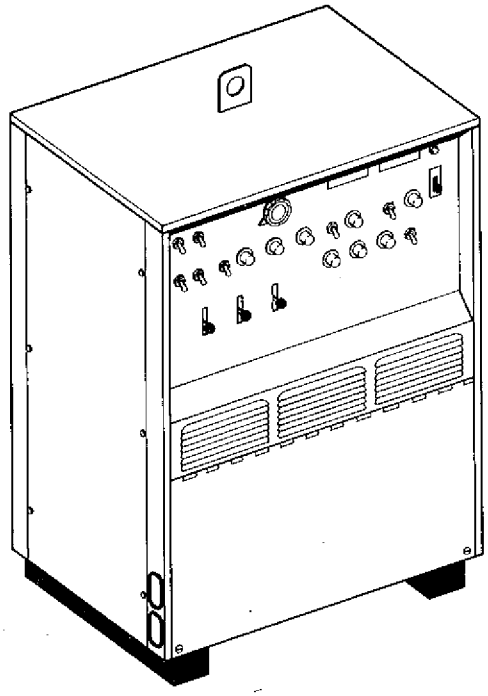
May 1977 FORM: OM-350C

Effective With Serial No. HG076580

MODEL	STOCK NO.
Syncrowave 300 (Basic)	901 718
Syncrowave 300 W/Pulser	902 015



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

OWNER'S MANUAL

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

NWSA CODE NO. 4579

PRINTED IN U.S.A.

LIMITED WARRANTY

EFFECTIVE: NOVEMBER 1, 1976

This warranty supersedes all previous MILLER warranties and is exclusive with no other guarantees or warranties expressed or implied.

LIMITED WARRANTY—Miller Electric Mfg. Co., Appleton, Wisconsin warrants to Customer that all new and unused Equipment furnished by Miller is free from defect in workmanship and material as of the time and place of delivery by Miller. No warranty is made by Miller with respect to engines, trade accessories or other items manufactured by others. