating, and maintenance procedures, practices, etc., which will result in damage to equipment.

### NOTE

Installation, operating, and maintenance procedures, practices, etc., which it is essential to emphasize.

## SECTION 3 - INSTALLATION

### 3-1. LOCATION

A good installation is essential if the welding power source is to provide satisfactory and dependable service.

The location should be such that a minimum amount of dust and dirt will be drawn into the air stream. Preventive maintenance consists of removing the wrapper from the welding power source and blowing out the dust accumulation inside the unit. For this reason it is desirable to locate the unit so that the wrapper can be removed without any difficulty.

### IMPORTANT

The welding power source should be located so that the panels with the air vents are clear of any obstruction. Cooling air is drawn through the lower area and expelled out of the rear air vent.

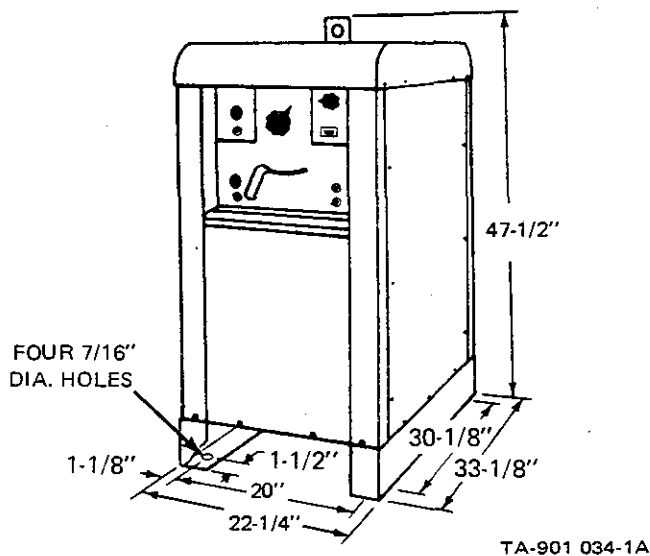


Figure 3-1. Dimensional Drawing

### 3-2. PRIMARY CONNECTIONS

This welding power source is designed for and must be operated on a single phase, 60 Hertz, ac power supply, having a voltage rating which corresponds to one of the voltages shown on the welding power source nameplate. If there is any question about the electrical system used locally, consult the local public electric utility.

#### A. Primary Wire Connections

### NOTE

It is recommended that the primary wires be of the heavy rubber covered type or be run in solid or flexible conduit. Table 3-1 is provided as a guide in selecting the proper primary wire and fuse size.

Route the two primary line wires plus one ground wire through the inlet hole provided on the rear panel of the welding power source. This inlet hole will accept standard conduit and associated fittings.

Table 3-1. Primary Wire And Fuse Sizes

Model	Primary Wire Size - AWG				Fuse Size In Amperes			
	208 V	230 V	460 V	575 V	208 V	230 V	460 V	575 V
200 Amp	No. 4 (No. 8)	No. 4 (No. 8)	No. 8 (No. 8)	No. 10 (No. 8)	150	125	70	50
300 Amp	No. 2 (No. 6)	No. 2 (No. 6)	No. 6 (No. 8)	No. 8 (No. 8)	200	175	90	70

( ) Indicates ground wire size.

### NOTE

It is recommended that the ends of the primary and ground wires which are to be connected to the input terminals have a terminal lug of suitable amperage rating attached.

A hinged door is provided on the rear panel for gaining access to the primary terminal board. After opening the door, connect the two primary line wires to the terminals on the primary terminal board labeled L or LINE. Connect the ground wire to the terminal labeled GRD. The opposite end of the ground wire should be connected to a proper ground. Use whatever grounding method which is acceptable to the local electrical inspection authority.

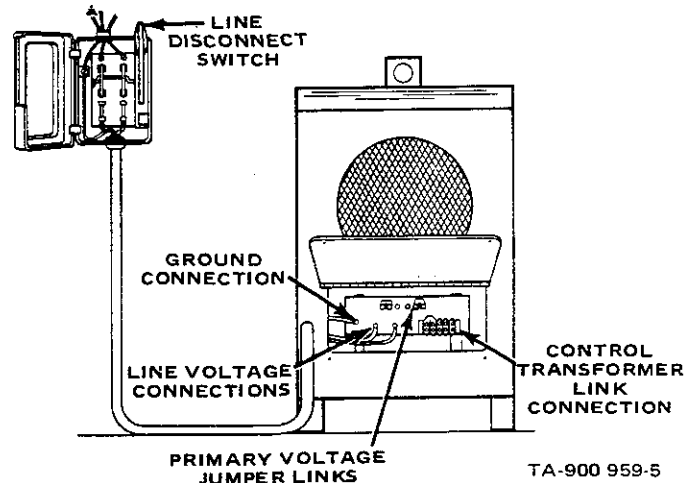


Figure 3-2. Primary Line Voltage Connections

#### B. Primary Voltage Jumper Links

The primary voltage jumper links are provided on the primary terminal board to permit the welding power source to be operated from various line voltages. The voltages which this welding power source may be operated from are stated on the front panel nameplate and on the input voltage sticker on the inside of the rear panel hinged door. This welding power source had the primary voltage jumper links set for the highest voltage position at the factory. If the welding power source is to be operated from a line voltage which is lower than the highest voltage the unit was designed for, the jumper links will have to be moved to the proper position before operation of the welding power source commences. Figure 3-3 shows the various jumper link positions that the jumper links may be set for on the standard welding power source. If the welding power source has input voltages different from those of the standard unit, that is, if the primary voltage on the welding power source nameplate differ from those shown in Figure 3-3, the primary voltage jumper links should be positioned as shown in the voltage sticker on the inside of the rear panel hinged door.

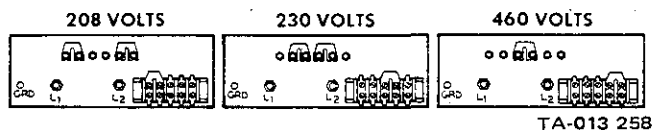


Figure 3-3. Primary Voltage Jumper Link Arrangement

### 3 - 3. SECONDARY CONNECTIONS

The secondary terminals are located behind the lower front access panel and are labeled ELECTRODE and WORK. See Figure 4-3 for the location of these terminals.

#### A. Welding Cables

It is recommended that the welding cables be kept as short as possible, placed close together and be of adequate current carrying capacity. The resistance of the welding cables and connections cause a voltage drop which is added to the voltage of the arc. Excessive cable resistance may result in overloading as well as reducing the maximum current output of which the welding power source is capable. The proper operation of any arc welding power source is to a great extent dependent on the use of welding cables and connections that are in good condition and of adequate size. An insulated holder must be used to ensure the operator's safety.

Table 3-2. Secondary Cable Sizes

WELDING AMPERES	*TOTAL LENGTH OF CABLE (COPPER) IN WELD CIRCUIT							
	*50	100	150	200	250	300	350	400
100	4	4	4	3	2	1	1/0	1/0
150	3	3	2	1	1/0	2/0	3/0	3/0
200	2	2	1	1/0	2/0	3/0	4/0	4/0
250	1	1	1/0	2/0	3/0	4/0	4/0	2-2/0
300	1/0	1/0	2/0	3/0	4/0	4/0	2-2/0	2-3/0
350	1/0	1/0	3/0	4/0	4/0	2-2/0	2-3/0	2-3/0
400	2/0	2/0	3/0	4/0	2-2/0	2-3/0	3-2/0	2-4/0
500	3/0	3/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0	3-3/0

TA-900 561-3

NOTE: \*A. 50 feet or less

\*B. Cable size is based on direct current (dc), 60% duty cycle and either a 4 volts or less drop or a current density of not over 300 circular MILS per amp.

\*C. Weld cable insulation with a voltage rating to withstand the open circuit voltage (OCV) of the welding power source must be used. While most welding power sources have an open circuit voltage of less than 100 volts, some welding power sources of special design may have higher open circuit voltage.

Use Table 3-2 as a guide for selecting the correct welding cable size for the anticipated maximum weld current that will be used. Table 3-2 takes into account the total length of cable for the weld circuit. This means the length of the Electrode cable that connects the Electrode Holder to the welding power source and the Work or ground cable between the welding power source and the work piece. For example: If the Electrode cable is 75 feet long and the work or ground cable is 25 feet long, you would select the size cable from Table 3-2 that is recommended for 100 feet at the maximum amperage that will be used. In the case of a maximum anticipated weld current of 300 amperes 1/0 weld cable would be recommended for both the Electrode and Work cables.

### 3 - 4. GAS AND WATER CONNECTIONS (Figure 4-3)

The gas and water valves, located behind the lower front panel door, provide on-off control of gas and water to the gun. The gas valve fittings have right hand threads, while the water fittings have left hand threads.

If a recirculating type of water cooling system is used, do not connect the system through the water valve as damage may occur to the motor of the coolant system because the water valve will shut off, thus blocking the water flow.

### 3 - 5. CONTACTOR CONTROL CONNECTIONS

The CONTACTOR CONTROL Receptacle, located on the front panel of the welding power source, provides a junction point for connecting a Remote Contactor Control to the contactor control circuitry in the welding power source.

If normal contactor control connections are to be made, (normal being when the remote contactor control switch energizes the contactor when closed and de-energizes the contactor when opened) a maintained contact switch should be used for a remote contactor control switch. This type of contactor control is the only type that can be obtained on the Standard Models.

On Water and Gas Models and Spot Models connected for water and gas panel operation, a momentary contact switch should be used for contactor control. When this setup is used, the contactor will de-energize whenever the arc is broken.

On Spot Models connected for spot welding operation, a momentary contact switch is to be used as the remote contactor control switch. Closing the momentary contactor control switch in this operation will energize the contactor and start the Spot Weld Timer as soon as an arc is initiated.

#### NOTE

If a Remote Contactor Control is to be used, the CONTACTOR CONTROL Switch must be in the REMOTE position. The complete operation of this switch will be explained in SECTION 4.

To connect the Remote Contactor Control to the CONTACTOR CONTROL Receptacle, insert the two pole plug from the Remote Contactor Control into the receptacle and rotate it as far as it will turn in a clockwise direction. The plug will now be locked in the receptacle and will not pull out under stress.

### 3 - 6. REMOTE AMPERAGE CONTROL CONNECTIONS

The REMOTE AMPERAGE CONTROL Receptacle, located on the front panel of the welding power source provides a junction point for connecting a Remote Amperage Control rheostat to the amperage control circuitry in the welding power source.

To connect the Remote Amperage Control to the REMOTE AMPERAGE CONTROL Receptacle, insert the three pole plug from the Remote Amperage Control into the receptacle and rotate the plug as far as it will turn in a clockwise direction. Once fully rotated, the plug will be locked in the receptacle and will not pull out under stress.

#### NOTE

If a Remote Amperage Control is to be used, the STANDARD REMOTE AMPERAGE CONTROL Switch must be placed in the REMOTE position. The complete operation of this switch will be explained in SECTION 4.

## SECTION 4 - FUNCTION OF CONTROLS

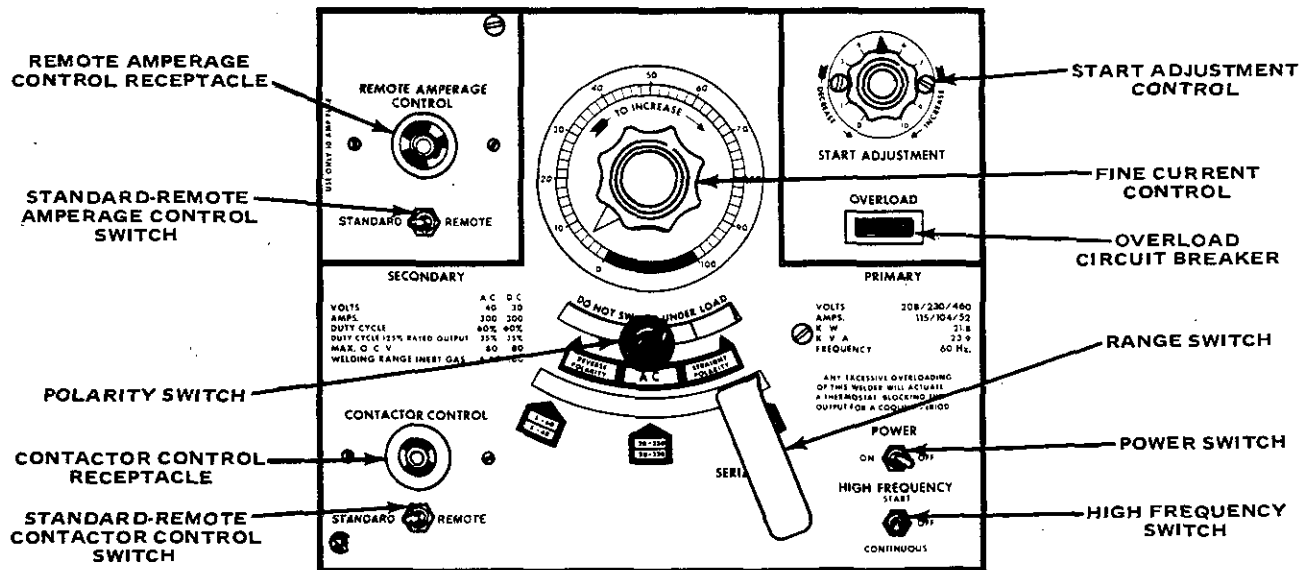


Figure 4-1. Upper Control Panel

AA-901 013-4A

### 4 - 1. CURRENT CONTROL (Figure 4-1)

#### A. Range Switch

The Range Switch provides the capability of being able to select from three ac or dc coarse amperage ranges. The amperage range of each switch position is provided on the welding power source nameplate. If the amperage desired should fall in the overlapping area of two ranges, it is recommended that the lower of the two ranges be used, as better fine amperage adjustment will be obtained in the lower of the two ranges.

Fine amperage adjustment within the coarse range selected is to be accomplished by the Fine Current Control. The complete function of this control will be explained in section 4-1B.

#### IMPORTANT

Do not change the position of the Range Switch while welding or under load as this will cause the contacts of the switch to arc. Arcing across the contacts will cause the contacts to become pitted and thereby eventually to become inoperative.

#### B. Fine Current Control

The Fine Current Control, located on the center portion of the upper front panel, provides a means of selecting the exact amperage desired within the entire range being used. Rotating the control in a clockwise direction will increase the amperage output.

#### NOTE

The contacts of the Fine Current Control are of the continuous contact type, thereby making it possible to adjust the amperage output while welding.

The scale surrounding the Fine Current Control is calibrated in percentage and should not be misconstrued as an amperage or voltage reading.

#### C. Remote Amperage Control

If a Remote Amperage Control is to be used, make connections from the Remote Amperage Control to the REMOTE AMPERAGE CONTROL Receptacle as instructed in section 3-7.

When remote control of the amperage is desired, it is essential that the STANDARD-REMOTE AMPERAGE CONTROL Switch be placed in the REMOTE position. Likewise, if a Remote Amperage Control is not to be utilized, the switch must be in the STANDARD position. When in the STANDARD position, the Fine Current Control on the front panel will solely control the amperage.

When a Remote Amperage Control is being used, it should be noted that the Remote Amperage Control is functioning as a fine amperage adjustment of the Fine Current Control setting on the welding power source. For example: If the Fine Current Control on the welding power source is set at the 50% position, the Remote Amperage Control will provide (from its min. to max. positions) fine amperage adjustment of one half of the welding power source output for the current range selected by means of the Range Selector Switch. If full adjustment thru use of the Remote Amperage Control of the current range selected is desired, the Fine Current Control on the welding power source must be set at 100% (max. position).

#### D. Polarity Switch

The Polarity Switch provides a means of selecting either ac, dc straight, or dc reverse polarity without having to change the secondary cable connections.

Placing the Polarity Switch fully to the right will provide DC STRAIGHT polarity; fully to the left will provide DC REVERSE polarity; the center position will provide AC weld current.

#### CAUTION

Do not change the position of the Polarity Switch while welding or under load as this will cause the contacts of the switch to arc. Arcing across the contacts will cause the contacts to become pitted and thereby eventually to become inoperative.

### 4 - 2. START ADJUSTMENT (Figure 4-1 & 4-2)

The Start Adjustment facility in this welding power source permits the operator to select an amperage setting for arc initiation which is different from the setting of the Fine Current Control. The starting current which is selected will be in effect for the first 35 to 40 cycles of the weld. After this time period, the weld current will go to the setting of the Fine Current Control.



## A. Start Circuit Switch

A two position toggle switch, located next to the gas valve on the lower front control panel, is provided to determine whether or not the start circuit will be functional. Placing the START CIRCUIT Switch to the IN position will make the START ADJUSTMENT Control on the upper front panel operative. The OUT position will make the START ADJUSTMENT Control inoperative and thereby causing the weld current to go immediately to the setting of the Fine Current Control at arc initiation.

## B. Start Adjustment Control

The START ADJUSTMENT Control provides fine current selection within the minimum to maximum capabilities of the range being used for the initial 35 to 40 cycle (approximately 2/3 of a second) time period of the weld. After this initial time period, the weld current will either slope up or down to the setting of the Fine Current Control.

## 4 - 3. CONTACTOR CONTROL RECEPTACLE & SWITCH (Figure 4-1)

The CONTACTOR CONTROL Circuitry in this welding power source provides a means of making weld output available whenever desired without having to position the POWER Switch ON or OFF. Whenever 115 volts ac is applied to the contactor coil, the coil will energize and thereby close the contactor normally open contacts. Once the contacts have closed, electrical power will be applied to the main transformer and in turn supply weld output. Likewise, whenever the 115 volt ac circuit to the contactor coil is opened, the coil will de-energize, open the contactor contacts and suspend the weld output.

If a Remote Contactor Control is to be used, make connections to the CONTACTOR CONTROL RECEPTACLE as instructed in section 3-6.

Whenever it is desired to have weld output available and a Remote Contactor Control Switch is not being used, it will be necessary to place the CONTACTOR CONTROL Switch to the STANDARD position. When in the STANDARD position, weld output will be available as soon as and for as long as the POWER Switch is positioned to ON.

When a Remote Contactor Control Switch is to be used, the CONTACTOR CONTROL Switch must be placed in the REMOTE position. With a Remote Contactor Control Switch weld output will be available whenever and for as long as the Remote Contactor Control Switch is closed.

### NOTE

When connected for spot welding operation, (Spot Panel Models Only) the Remote Contactor Control Switch need be only momentarily closed to energize the contactor and start the Weld Timer.

## 4 - 4. HIGH FREQUENCY SWITCH (Figure 4-1)

The HIGH FREQUENCY Switch, located on the upper front panel, provides three positions which will determine whether the high frequency will be on or off.

## A. Start Position

When in the START position, high frequency will be present at the welding electrode until the arc is initiated. Once an arc is established, and even though the Remote Contactor Control Switch is closed, the high frequency will be de-energized. High frequency will be present again only after the arc is broken and restarted.

## B. Continuous Position

The CONTINUOUS position will provide high frequency for as long as the Remote Contactor Control Switch is closed. The high frequency and weld current may be shut off during the weld by releasing the Remote Contactor Control Switch.

## C. Off Position

High frequency will not be available when in the OFF position, even if the contactor is energized. This position must be used when performing Shielded Metal-Arc Welding (Stick Electrode).

### CAUTION

Never try to use high frequency when performing Shielded Metal-Arc Welding (Stick Electrode). Failure to comply may result in the high frequency arcing through the electrode holder and seriously injuring the operator.

## 4 - 5. ON-OFF POWER SWITCH (Figure 4-1)

This welding power source is equipped with an ON-OFF POWER switch in order to eliminate the need of having to engage and disengage the line disconnect switch whenever it is desired to turn the welding power source on or off.

Placing the POWER Switch in the ON position will energize the welding power source fan and control circuitry and place the welding power source in a ready-to-weld status. Placing the POWER Switch in the OFF position will shut the welding power source down.

### CAUTION

Even though the POWER Switch is in the OFF position and the welding power source is apparently electrically shut down, primary electrical power is still present on all circuitry up to the POWER Switch. To completely cut-off all electrical power to the welding power source, it will be necessary to place the line disconnect switch in the OFF position or to disconnect the primary leads from terminal strip TE1 in the welding power source.

## 4 - 6. PRIMARY OVERLOAD CIRCUIT BREAKER (Figure 4-1)

The PRIMARY OVERLOAD Circuit Breaker provides protection against overloading of the welding power source. In the event of a continued overload or abnormal primary current drawn, a current transformer (located in the primary input lines to the main transformer) will detect this overload condition and cause the circuit breaker to open. The internal contacts of the circuit breaker are connected in series with the primary contactor coil of the welding power source. Thus, if the current transformer detects an overload condition, the opening or tripping of the circuit breaker causes the primary contactor to open thereby suspending weld current output. The Circuit Breaker must be positioned to ON before the primary contactor of the welding power source can be energized. If the Circuit Breaker should open or trip, it must be manually re-set.

## 4 - 7. WATER-GAS POST-FLOW TIMER (Figure 4-2)

An adjustable 0 to 60 second Water-Gas Post-Flow Timer, located on the center portion of the lower front panel, is provided for controlling the period of time shielding gas and water (coolant) will be allowed to flow after the arc is extinguished.

To select the desired portion of the maximum 60 second post-flow period available, rotate the adjustable stop arm on the timer until the appropriate setting is obtained.

As soon as the arc has been extinguished, the Post-Flow Timer will begin to time out the selected period of post-flow time. Once the timer has timed out, the gas and water valve will close and thereby cut off shielding gas and water flow. The timer will then automatically reset and be ready for another weld cycle.

## 4 - 8. HIGH FREQUENCY INTENSITY CONTROL (Figure 4-2)

A High Frequency Intensity Control is provided on the lower front panel for controlling the strength of the high frequency.

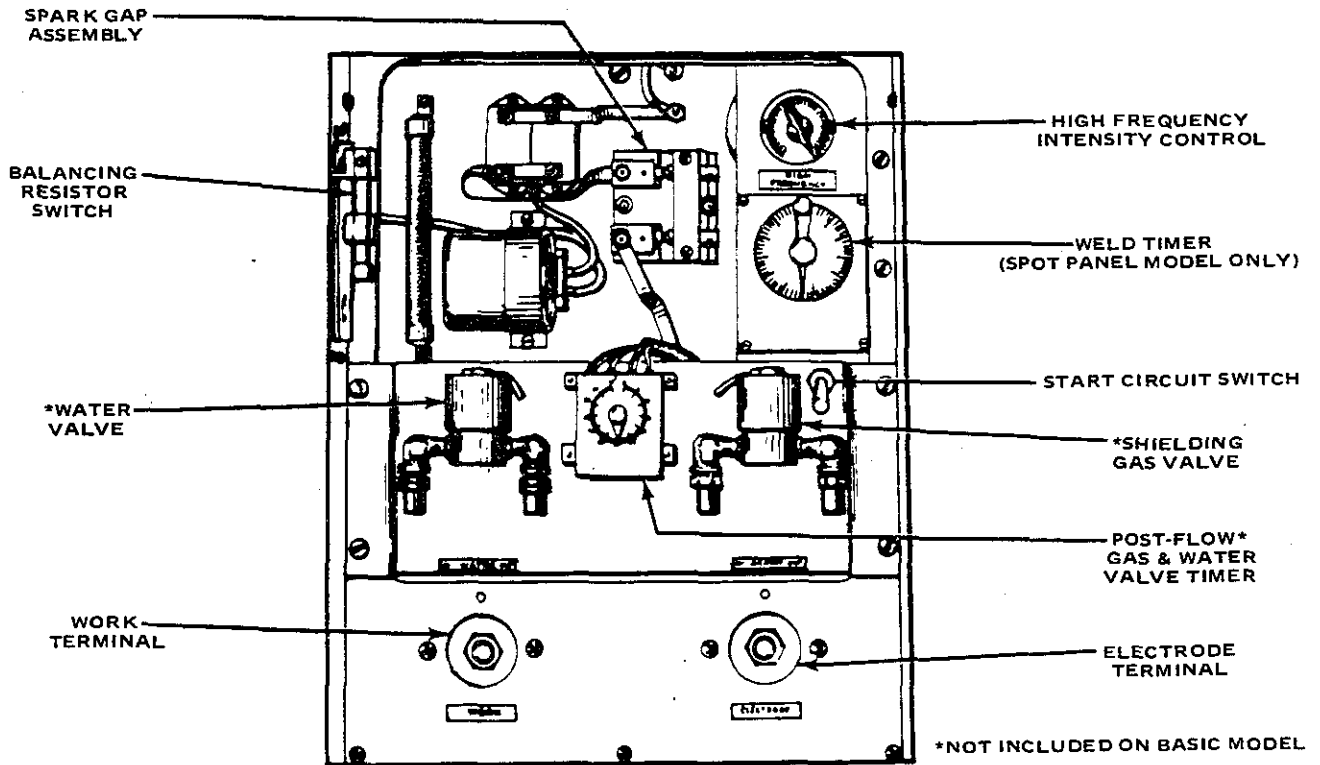


Figure 4-2. Lower Front Control Panel

TA-901 013-6

quency. Rotating the control in a clockwise direction will increase the intensity of the high frequency.

#### NOTE

As the high frequency intensity is increased, the possibility of causing interference with local radio and television receivers also increases. It is recommended that the High Frequency Intensity Control be set at as low a position as possible in order to avoid receiver interference.

#### 4 - 9. BALANCING RESISTOR SWITCH (Figure 4-2)

The Balancing Resistor Switch will place the proper amount of resistance in the welding power source necessary to provide proper welding characteristics for either Shielded Metal-Arc or Gas Tungsten-Arc welding.

When Shielded Metal-Arc Welding (Stick Electrode) is to be performed, the arm of the Balancing Resistor Switch must be in the METALLIC (down) position. When performing Gas Tungsten-Arc Welding (TIG), the arm of the switch must be in the TIG (up) position.

#### 4-10. FULL WAVE/HALF WAVE BALANCE (Figure 4-3)

Gas Tungsten-Arc Welding of magnesium and aluminum is commonly done with ac welding current. In theory, half of the total number of electrons in the welding current would flow from the tungsten to the work and the other half would flow from the work back into the tungsten.

In practice, however, this condition does not occur when Gas Tungsten-Arc Welding is being done on oxide forming materials such as aluminum or magnesium. The oxides on the surface of the metal make it easier for the welding current to pass from tungsten to workpiece than in the opposite direction.

This unbalancing of the ac welding current can cause problems in extreme cases. Some of the results which may be encountered are:

1. Poor cleaning action.
2. Porosity

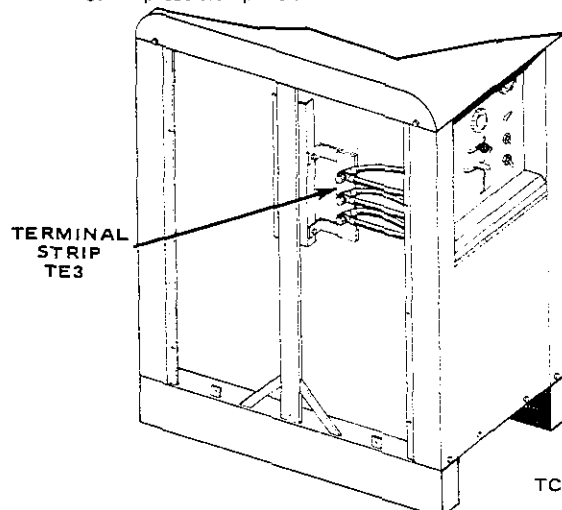
3. Fluctuation in the arc

4. Uneven weld penetration

It is important to remember that different alloys of aluminum or magnesium may react differently and that variations of temperature or technique play an important part. Generally speaking, problems caused by rectification may be corrected with this welding power source by changing over to the half wave circuit.

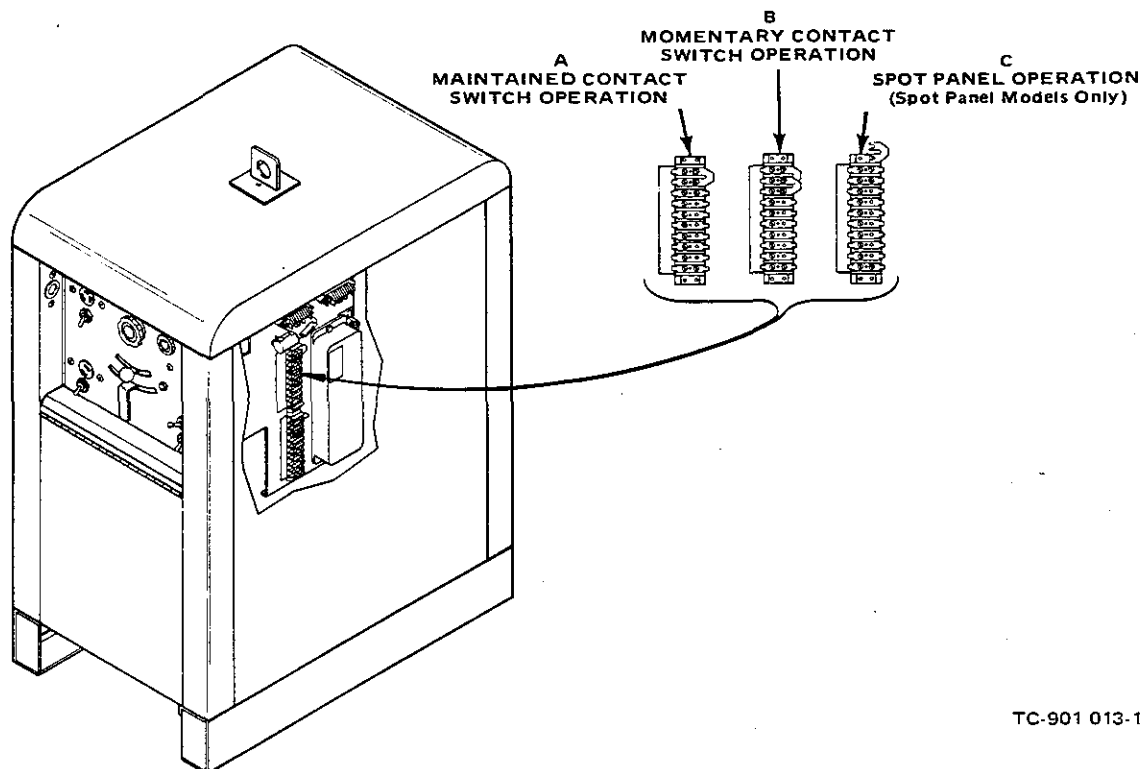
To change over to the half wave circuit, proceed as follows:

1. Remove the left side panel and locate terminal strip TE3. See Figure 4-3.
2. Disconnect wire No. 27 at terminal A, No. 57 at terminal B and No. 55 at terminal C.
3. Connect wire No. 55 to terminal A.
4. Connect wire No. 27 to terminal B.
5. Connect wire No. 57 to terminal C.
6. Replace side panel.



TC-901 013-2

Figure 4-3. Terminal Strip TE3 Location



TC-901 013-13

Figure 4-4. Terminal Strip 1T Location And Jumper Link Arrangement

#### 4-11. PANEL CONNECTION (Gas And Water Model And Spot Model Only)

##### A. Maintained Contact Switch Operation

Whenever it is desired to start and stop the welding arc by respectively closing and opening the Remote Contactor Control Switch, a maintained contact type switch must be used as the Remote Contactor Control Switch and the jumper links on terminal strip 1T must be positioned as shown in section A of Figure 4-4.

When welding in this fashion, closing the Remote Contactor Control Switch will provide weld current, high frequency, and energize the Gas and Water valves and thereby cause shielding gas and coolant to flow. All of these items will remain active (high frequency will remain on only if the HIGH FREQUENCY Switch is in the CONTINUOUS position) for as long as the Remote Contactor Control Switch is closed. Opening the Remote Contactor Control Switch will shutoff the weld current and high frequency and also will start the post-flow timer.

##### B. Momentary Contact Switch Operation

When the jumper links on terminal strip 1T are positioned as shown in section B of Figure 4-4, a momentary contact switch may be used as the Remote Contactor Control Switch. The Momentary Contact Switch need be closed only long enough to initiate the arc and then it may be released. To break the arc when welding in this manner, it will be necessary to pull the TIG gun away from the workpiece. High frequency will be present and the Gas and Water valves will energize and permit shielding gas and coolant to flow as soon as the Remote Contactor Control Switch is closed when utilizing this type of operation. When the arc is broken by pulling the TIG gun away from the workpiece, weld current and high frequency will be cutoff and the Post-Flow Timer will be started.

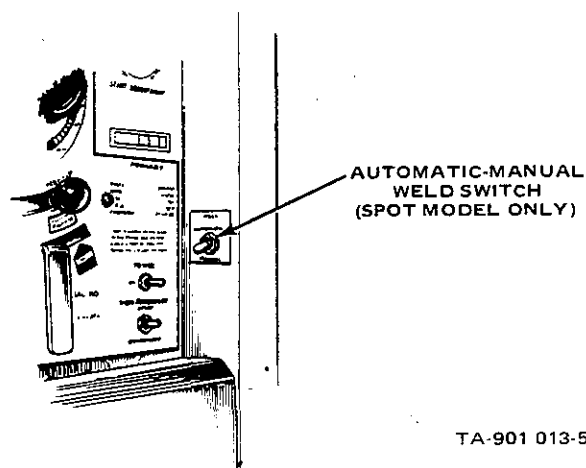
##### C. Spot Panel Operation (Spot Panel Models Only)

In order to utilize the Spot Weld Timer, it will be necessary to position the jumper links on terminal strip 1T as shown in section C of Figure 4-4. When utilizing the Spot Weld Timer, a momentary contact switch should be used as the Remote Contactor Control switch.

Upon closure of the Remote Contactor Control Switch the operator may proceed with establishing an arc. As soon as an arc is struck, the Spot Weld Timer will begin timing out. Also

upon closure of the Remote Contactor Control Switch, the Gas and Water valves will energize and permit shielding gas and coolant to flow and High Frequency will be present. Once an arc is established, the Remote Contactor Control Switch may be released as the weld current, high frequency, and Gas and Water valves will all be on until the time allotted on the Spot Weld Timer has elapsed. When the Spot Weld Timer has timed out, weld current and high frequency will be cutoff and the Post-Flow Timer will be started.

#### 4-12. AUTOMATIC-MANUAL WELD SWITCH (Figure 4-5 – Spot Panel Models Only)



TA-901 013-5

Figure 4-5. Automatic-Manual Weld Switch

The AUTOMATIC-MANUAL WELD Switch will determine whether the Spot Weld Timer or the Remote Contactor Control Switch will govern the amount of time that weld current will be available when the jumper link on terminal strip 1T is connected for spot panel operation.

When in the AUTOMATIC position the time of the weld will be determined by the Spot Weld Timer.

When in the MANUAL position, weld time will be governed by the Remote Contactor Control Switch. In this position, weld current will be available for as long as the Remote Contactor Control Switch is closed.

### NOTE

When in the MANUAL position the Spot Weld Timer will start to time out as soon as an arc is initiated. However, the timer will have no effect on when the weld current will be cutoff, this will be solely determined by the opening of the Remote Contactor Control Switch.

### 4-13. SPOT WELD TIMER (Figure 4-2 – Spot Panel Models Only)

The Spot Weld Timer provides a means of selecting the exact period of time that weld current will be available when spot welding is being performed.

### NOTE

In order for the Spot Weld Timer to be functional the WELD Switch must be in the AUTOMATIC position and the jumper link on terminal strip 1T must be connected for spot panel operation.

The Spot Weld Timer will begin to time out and provide weld current as soon as an arc is initiated. When the time set on the Spot Weld Timer has elapsed, weld current will be cutoff and the Post-Flow Timer will be started.

### 4-14. DUTY CYCLE (Figure 4-6)

The duty cycle of the welding power source is the percentage of the ten minute period that a welding power source can safely be operated at a given output current setting. This welding power source is rated at 200 or 300 amperes (depending on the model) amperes, 60 percent duty cycle. This means the welding power source can be safely operated at 200 or 300 amperes (depending on the model) amperes welding current for 6 minutes out of every ten. If the welding

current is decreased, the duty cycle will increase. Figure 4-6 enables the operator to determine the safe output of the welding power source at various duty cycles.

### IMPORTANT

Exceeding the indicated duty cycle will cause the machine to overheat thereby causing damage to the machine.

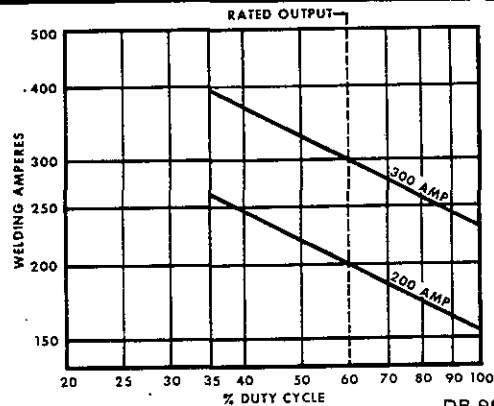
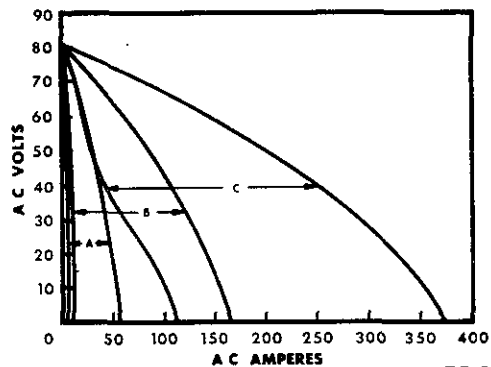


Figure 4-6. Duty Cycle Chart

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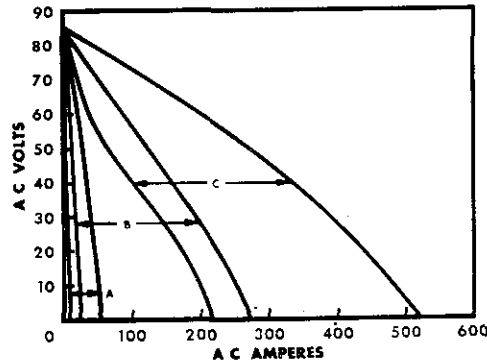
### 4-15. VOLT-AMPERE CURVE (Figure 4-7, 4-8 & 4-9)

The volt-ampere curve shows the output voltage available at any given output current within the limits of the minimum and maximum current control setting. Load voltage is pre-determined to a large degree by arc characteristics. With the use of the volt-ampere curve, it is possible to determine the amperage required for a specific load voltage. With reference to the volt-ampere curve, the curve shows the maximum and minimum settings of the current control only. Curves of other settings will fall between the maximum and minimum curves shown.



EB-901 013-1A

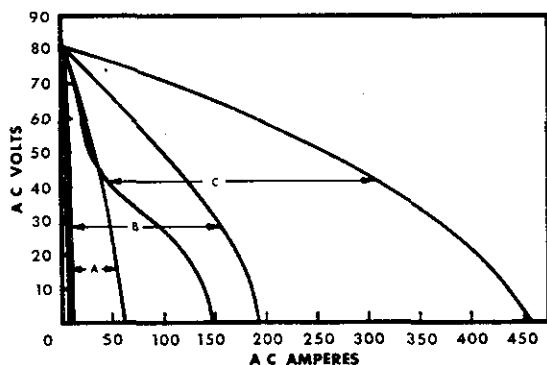
200 Amp Model



EB-901 034-1A

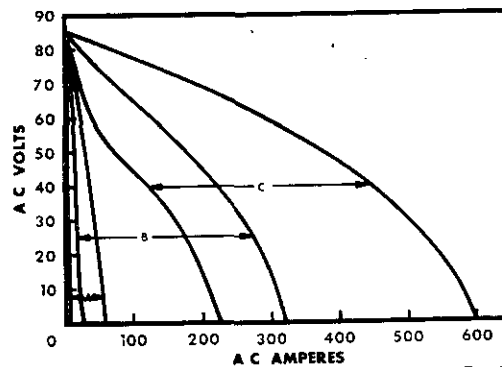
300 Amp Model

Figure 4-7. AC Gas Tungsten-Arc Volt-Ampere Curves



EB-901 013-2A

200 Amp Model



EB-901 034-2A

300 Amp Model

Figure 4-8. AC Shielded Metal-Arc Volt-Ampere Curves

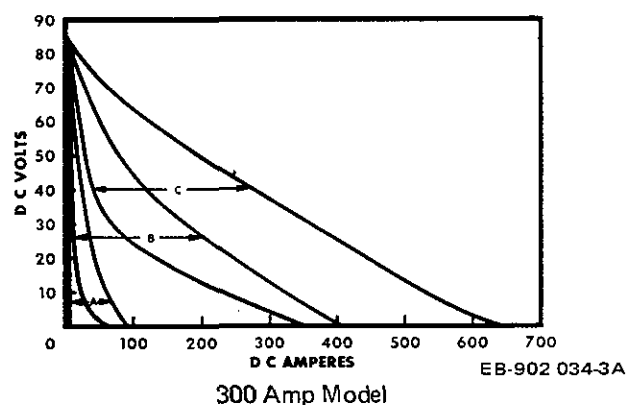
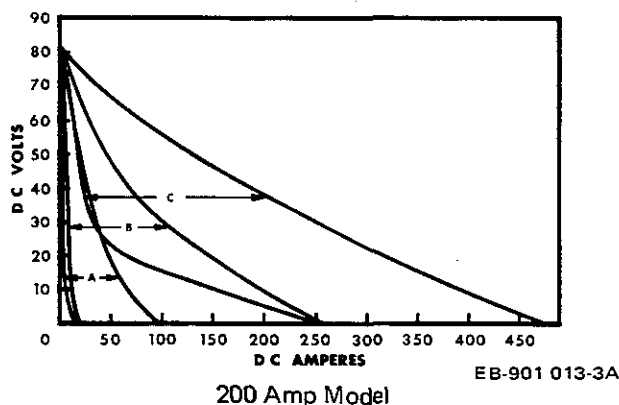


Figure 4-9. DC Shielded Metal-Arc Volt-Ampere Curves

## SECTION 5 - SEQUENCE OF OPERATION

### CAUTION

Never, under any circumstances, operate the welding power source with any portion of the wrapper removed. In addition to a safety hazard, improper cooling may result in damage to the welding transformer and the welding power source components. Warranty is void if the welding power source is operated with the wrapper removed.

### 5 - 1. SHIELDED METAL-ARC WELDING

1. Make all necessary connections as instructed in Section 3.
2. On all models except the basic, connect the jumper link on terminal strip 1T to the configuration shown in section A of Figure 4-4.
3. Place the CONTACTOR CONTROL Switch in the STANDARD position.
4. Place the Polarity Switch in the desired position.
5. If a Remote Amperage Control is not to be used, place the REMOTE AMPERAGE CONTROL Switch in the STANDARD position.
6. Place the START CIRCUIT Switch in the desired position. If this switch is positioned to IN, rotate the START ADJUSTMENT Control to the desired setting.
7. Place the Range Switch in the desired position.
8. Rotate the Fine Current Control to the desired setting.
9. Place the HIGH FREQUENCY Switch in the OFF position.
10. Place the Balancing Resistor Switch in the METALLIC position.
11. Ensure that the PRIMARY OVERLOAD Circuit Breaker is in the ON position.
12. Place the POWER Switch in the ON position.

### CAUTION

Prior to welding, it is imperative that proper protective clothing (welding coat and gloves) and eye protection (glasses and/or welding helmet) be put on. Failure to comply may result in serious and even permanent bodily damage.

13. Commence welding.

### 5 - 2. GAS TUNGSTEN-ARC WELDING

1. Make all necessary connections as instructed in Section 3.
2. Connect the jumper link on terminal strip 1T for either momentary or maintained switch operation. (This step does not apply to basic models.)
3. Place the CONTACTOR CONTROL Switch in the REMOTE position.
4. Place the Polarity Switch in the desired position.
5. If a Remote Amperage Control is not to be used, place the REMOTE AMPERAGE CONTROL Switch in the STANDARD position.
6. Place the Range Switch in the desired position.
7. Rotate the Fine Current Control to the desired setting.
8. Place the START CIRCUIT Switch in the desired position. If this switch is positioned to IN, rotate the START ADJUSTMENT Control to the desired setting.
9. Place the HIGH FREQUENCY Switch in the START or CONTINUOUS position and rotate the HIGH FREQUENCY Intensity Control to the desired setting.
10. Place the Balancing Resistor Switch in the TIG position.
11. Set the Post-Flow Timer for the desired amount of time.
12. Connect for full or half wave operation as instructed in paragraph 4-10.
13. Ensure that the PRIMARY OVERLOAD Circuit Breaker is in the ON position.
14. Place the POWER Switch in the ON position.

### CAUTION

Prior to welding, it is imperative that proper protective clothing (welding coat and gloves) and eye protection (glasses and/or welding helmet) be put on. Failure to comply may result in serious and even permanent bodily damage.

15. Commence welding.

### 5 - 3. GAS TUNGSTEN-ARC SPOT WELDING (Spot Panel Models Only)

1. Make all necessary connections as instructed in Section 3.
2. Connect the jumper link on terminal strip 1T for spot panel operation.

3. Place the CONTACTOR CONTROL Switch in the REMOTE position.
4. Place the Polarity Switch in the desired position.
5. If a Remote Amperage Control is not to be used, place the REMOTE AMPERAGE CONTROL Switch in the STANDARD position.
6. Place the Range Switch in the desired position.
7. Rotate the Fine Current Control to the desired setting.
8. Place the START CIRCUIT Switch in the desired position. If this switch is positioned to IN, rotate the START ADJUSTMENT Control to the desired setting.
9. Place the HIGH FREQUENCY Switch in the START or CONTINUOUS position and rotate the HIGH FREQUENCY Intensity Control to the desired setting.
10. Place the Balancing Resistor Switch in the TIG position.
11. Place the WELD Switch in the AUTOMATIC position.

12. Set the Spot Weld Timer for the desired amount of time.
13. Set the Post-Flow Timer for the desired amount of time.
14. Connect for full or half wave operation as instructed in paragraph 4-10.
15. Ensure that the PRIMARY OVERLOAD Circuit Breaker is in the ON position.
16. Place the Power Switch in the ON position.

#### CAUTION

Prior to welding, it is imperative that proper protective clothing (welding coat and gloves) and eye protection (glasses and/or welding helmet) be put on. Failure to comply may result in serious and even permanent bodily damage.

17. Commence welding.

## SECTION 6 - MAINTENANCE

#### CAUTION

Ensure that the branch circuit or main disconnect switch is open or primary input circuit fuses are removed before attempting any inspection or work on the inside of the welding power source. Placing the welding power source on-off power switch in the OFF position does not remove voltage from the power terminals inside the welding power source.

#### NOTE

Cleaning or dressing the points of the spark gaps is not recommended, as the material at the points is tungsten and is impossible to file. The entire point should be replaced when the tungsten section is completely disappeared.

### 6 - 1. RECTIFIER

It is recommended that the rectifier be cleaned occasionally by blowing it out with compressed air. This cleaning operation is necessary so that maximum cooling will be accomplished by the air stream. This should be done periodically depending upon the location of the unit and the amount of dust and dirt in the atmosphere.

### 6 - 2. FAN MOTOR

All models are equipped with an exhaust fan and rely on forced draft for adequate cooling for high duty cycles and overloads. The fan motor is manufactured with lifetime lubricated sealed ball bearings and no attention should be required.

### 6 - 3. RECTIFIER

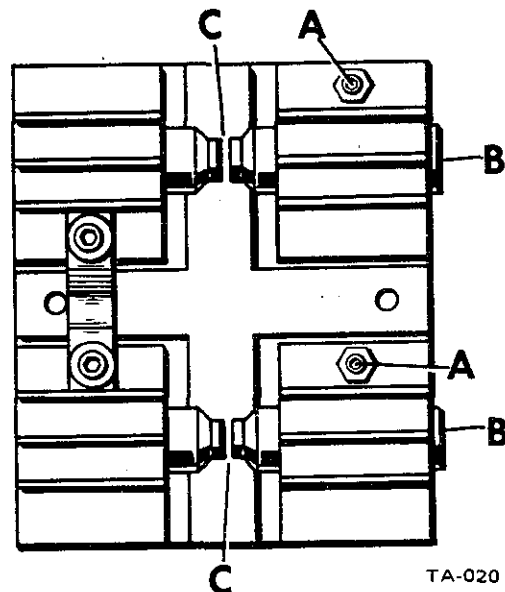
It is recommended that the rectifier be cleaned occasionally by blowing it out with compressed air. This cleaning operation is necessary so that maximum cooling will be accomplished by the air stream. This should be done periodically, depending upon the location of the unit and the amount of dust and dirt in the atmosphere.

### 6 - 4. SPARK GAP

The spark gaps can be readily inspected by opening the access door on the front of the welding power source.

The spark gaps are normally set a .008" clearance at the factory. It will be necessary to periodically readjust these after extended operation. Usually inspection and adjustment every three or four months will suffice. Readjustment is also indicated when intermittent operation of the gaps is noted. Usually this occurs when the setting has increased to .013" or greater.

Generally speaking, the high frequency output varies directly (up to a certain point) with the spark gap spacing. In extreme cases where the greatest amount of high frequency is needed, it may be necessary to adjust the spark gap setting to .010" or even .013". This also increases the high frequency radiation and it is suggested that the minimum gap setting (.004" to .008"), consistent with good welding operation, be used.



TA-020 623-A2

**Figure 6-1. Spark Gap Adjustment**  
To Adjust Spark Gaps, Proceed As Follows:

1. Loosen screw A on both sides.
2. Place feeler gauge of proper thickness between gaps C.
3. Apply slight pressure against point B so feeler gauge is held firmly in gap.
4. Tighten screws A.

### 6 - 5. CONTROL CIRCUIT FUSING

The control circuit fuse is a 600 volt, 6 ampere type fuse and is mounted in the case next to the primary terminal board. Do not use any fuse other than a 600 volt, 6 ampere size. The purpose of this fuse is to provide protection to the control rectifier and the circuit components.

The symptom of a blown fuse is complete loss of control of the welding current but minimum output of each range is available. Before replacing the fuse, examine leads for short circuit or other signs of trouble, especially at the point where the leads enter the remote amperage control case. Examine the Amperage Adjustment Control Rheostat in the welding power source, and, if a remote amperage control is used, also examine the rheostat in the remote amperage control.

## 6 - 6. THERMAL PROTECTION

This welding power source is protected with one normally closed overload thermostat located in the Right Secondary Coil of the Main Weld transformer (TP1). Any excessive overloading will cause the Main Contactor to open, stopping the welding power source output. If this occurs, stop welding and allow the welding power source about three minutes cooling off time. Normal operation can then be resumed.

## SECTION 7 - TROUBLESHOOTING

### INTRODUCTION

The data collected here, discusses some of the common problems which may occur in this welding power source. A little thought will probably solve the problem involved through the information provided.

The assumption of this data is that a proper welding condition has been achieved and has been used until trouble developed. In all cases

of equipment malfunction, the manufacturer's recommendations should be strictly adhered to and followed.

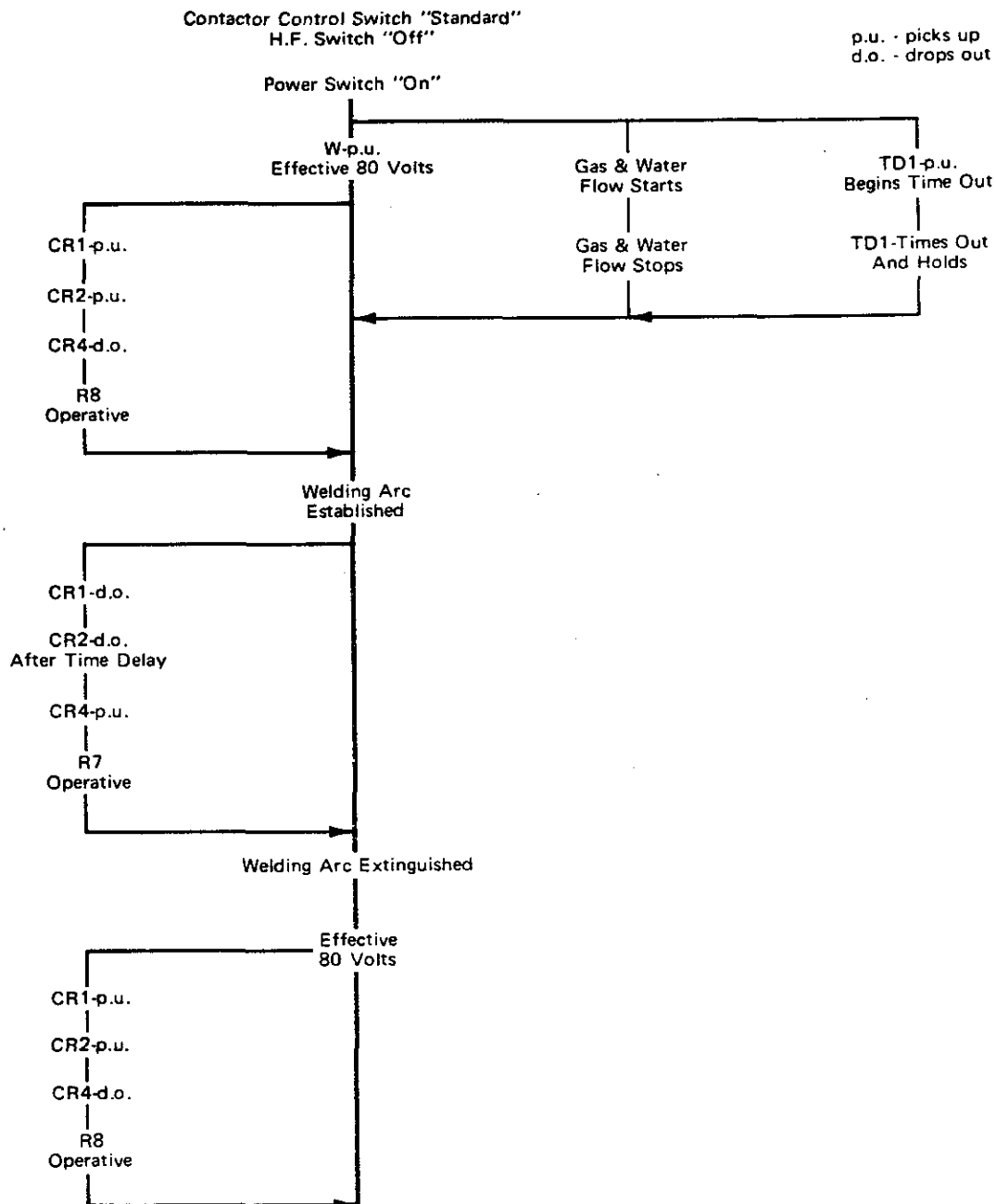
If after performing the following procedures the trouble is still not remedied, it is recommended that a serviceman be called.

It is recommended that the circuit diagram be used for reference during the troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Control of welding current with Start Adjustment Control only. High Frequency remains on when H.F. Switch is in "START" position.	CR1 relay remains energized after arc begins.	Examine CR1 relay. May be necessary to adjust R2 resistor.
Changing position of Start Adjustment Control does not affect starting current. High frequency does not turn on when switch is in "START" position.	CR1 relay does not p.u. when welding machine is turned on and no arc is established.	May be necessary to adjust R2 resistor to increase voltage applied to CR1.
	Start Control Switch in OUT position.	Place Start Control Switch in IN position if starting current is desired.
Welding current very low - increasing Weld Current Control setting does not increase welding current.	Blown control circuit fuse.	Replace if defective with a 6 amp, 600 volt fuse.
	Amperage Control Switch in the REMOTE position with no remote amperage control connected to receptacle.	Either place Amperage Control Switch in the STANDARD position or connect a remote amperage control to the Remote Amperage Control Receptacle.
	Using remote amperage control with Weld Current Control on machine turned to minimum.	Increase the setting of the Weld Current Control on the machine.
Welding current low - Weld Current Control does not control current.	Low line voltage.	Check line voltage - if low. Check with Power Company to determine cause.
	Use of welding cable which is too long or too small for the welding current employed.	See Table 3-2 for cable size requirement for current used.
	Loose connection to workpiece or in welding cable connections.	Check all secondary welding connections.
Machine delivering welding amperage more or less than marked on nameplate.	Operating welding power source on incorrect line voltage.	Check jumper links on primary line voltage connections. See Figure 3-3.
Lack of high frequency, difficulty in establishing arc.	Spacing of spark gaps has increased.	Set spark gap points .008" to .010".
	Use of tungsten larger than recommended for welding amperage involved.	Use proper size tungsten.
	Dissipation of high frequency from electrode holder lead.	Make certain electrode holder cable is not in close proximity to any grounded metal.
	High Frequency Intensity Control setting too low.	Increase setting of High Frequency Intensity Control.
Wandering arc - poor control of direction of arc.	Use of tungsten considerably larger than recommended.	Use proper tungsten size.
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Water lead in electrode holder.	Refer to gun parts list for parts or parts requiring replacement.
	Loose gas fittings on regulator or gas line. This will siphon oxygen into the weld zone.	Check all gas fittings and tighten.
	Insufficient gas flow.	Increase gas flow setting.
	Drafts blowing gas shield away from tungsten.	Shield weld zone from drafts.
	Dirty filler rod or material.	Use clean filler rod or material.
	Gas shutting off too quickly after end of weld.	Increase time delay setting of Post-Flow Gas and Water Valve Timer.

Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Insufficient high frequency.	Increase setting of High Frequency Intensity Control.
Power switch on, no weld current, and fan motor is not running.	F2 fuse blown.	Replace if defective.
High frequency unit has no power.	F3 fuse blown.	Replace if defective.

## SHIELDED METAL-ARC (STICK ELECTRODE) WELDING

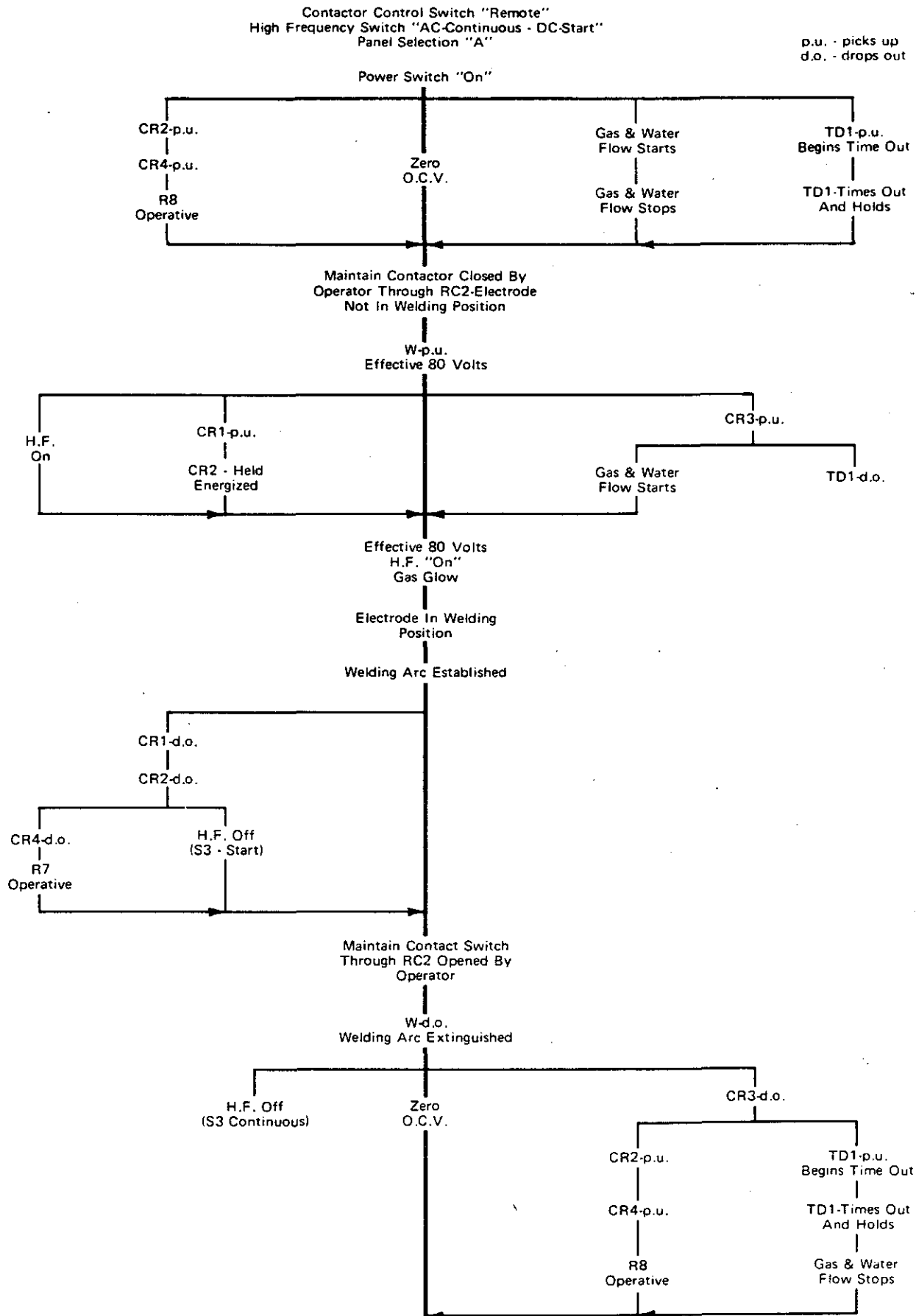


TA-901 013-9

Figure 7-1. Shielded Metal-Arc Welding Flow Chart



## AC AND DC GAS TUNGSTEN-ARC (TIG) WELDING



TA-901 013-10

Figure 7-2. A Panel AC/DC Gas Tungsten-Arc Welding Flow Chart

# AC AND DC GAS TUNGSTEN-ARC (TIG) WELDING

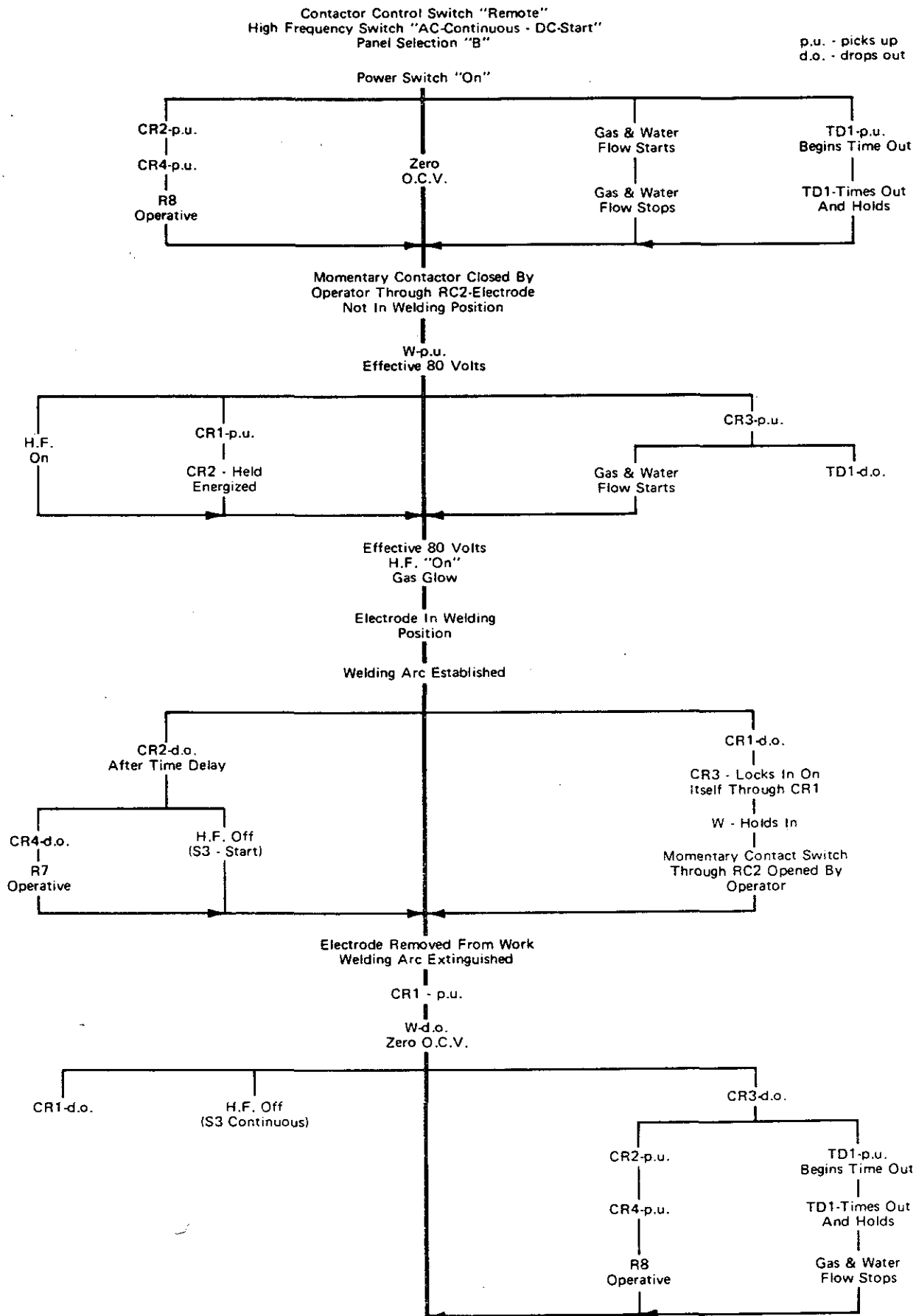
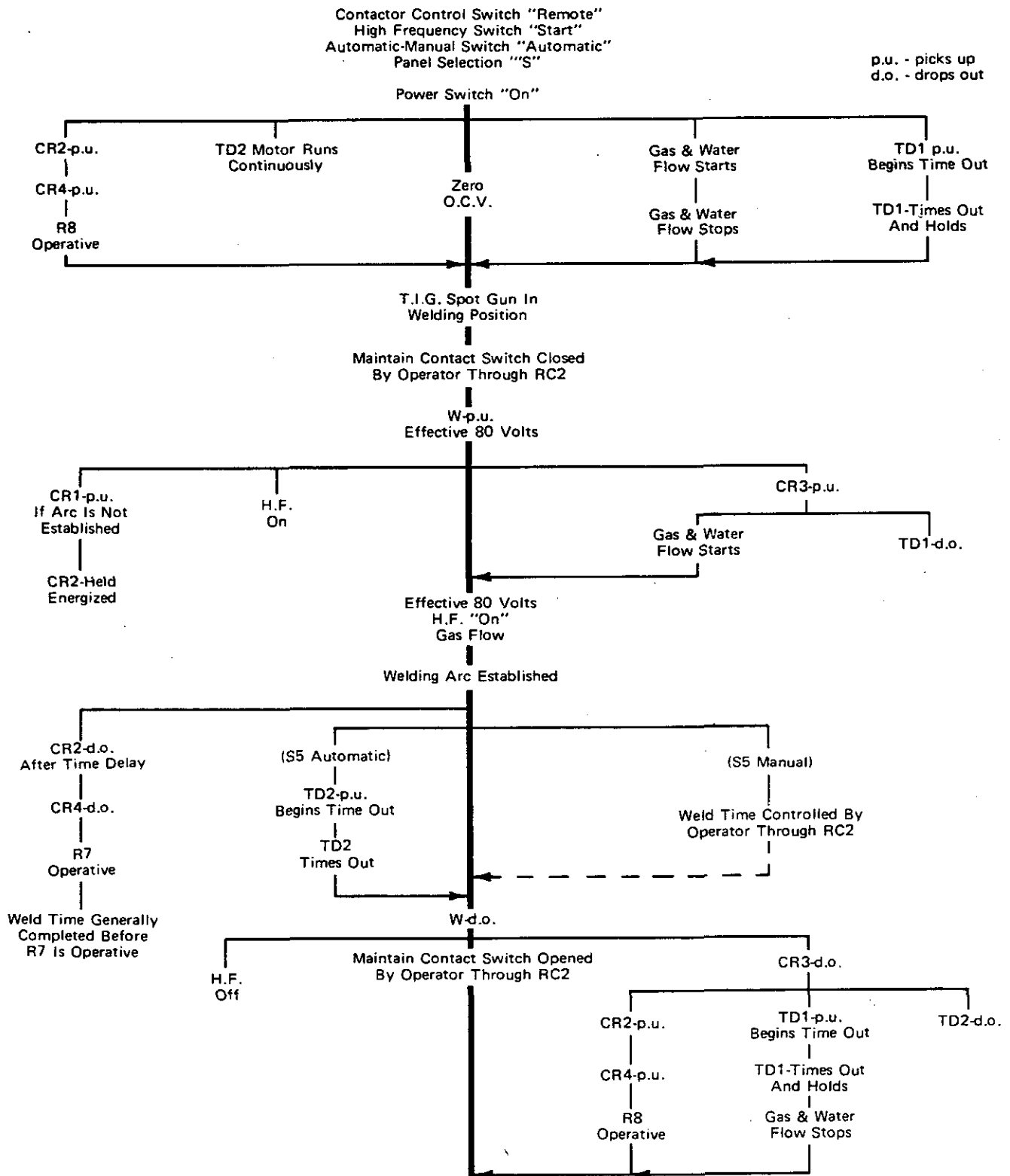


Figure 7-3. B Panel AC/DC Gas Tungsten-Arc Welding Flow Chart

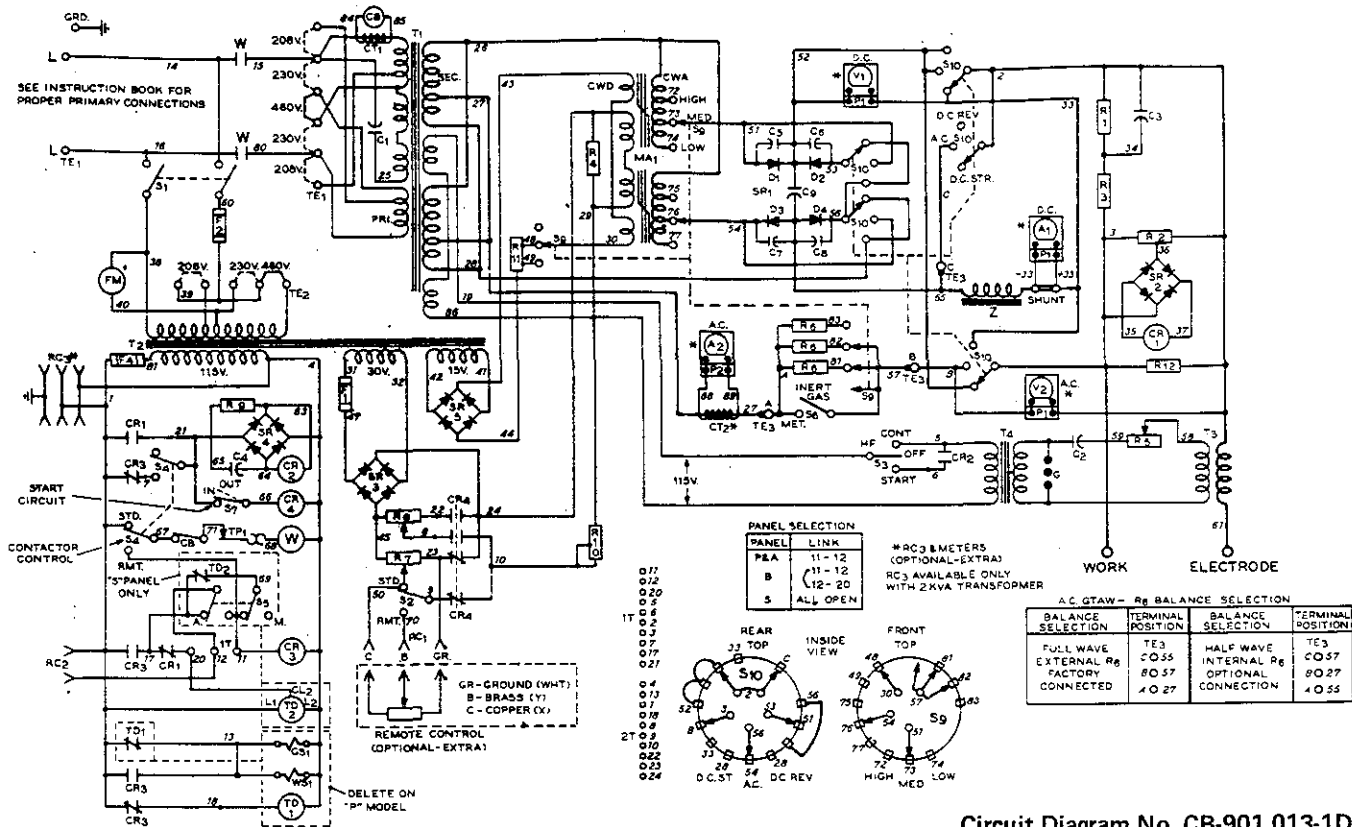
TA-901 013-11

# DC GAS TUNGSTEN-ARC (TIG) SPOT WELDING



TA-901 013-12

Figure 7-4. DC Gas Tungsten-Arc Spot Welding Flow Chart



## SECTION 8 - CERTIFICATION FOR HIGH FREQUENCY ARC WELDING EQUIPMENT

### 8 - 1. GENERAL

This following information is necessary to make a proper installation of the high frequency arc welding equipment described in this instruction manual. In order to comply with Part 18 of the Rules and Regulations of the Federal Communications Commission, the certificate in front of this manual must be filled in completely and signed. The certificate must be kept WITH THE EQUIPMENT AT ALL TIMES to comply with the regulation.

The manufacturer of the equipment covered herein has conducted approved field tests and certifies that the radiation can reasonably be expected to be within the legal limits if the correct installation procedures, as outlined, are followed.

The importance of a correct installation cannot be over-emphasized since case histories of interference due to high frequency stabilized arc Welding Machines have shown that invariably an inadequate installation was at fault.

The user of the equipment must complete the certification by stating that he has installed the equipment and is using it, according to the manufacturer's instructions. The user must sign the certification notice appearing in front of this instruction booklet indicating that he has complied with the requirements.

In the event that interference with authorized services occurs, in spite of the fact that the radiation from the welding equipment is within the specified limits, the user is required to take suitable steps to clear the situation. The factory personnel will assist the user by supplying technical information to clear the situation.

In lieu of complying with the installation requirements and the certification of each individual installation, the user may elect to certify his entire plant by having a reputable engineering firm make a plant radiation survey. In such cases, the installation instructions incorporated in this instruction booklet could very well serve as a guide in minimizing interference that might be contributed by the high frequency arc welding equipment.

### 8 - 2. GENERAL INFORMATION

In a high frequency stabilized arc Welding Machine installation, interfering radiation can escape in four distinct ways as outlined below:

1. Direct radiation from the welding machine. This is radiation that escapes directly from the Welding Machine case. This is very pronounced if access doors are left open and unfastened and if the Welding Machine case is not properly grounded. Any opening in the metal Welding Machine case will allow some radiation to escape. The high frequency unit of this certified equipment is adequately shielded to prevent direct radiation of any consequences if proper grounding is carried out.
2. Direct feedback to the power line. High frequency energy may get on the power line by direct coupling inside the equipment or the high frequency unit, the power line then serving as a radiating antenna.

By proper shielding and filtering, direct coupling is prevented in this certified equipment.

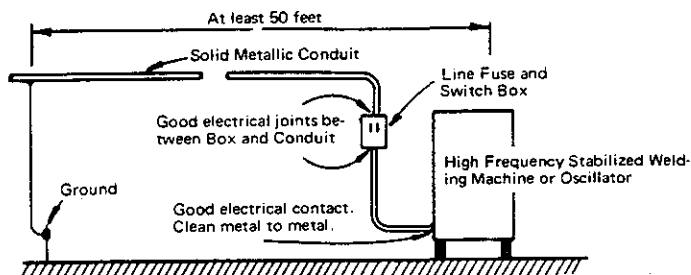


Figure 8-1. Power Service Installation H.F. Stabilized Arc Welding Machine

3. Direct radiation from welding leads. Direct radiation from the welding leads, although very pronounced, decreases rapidly with distance from the welding leads. By keeping the welding leads as short as possible, the operator can do a great deal to minimize interference from the source.

The intensity and frequency of the radiation can be altered over wide limits by changing the location and relative position of the welding leads and work. If possible, loops and suspended sections should be avoided.

4. Pick-up and reradiation from power lines. Even though welding lead radiation falls off rapidly with distance, the field strength in the immediate vicinity of the welding area may be extremely high. Unshielded wiring and ungrounded metallic objects in this strong field may pick up the direct radiation, conduct the energy for some distance, and produce a strong interference field in another area.

This is usually the most troublesome source of interference, but careful adherence to proper installation procedure as outlined in this booklet will minimize this type of interference.

### 8 - 3. POWER SERVICE

The specific installation instructions for making the proper primary connections to the equipment as outlined in the instruction booklet furnished with the equipment, should be followed carefully with one exception as noted in the following paragraph.

Frequently installation instructions specify that the primary power service shall be run in solid or flexible metallic conduit. Ordinary helically wrapped conduit is designed for mechanical protection and is not suitable for electrical shielding. Only solid metallic conduit or conduit of "equivalent electrical shielding ability" should be used to enclose the primary power service leads.

Solid metallic shielding shall enclose the primary power service to the equipment from a point 50 feet from the equipment in a unbroken run.

This shielding shall be grounded at the farthest point from the equipment and should make good electrical contact with the casing of the equipment. The ground should be in accordance with the specifications outlined in the section entitled "GROUNDS" and as shown in Figure 8-1. Care should be taken that paint or corrosion at the junction of conduit and case, does not interfere with good electrical contact.

There shall be no gap in this shielding run. This simply means that within 50 feet of the equipment, no portion of the power wires serving the equipment shall be unshielded. If there is any question about the electrical efficiency of the joints between individual conduit sections, outlet boxes and the equipment case, bonding should be carried out by soldering a copper strap or wire across the joint as shown in Figure 8-2.

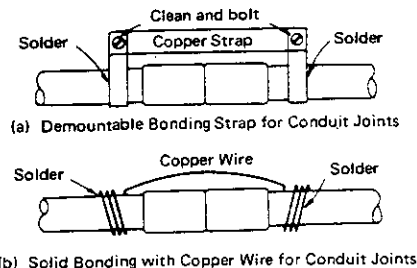
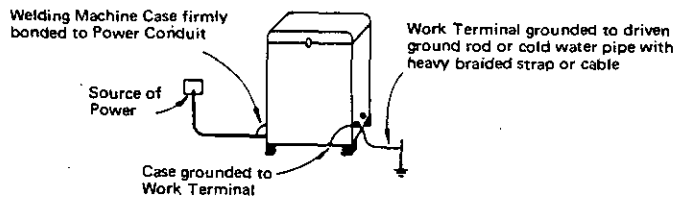


Figure 8-2. Two Recommended Methods For Electrical Bonding Across Poor Conductivity Conduit Joints

### 8 - 4. WELDING MACHINE

The location of the equipment should be chosen with respect to nearness to a suitable ground connection. The equipment case, firmly bonded to the power conduit, should be grounded to the work terminal of the equipment with a copper cable or braid with rated current carrying capacity equal to or greater than that of the power service wires.

This "work" output terminal of the equipment should then be grounded to a "good electrical ground" (as defined in section entitled "GROUNDS") with a short length of welding cable of the same capacity as the "work lead". (See Figure 8-3).



**Figure 8-3. Ground Connections At Welding Machine**

No change in the wiring or the location of parts inside the equipment, other than power service tap changes or other adjustments specifically covered shall be made. The equipment shall not be modified in any way since changes in the equipment can affect the radiation characteristics and may not be in accordance with the test data upon which the manufacturer bases his certification.

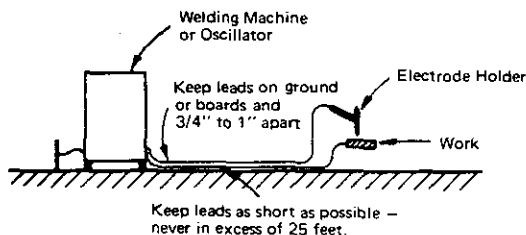
While the equipment is in operation, all access and service doors shall be closed and properly fastened.

Spark gap settings shall be maintained at the minimum separation consistent with satisfactory welding results.

## 8 - 5. WELDING LEADS

In order to minimize direct weld lead radiation, the welding leads (electrode lead and work lead) must be kept as short as possible. Certification tests on this machine have been made with leads 25 feet long. Considerable improvement in radiation minimization can be had by shortening the leads as much as possible.

Keeping the electrode lead and ground or work lead as close as possible and on the floor serves to reduce the radiation. (See Figure 8-4).



**Figure 8-4. General Rules For Welding Leads**

## 8 - 6. WIRING IN THE VICINITY OF THE WELDING AREA

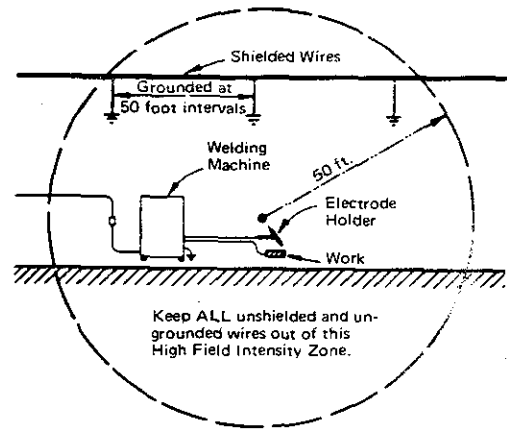
As discussed in the general information section, the most serious source of interference is reradiation from wires that are located near the welding area.

Any ungrounded electrical conductor in the strong "directly radiated" field, produced by the welding leads, serves as a pick-up device and may conduct the interference for some distance and reradiate strongly at another location.

For purpose of simplification and standardization, the space all around the weld zone at a distance of 50 feet in all directions is referred to as the High Field Intensity (H.F.I.) zone. (See Figure 8-5).

To minimize radiation of this type all wiring in the H.F.I. zone shall be in rigid metallic conduit, lead covered cable, copper braid or material of equivalent shielding efficiency. Ordinary flexible helically wrapped metallic conduit, commonly referred to as "B.X." is not satisfactory for shielding, and should not be used. The shield on all wiring should be grounded at intervals of 50 feet and good electrical bonding between sections shall be maintained.

This shielding requirement applies to all wiring, including telephone, inter-communication, signal and control and incidental service.



**Figure 8-5. General Requirements to Minimize Reradiation Pick-Up In the Vicinity of the Weld Zone**

Extreme precaution should be taken to make sure that the location of the zone is chosen so that none of the conditions are voided by unshielded wires off the premises but still within the radial dimensions of the H.F.I. zone.

This 50 foot H.F.I. zone is a minimum that is imposed on the installation. Certification tests by the manufacturer are based on this limit.

Keeping unshielded wires farther than 50 feet from the weld zone will materially aid in minimizing interference.

If it is impossible to relocate unshielded wires, that section within the H.F.I. zone, should be placed in conduit and each end of the conduit section grounded.

### NOTE

It must be emphasized that all changes in power and lighting wiring should be made by a qualified electrician and comply with the National Electrical Code requirements. Any shielding or relocation of telephone or signal wires must be done either by the service company concerned or with the specific permission of said company.

## 8 - 7. GROUNDS

Frequent reference is made to a "good ground" in previous sections. Although there is considerable leeway in the interpretation of this term, for the purpose covered in this booklet the following specifications apply:

A "ground" connection should be made to a driven rod at least 8 feet long and driven into moist soil.

A cold water pipe can be used in place of the ground rod provided it enters the ground within 10 feet of the equipment to be grounded.

All leads connecting the point to be grounded to the ground rod or pipe should be as short as possible since the ground lead itself can become an effective radiating antenna.

The effectiveness of a ground in reducing interference depends upon the ground conductivity. In certain locations it may become necessary to improve the ground conductivity by treating soil around the ground rod with a salt solution.

## 8 - 8. METAL BUILDING

It is frequently thought that operating of high frequency stabilized arc welding equipment in metallic buildings will completely eliminate troublesome radiation. This, however, is a false assumption.

A metallic building structure, if properly grounded, may serve to reduce direct radiation from the weld zone but will have no effect on conducted interference and reradiation. As a result, all installation requirements necessary for certification must be complied with.

If the metallic building is not properly grounded, bonding to several good electrical grounds placed around the periphery of the building will give reasonable assurance that the building itself is not contributing to the radiation.

## 8-9. INDIVIDUAL INSTALLATION CERTIFICATION

Any or all of the above installation requirements may be waived by the user if he desires to exercise the option of making an individual field survey of the particular unit installation (or the complete installation if more than one unit is involved), and certifying on that basis.

This survey shall be made by a competent engineer in accordance with the test procedure requirements as set forth in Part 18 of the Rules and Regulations of the Federal Communications Commission.

Surveys of this nature can cover a single unit or multiple units or may include the complete plant structure.

## 8-10. CHECK LIST

The following questions may be used by the installer as a check to see if all installation requirements have been met:

1. Has the equipment been located so that ground leads can be kept short?
2. Are the power leads, serving the unit, in conduit?
3. Is there good electrical contact between power conduit and case?
4. Do the conduit couplings make good electrical contact? (If in doubt, use bonding).
5. Is there good electrical contact between conduit and switch on service boxes?
6. If rigid metallic conduit is not used, is the shielding used of equivalent shielding efficiency? (Copper sleeving, lead covered cable, etc., is satisfactory. Spirally wound flexible metallic conduit is not suitable).
7. Is the conduit system grounded at a point at least 50 feet from the equipment?
8. Is the conduit run complete (without any gap) in the H.F.I. zone?
9. Is the equipment case connected to the work terminal of the secondary?
10. Is the wire used for this connection of sufficient size?
11. Is the work terminal connected to a good electrical ground?
12. Is the cable or copperbraid used for this connection equal to or greater in current carrying capacity than the welding lead?
13. Is this cable as short as possible?
14. Are the spark-gaps set at .008" or less?
15. Are all service and access doors closed and bolted?
16. Are the welding leads less than 25 feet long?
17. Are they as short as possible?
18. Are the welding leads on the floor or placed on a suitable board?
19. Are the welding leads approximately 3/4" to 1" apart?
20. Have you visualized the H.F.I. zone, a sphere with a 50 foot radius centered on the weld zone?
21. Have the unshielded power and light wires originally in this H.F.I. zone been placed in grounded shields or been relocated outside the zone?
22. Have all large metallic objects and any long guy or supporting wires in the H.F.I. zone been grounded?
23. Have you checked so that no external power or telephone lines off the premises are within the zone?
24. Are the grounds driven ground rods?
25. Is a cold water pipe used as ground?
26. If so, does it enter the ground 10 feet or less from the connection?
27. Are the connections to the ground clean and tight?
28. If operated within a metal building, is the building properly grounded?

If your answer is "yes" to the above questions, you can certify the installation by signing the certificate.

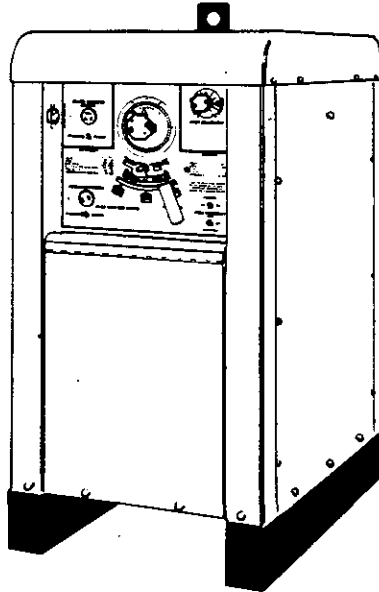




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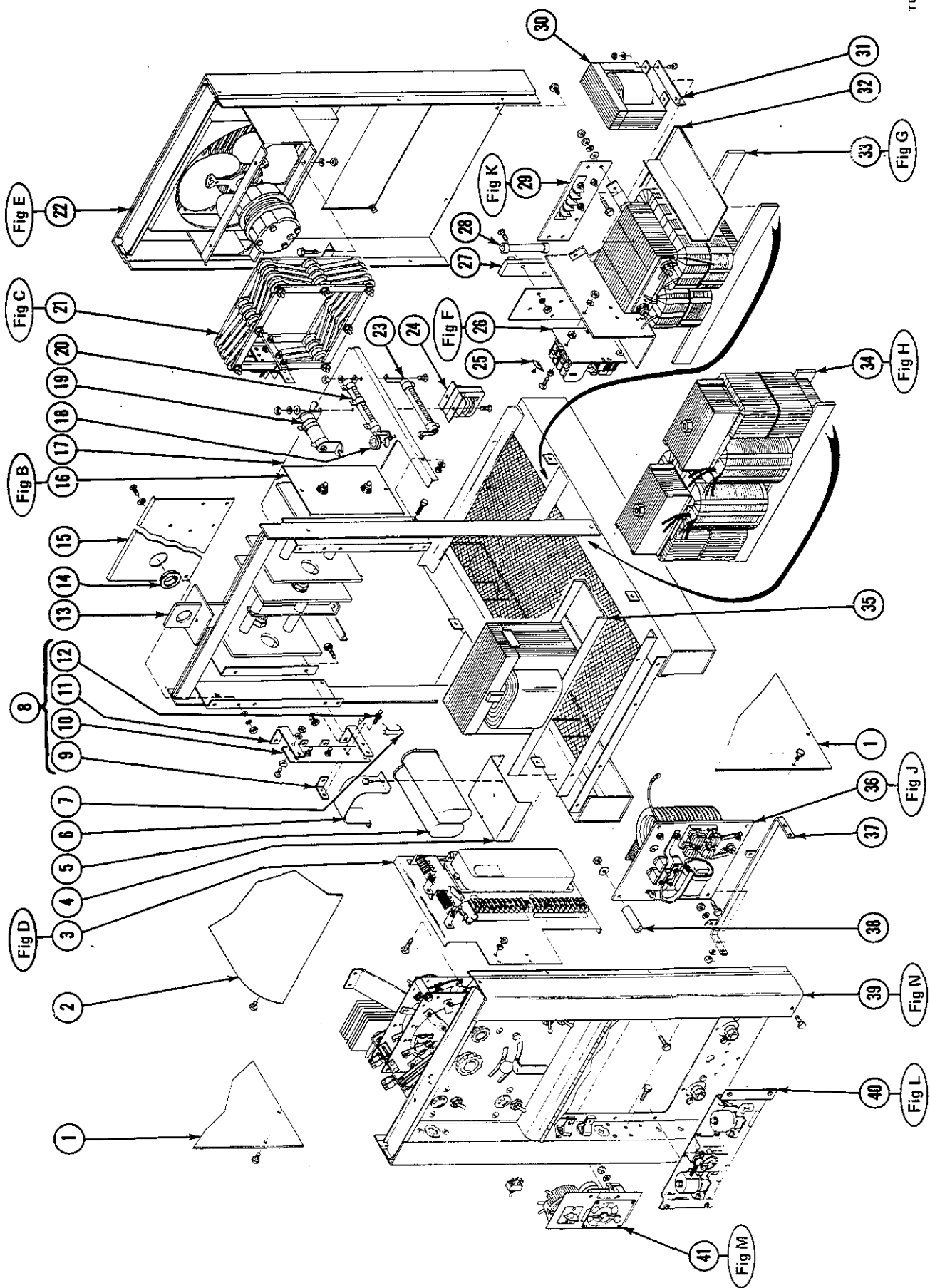
FORM: OM-340

Effective with serial No. HD684370



MODEL/STOCK NO.	SERIAL/STYLE NO.	DATE PURCHASED

# PARTS LIST



TD-901 048

Figure A — Main Assembly

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				Model 200 Amp	Model 300 Amp
Figure A				Main Assembly	
1		014 607	PANEL, side	2	2
2		014 604	COVER, top	1	1
3		016 608	CONTROL PANEL, master (See Fig. D Page 4)	1	1
4		018 752	BASE, mounting - capacitor	1	1
5	C1	025 315	CAPACITOR, paper-oil 30 uf 460 volt	1	2
6		025 143	BRACKET, mounting - capacitor	1	
6		025 142	BRACKET, mounting - capacitor		1
7	R4	030 603	RESISTOR, WW fixed 10 watt 10K ohm	1	1
8		038 461	TERMINAL ASSEMBLY, connecting-resistor (consisting of)	1	1
9		023 001	. BUS BAR	1	1
10		038 323	. TERMINAL BOARD	1	1
11		019 177	. BRACKET, mounting	2	2
12		038 888	. STUD, brass 1/4-20 x 1-1/2 w/hex collar	3	3
13		016 876	BASE	1	1
14		010 494	BUSHING, snap-in 1-3/4 dia hole	1	1
15		014 630	BAFFLE, air - vertical	1	1
16	SR1	037 324	RECTIFIER, silicon diode (See Fig. B Page 3)	1	
16	SR1	037 111	RECTIFIER, silicon diode (See Fig. B Page 3)		1
17		014 628	BAFFLE, air - horizontal	1	
17		015 548	BAFFLE, air - horizontal		1
18		010 493	BUSHING, snap-in 7/8 dia hole	1	1
19	R10	030 636	RESISTOR, WW adj 50 watt 4 ohm	1	1
20	R11	030 640	RESISTOR, WW adj 100 watt 5 ohm	1	1
21	R6	030 608	RESISTOR, balance (See Fig. C Page 3)	1	
21	R6	030 609	RESISTOR, balance (See Fig. C Page 3)		1
22		Figure E	PANEL, rear w/components (See Page 5)	1	1
23	R12	030 965	RESISTOR, WW fixed 100 watt 100 ohm	1	1
24	CT	036 208	TRANSFORMER, current 200/5	1	1
25		022 027	LINK, jumper - contactor (Allen Bradley Contg) or		
25		038 264	LINK, jumper - contactor (Furnas Contg)	4	4
26	W	034 653	CONTACTOR, size 1-4 pole 115 volt (Allen Bradley) or		
26	W	034 820	CONTACTOR, size 1-3/4 - 4 pole 115 volt (Furnas)(See Fig. F Page 5)	1	1
27		012 638	HOLDER, fuse - cartridge 600 volt	1	1
28	F2	*012 639	FUSE, cartridge 6 amp 600 volt	1	1
28	F2	†*012 641	FUSE, cartridge 10 amp 600 volt	1	1
29	TE1	038 442	TERMINAL ASSEMBLY, primary (See Fig. K Page 9)	1	1
30	T2	036 629	TRANSFORMER, kva 1/2	1	1
30	T2	†036 646	TRANSFORMER, kva 2	1	1
31		100 917	BRACKET, mounting - xfmr kva	2	2
32		017 998	BAFFLE, air & mounting component	1	1
33	T1	**022 519	TRANSFORMER, power - main (See Fig. G Page 6)	1	
33	T1	**022 520	TRANSFORMER, power - main (See Fig. G Page 6)		1
34	MA1	**022 521	AMPLIFIER, magnetic (See Fig. H Page 7)	1	
34	MA1	**022 522	AMPLIFIER, magnetic (See Fig. H Page 7)		1
35	Z	023 060	STABILIZER	1	
35	Z	023 061	STABILIZER		1
36		020 846	HF PANEL (See Fig. J Page 8)	1	1
37		020 665	BRACKET, mounting - HF Panel	1	1
38		010 957	TUBING, steel 1/2 OD x 17 Ga. wall x 1-3/4	2	2
39		Figure N	PANEL, front w/components (See Page 12)	1	1
40		020 100	CONTROL PANEL, start (See Fig. L Page 10) or		
40		018 563	CONTROL PANEL, gas & water (See Fig. L Page 10)	1	1
41		Figure M	TIMER & RHEOSTAT (See Page 10)	1	1
	A1	†025 603	METER, amp dc 0-300 scale	1	
	A1	†025 608	METER, amp dc 0-500 scale		1
	A2	†025 601	METER, amp ac 0-300 scale	1	
	A2	†025 617	METER, amp ac 0-500 scale		1
	CT2	†036 609	TRANSFORMER, current 300/5	1	
	CT2	†036 611	TRANSFORMER, current 500/5		1
	P1	†025 701	FILTER, HF	3	3
	P2	†025 700	FILTER, HF	1	1
	V1	†025 604	METER, volt dc 0-100 scale	1	1
	V2	†025 602	METER, volt ac 0-100 scale	1	1
		011 751	SWITCH ASSEMBLY, normally open	1	1
		011 754	SWITCH ASSEMBLY, maintained	1	1

\*Recommended Spare Parts.

\*\*Replace At Factory or Authorized Service Station

†Optional Parts

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				Model	Model
				200 Amp	300 Amp
<b>Figure B</b>			<b>Rectifier, Silicon Diode (See Fig. A Page 2 Item 16)</b>	037 324	037 111
51	D1-4	037 305	DIODE, 150 amp 300 volt straight polarity .....	4	
51	D1-4	037 956	DIODE, 275 amp 250 volt straight polarity .....		4
52		010 014	CLAMP, mounting - capacitor .....	1	1
53	C9	031 683	CAPACITOR, paper-oil .5 uf 200 volt dc .....	1	1
54	C5-8	031 689	CAPACITOR, ceramic .01 uf w/leads & terminal .....	4	4

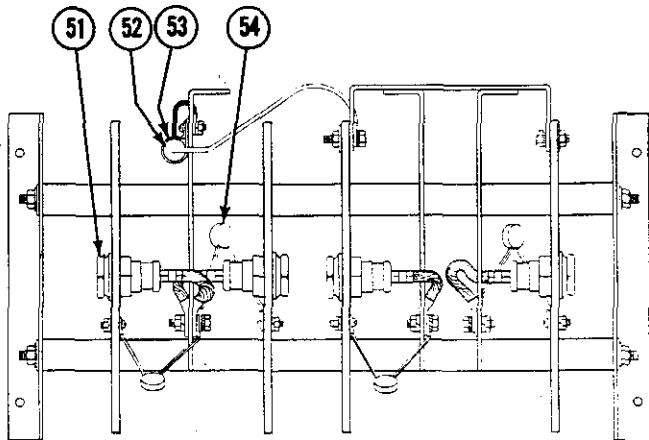


Figure B — Rectifier, Silicon

TB-037 110

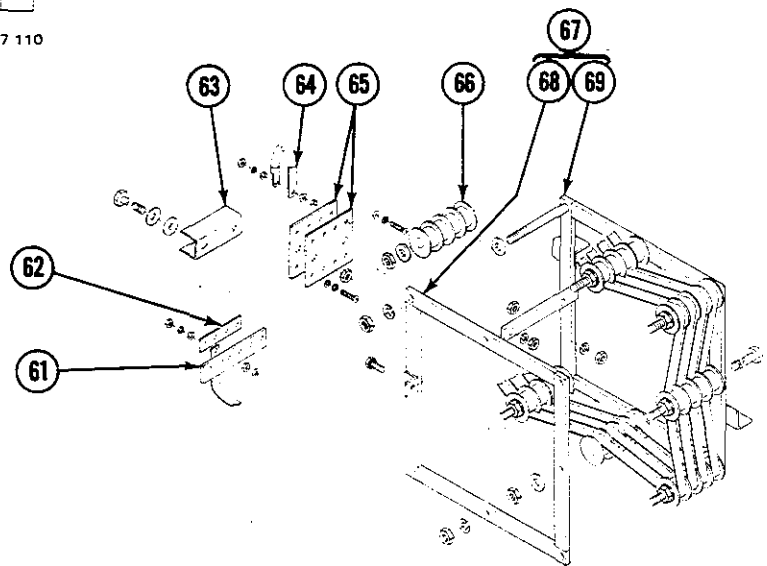


Figure C — Resistor, Balance

TC-030 609

Item No.	Factory Part No.	Description	Quantity	
			Model	Model
			200 Amp	300 Amp
<b>Figure C</b>			030 608	030 609
<b>Resistor, Balance (See Fig. A Page 2 Item 21)</b>				
61	102 552	BUS BAR .....	1	1
62	102 551	BUS BAR .....	1	1
63	026 932	INSULATION .....	1	1
64	**030 612	BAND, michrome .....	3	4
65	038 671	TERMINAL BOARD .....	2	2
66	026 616	SPOOL, insulating - band .....	7	7
67	014 629	BRACKET, mounting (consisting of) .....	1	1
68	018 744	. BRACKET, mounting - frame section .....	1	1
69	018 764	. FRAME .....	1	1

\*\*Replace At Factory or Authorized Service Station.

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
<b>Figure D      016 608    Control Panel, Master (See Fig. A Page 2 Item 3)</b>				
77		019 829	PANEL, mounting - component .....	1
78	SR2,4	*037 568	RECTIFIER, signal (consisting of) .....	2
79		102 863	. BRACKET, mounting .....	2
80		601 242	. WASHER, insulating .....	2
81		603 115	STRIPPING, weather (order by foot) .....	4 ft.
82		013 867	LABEL, CR1 .....	1
83		013 868	LABEL, CR2 .....	1
84		026 844	STRIP, insulating - resistor .....	1
85	R2	*030 601	RESISTOR, WW adj 25 watt 1000 ohm .....	1
86	CR1	034 601	RELAY, medium duty 24 volt dc DPDT .....	1
87	CR2	034 612	RELAY, medium duty 110 volt dc DPDT .....	1
88		038 620	LINK, jumper - terminal block .....	2
89		013 535	LABEL, CR3 .....	1
90		013 534	LABEL, link arrangement .....	1
91		014 118	COVER, dust - relay .....	1
92	CR3,4	034 615	RELAY, medium duty 115 volt ac DPDT .....	2
93		013 536	LABEL, CR4 .....	1
94		038 867	CONNECTOR, 45 degree 2 side .....	1
95		601 218	CONNECTOR, 45 degree 1 side .....	1
96	1T,2T	038 646	BLOCK, terminal 30 amp 10 pole .....	2
97		013 532	LABEL, terminal marking .....	1
98	R9	030 615	RESISTOR, WW fixed 2 watt 1000 ohm .....	1
99	C4	031 610	CAPACITOR, electrolytic 40 uf 250 volt dc .....	1
100		026 845	STRIP, insulating - capacitor .....	1
101		013 533	LABEL, terminal marking .....	1

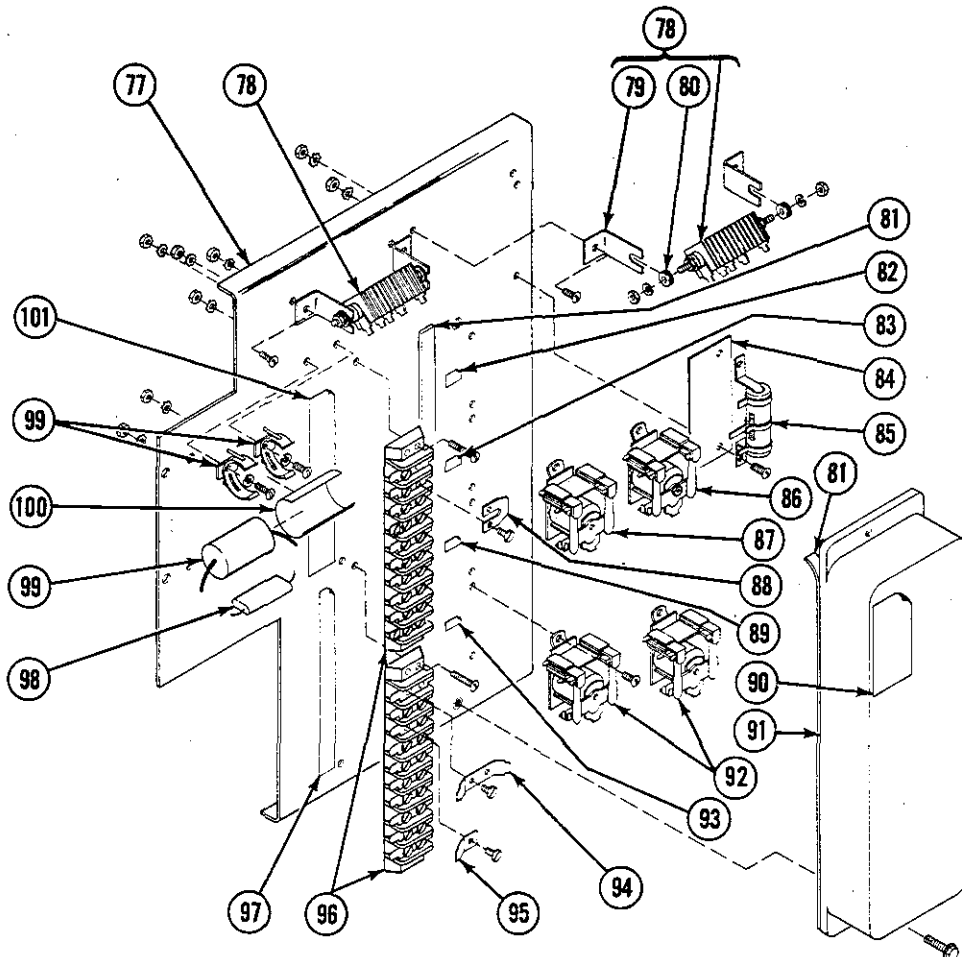


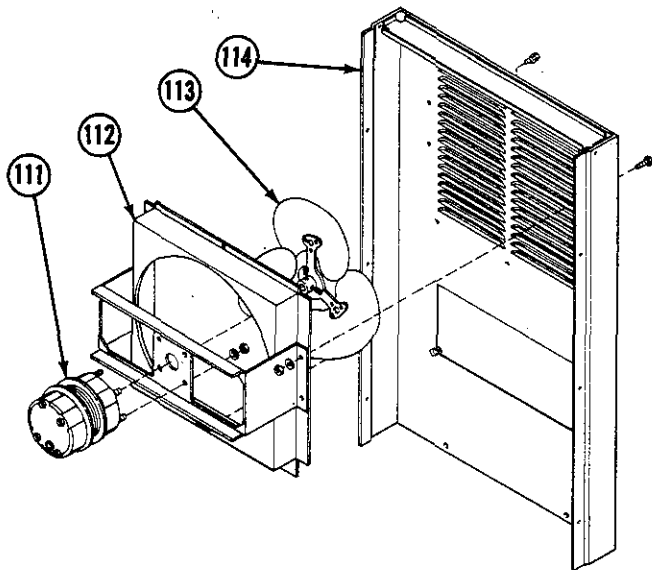
Figure D — Control Panel, Master

TC-016 608

\*Recommended Spare Parts

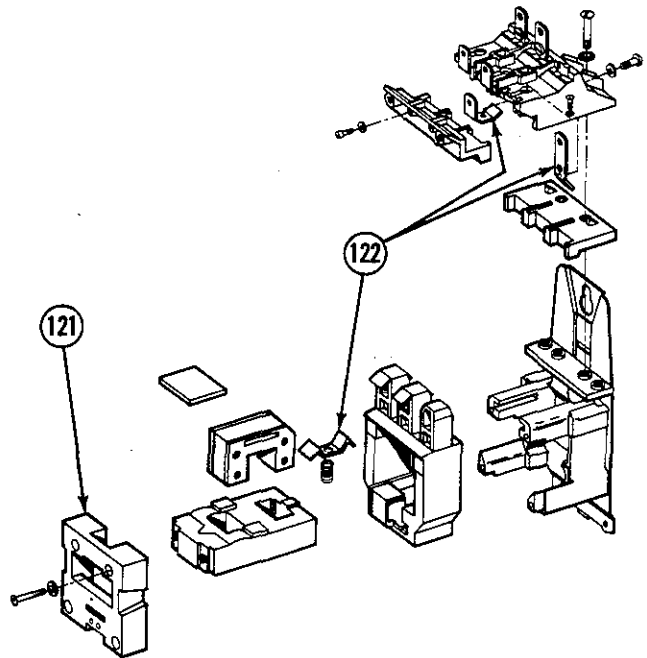
BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				Model 200 Amp	Model 300 Amp
Figure E Panel, Rear With Components (See Fig. A Page 2 Item 22)					
111	FM	032 603	MOTOR, 230 volts ac (consisting of)	1	1
		*024 601	. BEARING	2	2
112		016 258	CHAMBER, plenum	1	1
113		032 604	BLADE, fan 60 Hz 14 in. 3 wing	1	1
113		†032 611	BLADE, fan 50 Hz 14 in. 3 wing	1	1
114		022 025	PANEL, rear	1	1



TC-022 518

Figure E – Panel, Rear With Components



TC-034 652

Figure F – Contactor

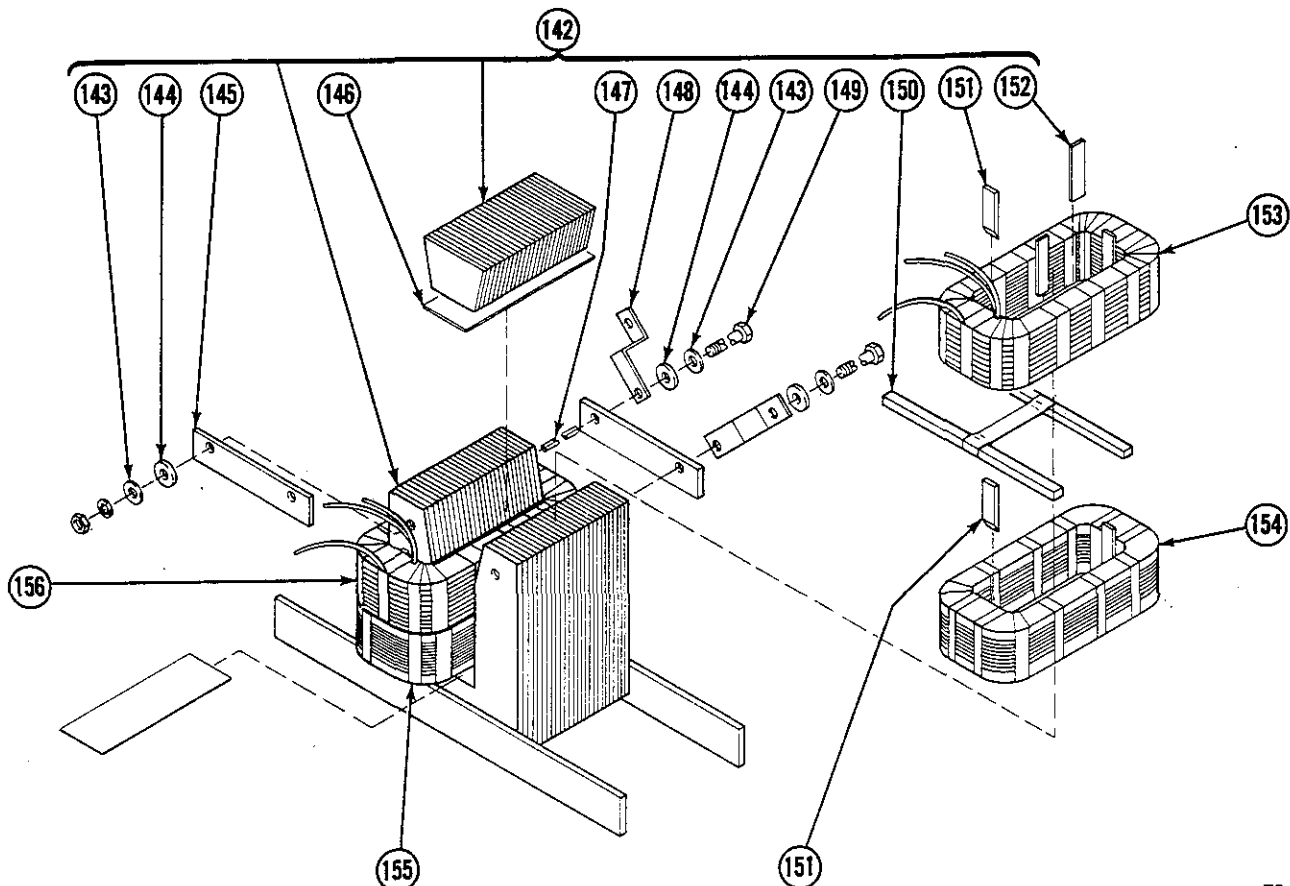
Item No.	Factory Part No.	Description	Quantity
<b>Figure F Contactor (See Fig. A Page 2 Item 26)</b>			
121	033 675	COIL, 115 volt ac	1
121	033 410	COIL, 115 volt ac	1
122	*034 662	KIT, contact points	1
122	*034 825	KIT, contact points	1

\*Recommended Spare Parts

†Optional Parts

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				Model	
				200 Amp	300 Amp
Figure G			Transformer, Power-Main (See Fig. A Page 2 Item 33)	022 519	022 520
142		**036 877	TRANSFORMER SUBASSEMBLY, power-main (consisting of)	1	
142		**036 878	TRANSFORMER SUBASSEMBLY, power-main (consisting of)		1
143		602 242	. WASHER, flat - steel 5/16 standard	4	4
144		602 195	. WASHER, flat - fibre 3/8 ID x 7/8 OD x 3/32	4	4
145		018 342	. BAR, clamping - core	2	2
146		032 157	. STRIP, glastic 1/16 x 2-33/64 x 6-1/8	2	
146		032 108	. STRIP, glastic 1/16 x 2-33/64 x 7-3/8		2
147		026 955	. TUBING, vinyl - No. 2 x 6-1/2	2	
147		026 950	. TUBING, vinyl - No. 2 x 7-5/8		2
148		103 923	. BRACKET, mounting-terminal assembly primary	2	2
149		601 800	. BOLT, machine - steel hex head 1/4-20 x 7	2	
149		601 802	. BOLT, machine - steel hex head 1/4-20 x 8		2
150		602 819	. STRIP, phenolic 1/4 x 3/8 x 10-1/2	2	2
		021 499	. STRIP, phenolic 1/4 x 3/8 x 5-1/4	2	
151		010 371	. WEDGE, hardwood 1/4 x 1 x 2	8	8
152		021 099	. WEDGE, glastic 1/8 x 5/8 x 2	4	4
153	Pri	**033 629	COIL, primary - right hand	1	
153	Sec	**033 497	COIL, secondary - right hand		1
154	Sec	**033 529	COIL, secondary	1	
154	Pri	**033 630	COIL, primary - right hand		1
155	Sec	**033 529	COIL, secondary	1	
155	Pri	**033 631	COIL, primary - left hand		1
156	Pri	**033 628	COIL, primary - left hand	1	
156	Sec	**033 496	COIL, secondary - left hand		1
	TP1	026 181	THERMOSTAT, normally open	1	1

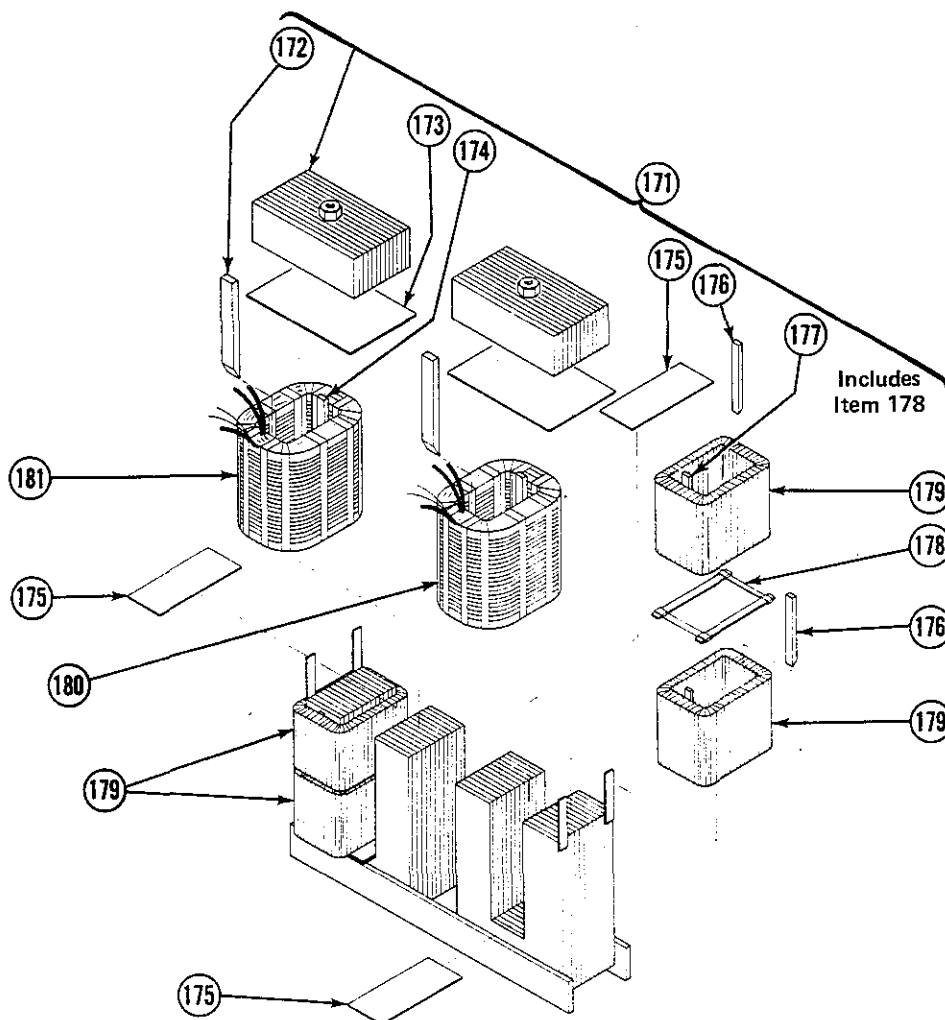


TB-022 519

Figure G — Transformer, power-main

\*\*Replace At Factory or Authorized Service Station.  
BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mks.	Factory Part No.	Description	Quantity	
				Model 200 Amp	Model 300 Amp
Figure H			Amplifier, Magnetic (See Fig. A Page 2 Item 34)	022 521	022 522
171		**036 459	AMPLIFIER SUBASSEMBLY, magnetic (consisting of) .....	1	
171		**036 882	AMPLIFIER SUBASSEMBLY, magnetic (consisting of) .....		1
172		026 966	. WEDGE, hardwood 1/4 x 1 x 6 .....	2	2
173		026 931	. STRIP, fibre .020 x 4-1/2 x 7-1/2 .....	2	
173		026 934	. STRIP, fibre .025 x 4-1/2 x 7-1/2 .....		2
174		026 967	. WEDGE, hardwood 5/16 x 1 x 6 .....	2	2
175		032 082	. STRIP, glastic 1/16 x 2-1/2 x 5 .....	4	4
176		010 371	. WEDGE, hardwood 1/4 x 1 x 2 .....	4	4
177		021 807	. WEDGE, hardwood 5/16 x 1 x 2 .....	4	4
178		010 372	. STRIP, glastic 1/8 x 1 x 6 .....	4	4
179	CWD	**033 645	COIL, control dc .....	4	
179	CWD	**033 640	COIL, control dc .....		4
180	CWA	**033 530	COIL, control ac - right hand .....	1	
180	CWA	**033 498	COIL, control ac - right hand .....		1
181	CWA	**033 531	COIL, control ac - left hand .....	1	
181	CWA	**033 499	COIL, control ac - left hand .....		1



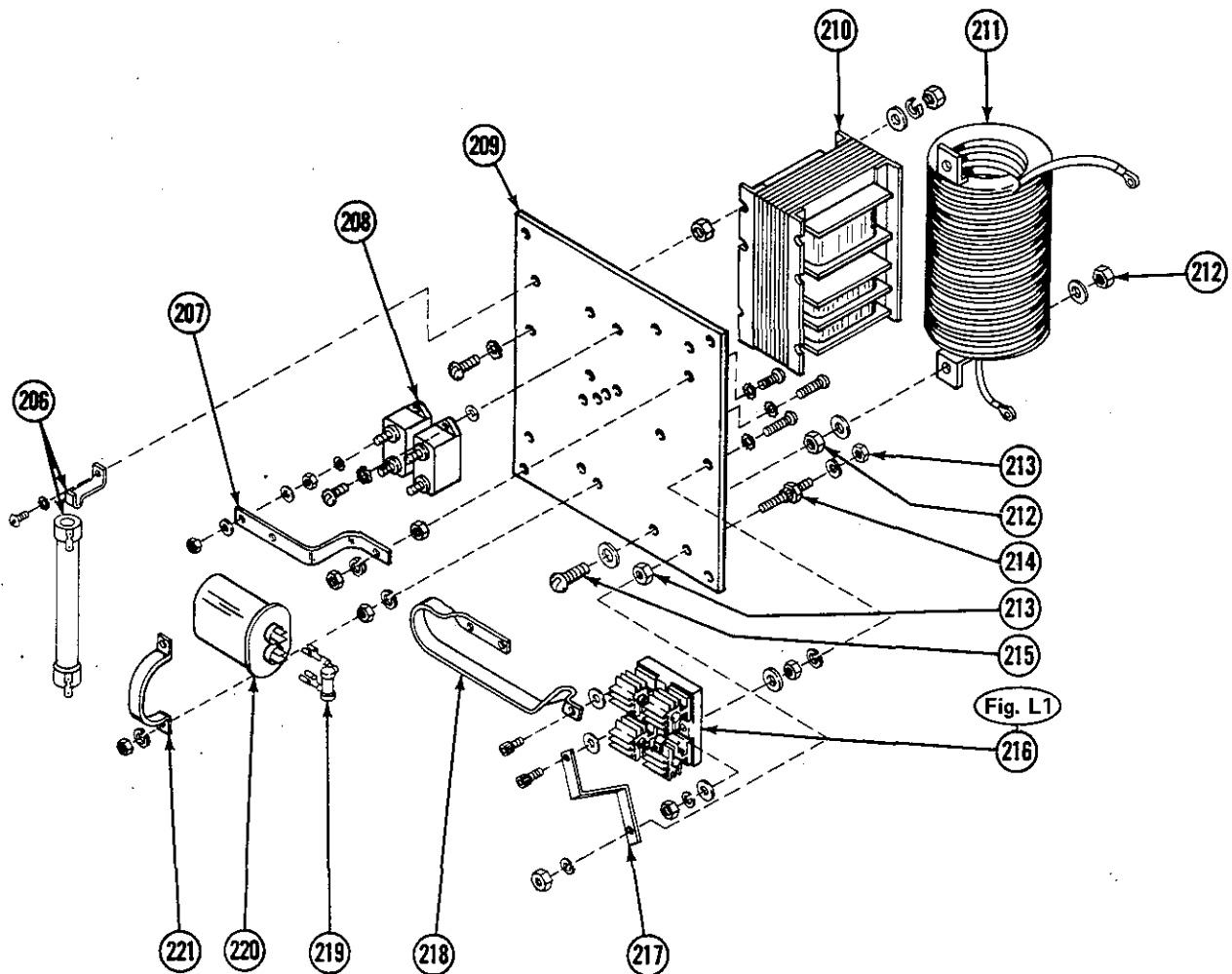
TC-022 522

Figure H — Amplifier, Magnetic

\*\*Replace At Factory or Authorized Service Station  
BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.



Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
<b>Figure J      020 846    HF Panel (See Fig. A Page 2 Item 36)</b>				
206	R3	030 602	RESISTOR, WW fixed 100 watt 10 ohm .....	1
207		010 884	STRIP, conductor .....	1
208	C2	031 602	CAPACITOR, mica .002 uf 6000 volt .....	2
209		016 601	MOUNTING BOARD, component .....	1
210	R4	036 865	TRANSFORMER, high voltage 115 volt primary .....	1
211	T3	033 601	COIL, coupling .....	1
212		601 838	NUT, hex - jam 3/8-16 brass .....	4
213		601 835	NUT, hex - reg 10-32 brass .....	7
214		038 887	STUD, brass 10-32 x 1-3/8 with hex collar .....	2
215		603 737	SCREW, machine round hd 3/8-16 x 1-3/4 brass .....	2
216	G	020 623	SPARK GAP ASSEMBLY (See Fig. J1 Page 9) .....	1
217		010 885	STRIP, conductor .....	1
218		010 883	STRIP, conductor .....	1
219	R1	030 603	RESISTOR, WW fixed 10 watt 10K ohm .....	1
220	C3	*031 601	CAPACITOR, paper-oil 10 uf 600 volt .....	1
221		014 159	BRACKET, mounting - capacitor .....	1



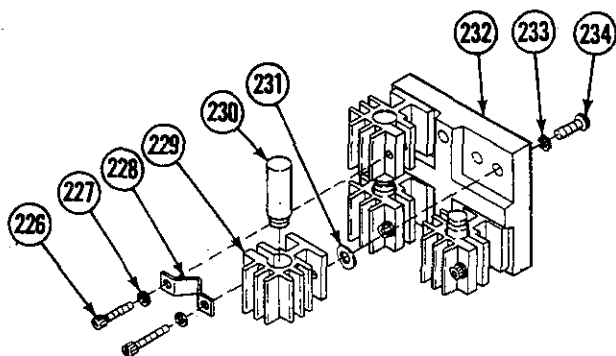
TC-020 612

Figure J — HF Panel

\*Recommended Spare Parts.

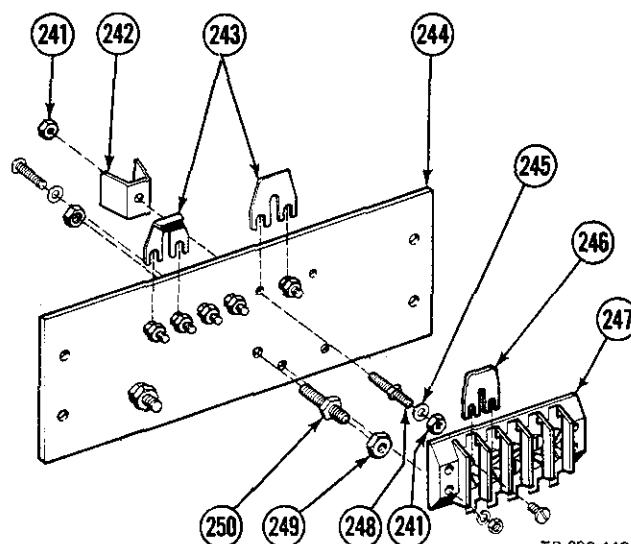
BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
<b>Figure J1      020 623    Spark Gap Assembly (See Fig. J Page 8 Item 216)</b>				
226		602 023	SCREW, cap - socket head 10-24 x 3/4	4
227		604 772	WASHER, flat No. 8 SAE	4
228		010 888	CONNECTOR, holder	1
229		020 622	HOLDER, points	4
230	G	*020 603	POINT, spark gap (set of 4)	1 set
231		010 913	WASHER, flat - brass 3/16 ID	8
232		020 621	BASE	1
233		602 204	WASHER, lock external tooth No. 10	8
234		602 101	SCREW, machine round head 10-24 x 5/8	8



TA-020 623

Figure J1 — Spark Gap Assembly



TB-038 442

Figure K — Terminal Assembly, Primary

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
<b>Figure K      038 442    Terminal Assembly, Primary (See Fig. A Page 2 Item 29)</b>				
241		601 835	NUT, hex - brass 10-32	8
242		026 754	INSULATION, stud - barrier	6
243		038 618	LINK, jumper - terminal	2
244		038 662	TERMINAL BOARD, mounting - component	1
245		010 913	WASHER, flat - brass 3/16 ID	6
246		038 620	LINK, jumper - terminal block	1
247	TE2	038 622	BLOCK, terminal 30 amp 5 pole	1
248		038 887	STUD, brass - 10-32 x 1-3/8 with hex collar	6
249		601 836	NUT, hex - brass 1/4-20	4
250		038 888	STUD, brass - 1/4-20 x 1-1/2 with hex collar	2

\*Recommended Spare Parts

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				P Panel	A/B Panel Spot Timer
Figure L			Control Panel, Gas & Water (See Fig. A Page 2 Item 40)	020 100	018 563
256		010 295	ELBOW, street - brass 1/4 MPT 5/8-18 left hand thread . . . . .		2
257	GS1,WS1	035 601	VALVE, 115 volt ac 1/4 IPS port (consisting of) . . . . .		2
		033 050	COIL, 115 volt ac . . . . .		1
258		010 296	ELBOW, street - brass 1/4 MPT 5/8-18 right hand thread . . . . .		2
259	S7	011 620	SWITCH, toggle SPST . . . . .	1	1
260		022 159	LABEL, start circuit-In-Out . . . . .	1	1
261		013 983	LABEL, In-Gas-Out . . . . .		1
262	TD1	*034 701	TIMER, 60 second 115 volt ac or		
262	TD1	+034 836	TIMER, 60 second 115 volt ac . . . . .		1
263		013 982	LABEL, In-Water-Out . . . . .		1
264		014 627	PANEL, mounting - components . . . . .	1	1
265		010 853	SCREW, No. 2 . . . . .	4	4
266		010 855	WASHER, retainer . . . . .	4	4

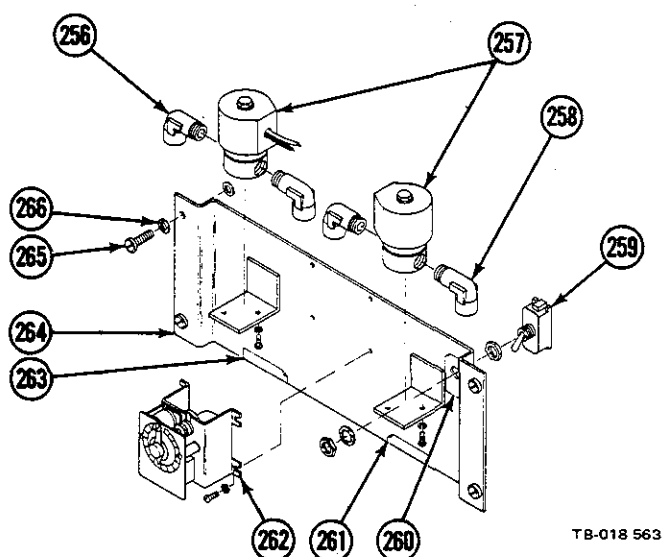


Figure L — Control Panel, Gas And Water

TB-018 563

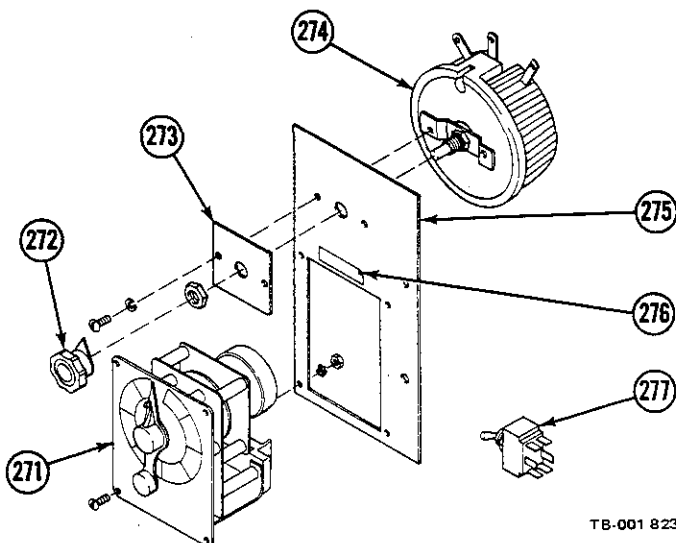


Figure M — Timer and Rheostat

TB-001 823

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity		
				P Panel	A/B Panel	Spot Timer
Figure M		Timer & Rheostat (See Fig. A Page 3 Item 41)				
271	TD2	034 712	TIMER, 3 second 115 volt ac			1
272		024 366	KNOB, pointer 1-1/8 OD x 1/4 bore	1	1	1
273		013 518	PLATE, indicator HF intensity	1	1	1
274	R5	603 942	RHEOSTAT, WW 150 watt 5 ohm	1	1	1
275		042 211	STRIP, mounting - component	1	1	
275		042 212	STRIP, mounting - component			1
276		013 331	LABEL, high frequency	1	1	1
277	S5	011 611	SWITCH, toggle DPDT			1

\*Recommended Spare Parts

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

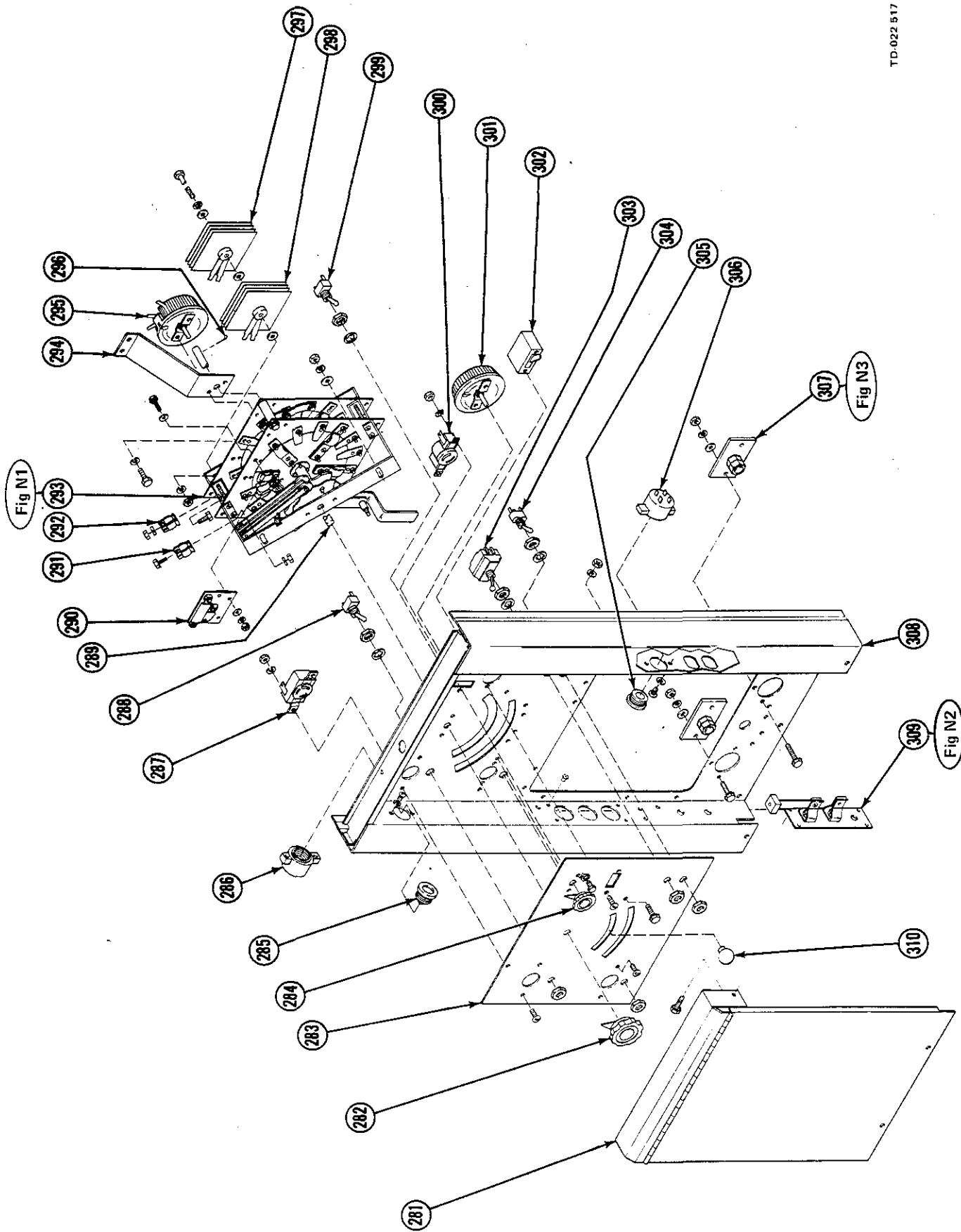


Figure N — Panel, Front With Components

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity	
				Model	
				200 Amp	300 Amp
Figure N Panel, Front With Components (See Fig. A Page 2 Item 39)					
281		015 110	DOOR, access - front	1	1
282		019 602	KNOB, pointer 2-3/8 OD x 3/8 bore	1	1
283			NAMEPLATE (order by stock, model, and serial number)	1	1
284		019 609	KNOB, pointer 1-5/8 OD x 1/4 bore	1	1
285	F1	*012 601	FUSE, plug 10 amp 250 volt	1	1
		013 206	LABEL, fuse 10 amp	1	1
286		012 602	HOLDER, fuse - plug 250 volt	1	1
287	RC1	039 607	RECEPTACLE, twistlock 3P3W	1	1
288	S2	011 609	SWITCH, toggle SPDT	1	1
289		030 655	SHAFT, rheostat	1	1
290		031 897	CONTROL CORE RESET (consisting of)		1
	D5	037 906	. DIODE, 12 amp 400 volt		1
	R13	030 947	. RESISTOR, WW fixed 40 watt 5 ohm		1
		031 889	. MOUNTING BOARD, component		1
		031 890	. HEAT SINK		1
291		010 876	HANGER, minerallic No. 1	1	
291		010 926	HANGER, minerallic No. 2		1
292		010 926	HANGER, minerallic No. 2	1	1
293	S9,10	011 726	SWITCH ASSEMBLY, range & selector (See Fig. N1 Page 13)	1	1
294		011 660	BRACKET, support - switch	1	1
295	R7	030 041	RHEOSTAT, WW 150 watt 15 ohm	1	1
296		602 355	PIN, cotter 3/32 x 2	1	1
297	SR5	037 615	RECTIFIER, selenium - control	1	1
298	SR3	*037 601	RECTIFIER, selenium - control	1	1
299	S4	011 611	SWITCH, toggle DPDT	1	1
300	RC2	039 602	RECEPTACLE, twistlock 2P2W	1	1
301	R8	030 653	RHEOSTAT, WW 150 watt 15 ohm	1	1
302	CB	011 914	CIRCUIT BREAKER, 1 pole 5 amp 250 volt	1	1
303	S1	*011 813	SWITCH, toggle 3PST	1	1
304	S3	011 610	SWITCH, toggle SPDT with center off	1	1
305	F4	*012 601	FUSE, plug - 10 amp 250 volt	1	1
305	F4	†012 606	FUSE, plug - 15 amp 250 volt (with duplex receptacle)	1	1
306		012 602	HOLDER, fuse - plug 250 volt	1	1
	RC3	†604 176	RECEPTACLE, duplex grounded straight 2P3W	1	1
307		038 630	TERMINAL, power output (See Fig. N3 Page 16)	1	1
308		020 299	PANEL, front	1	1
309	S6	011 787	SWITCH, changeover - Tig Metallic (See Fig. N2 Page 16)	1	1
310		019 603	KNOB, ball 1-1/4 OD x 1/4-20 female thread	1	1

\*Recommended Spare Parts

†Optional Parts

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
<b>Figure N1 011 726 Switch Assembly, Range &amp; Selector (See Fig. N Page 12 Item 293)</b>				
316		011 654	BRACKET, mounting - switch (consisting of)	1
317		010 671	. SPRING	2
318		019 605	HANDLE, switch - selector	1
319		019 604	HANDLE, switch - range	1
320	S9	011 635	PLATE ASSEMBLY, switch - range (See Fig. N1A Page 14)	1
321		011 657	SPACER, 1 x 2 x 2 with hole	1
322		011 826	TUBING, steel 5/8 OD x 12 Ga. wall x 2	1
323		011 659	SHAFT, control - switch	1
324	S10	011 604	PLATE ASSEMBLY, switch - selector (See Fig. N1B Page 15)	1
325		011 643	BRACKET, mounting - switch	1
326		011 826	TUBING, steel 5/8 OD x 12 Ga. wall x 2	1
327		011 671	SPACER, 1 x 1 x 2	1

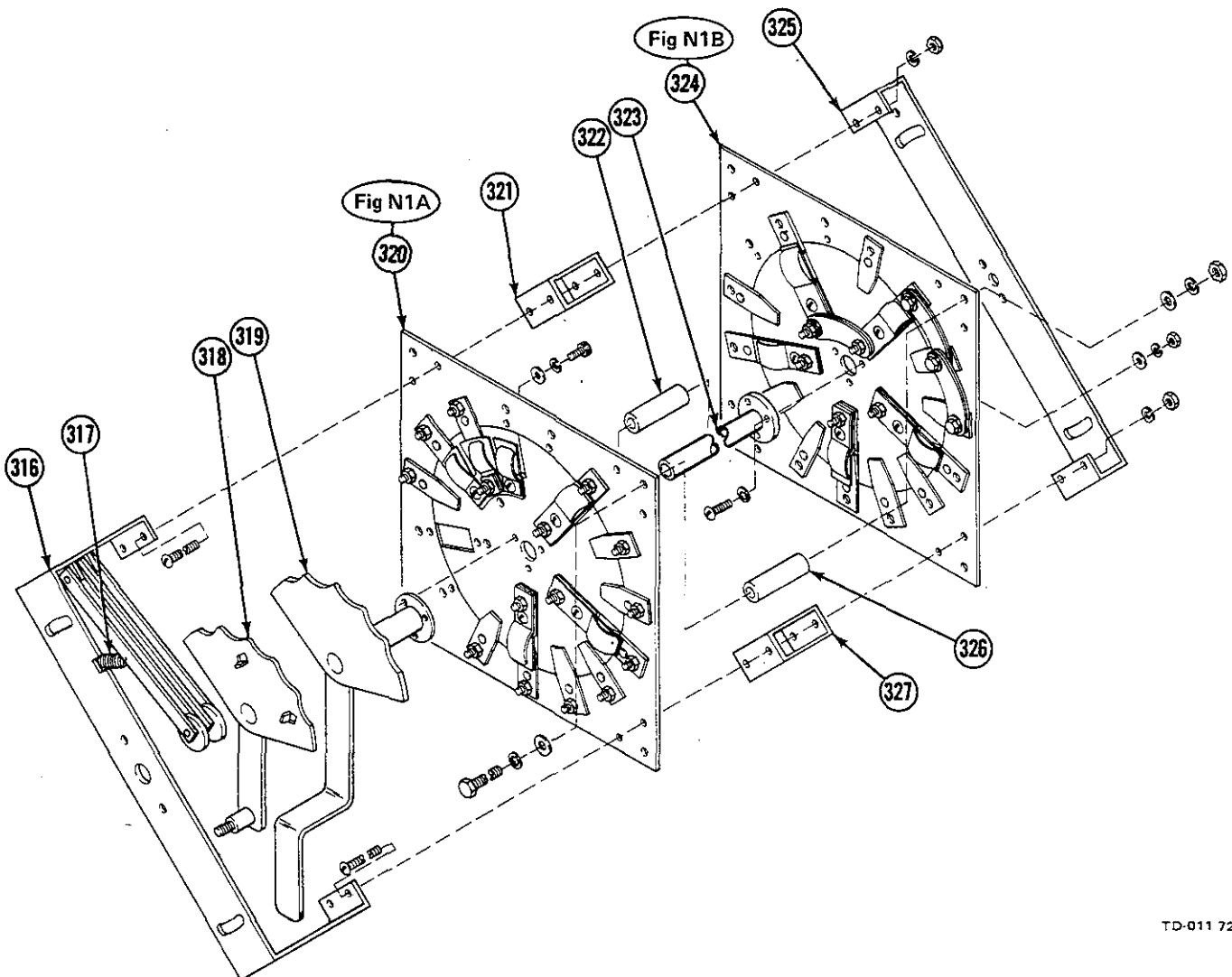
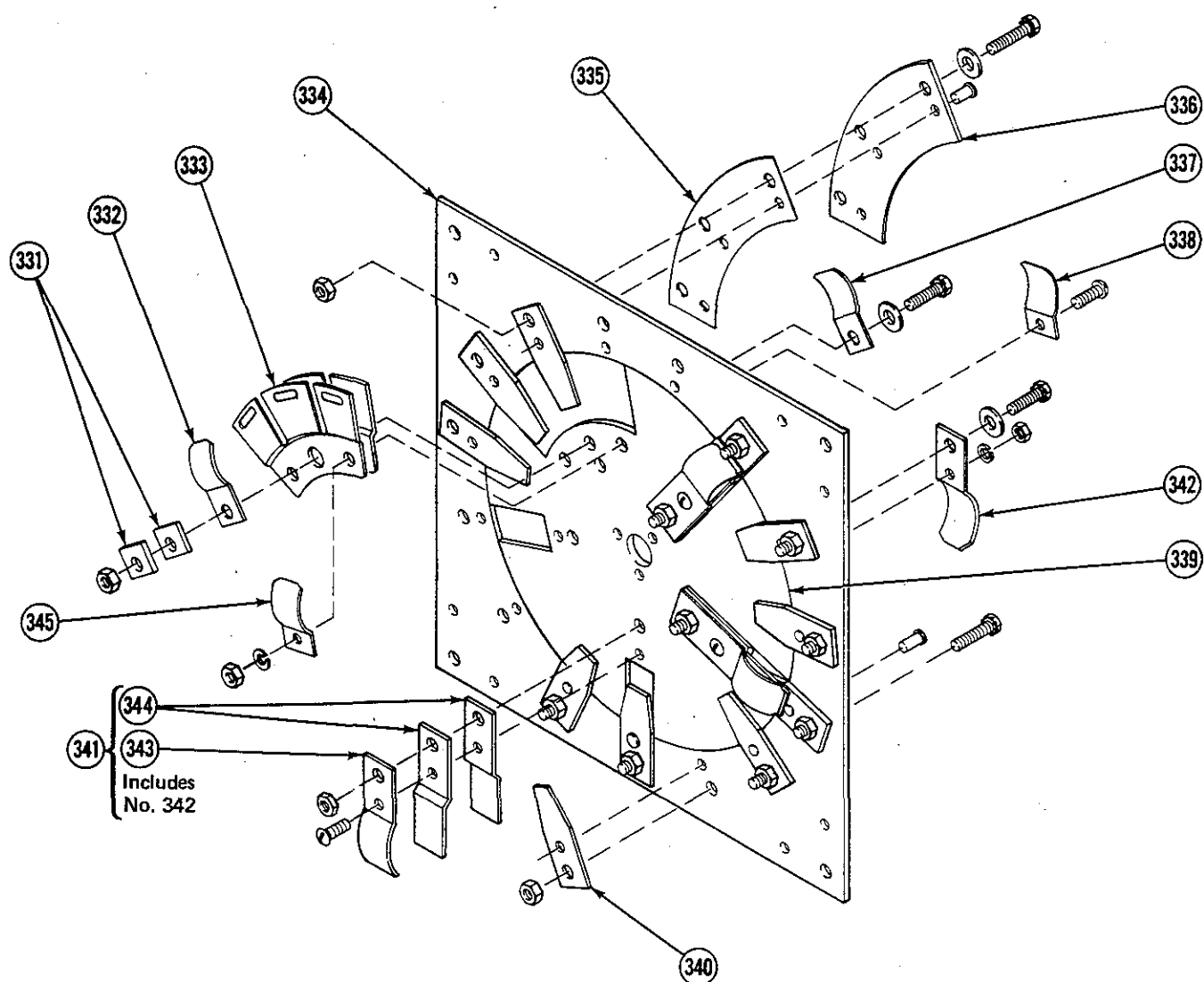


Figure N1 — Switch Assembly, Range and Selector

TD-011 726

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Factory Part No.	Description	Quantity
Figure N1A	011 635	Plate Assembly, Switch - Range (See Fig. N1 Page 13 Item 320)	
331	010 080	SPACER, copper	2
332	011 079	SPRING, pressure - center front	1
333	011 371	CONTACT, segment	2
334	011 968	MOUNTING BOARD, component - stationary	1
335	100 622	SHIM, guide - rotor	As Req.
336	100 623	GUIDE, rotor	3
337	011 078	SPRING, pressure - center rear	1
338	011 049	SPRING, pressure - rear	2
339	100 747	ROTOR, switch	1
340	011 644	CONTACT, copper - stationary	11
341	011 645	CONTACT ASSEMBLY, copper - movable (consisting of)	3
342	011 075	SPRING, pressure - rear	1
343	011 074	SPRING, pressure - front	1
344	011 953	CONTACT, copper - movable	2
345	011 048	SPRING, pressure - front	2



TC-011 635

Figure N1A - Plate Assembly, Switch Range

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Factory Part No.	Description	Quantity
<b>Figure N1B 011 604 Plate Assembly, Switch - Selector (See Fig. N1 Page 13 Item 324)</b>			
351	100 621	BAR, shorting .....	6
352	011 968	MOUNTING BOARD, component - stationary .....	1
353	011 969	ROTOR, switch .....	1
354	100 623	GUIDE, rotor .....	3
355	100 622	SHIM, guide - rotor .....	As Req.
356	011 644	CONTACT, copper - stationary .....	13
357	011 645	CONTACT ASSEMBLY, copper - movable .....	5
358	011 075	. SPRING, pressure - rear .....	1
359	011 953	. CONTACT, copper .....	2
360	011 074	. SPRING, pressure - front .....	1

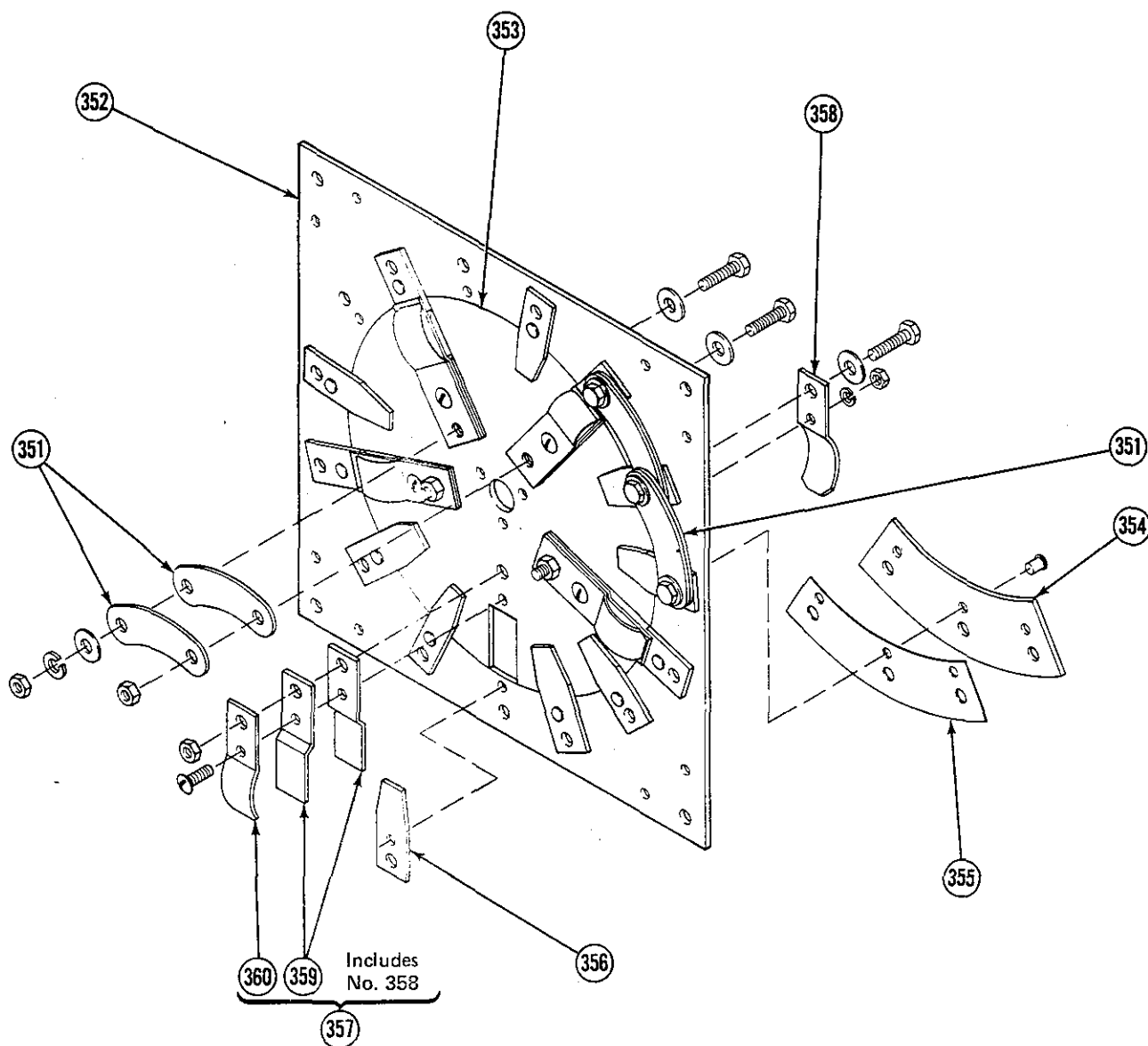


Figure N1B — Plate Assembly, Switch Selector

TC-011 604

BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.





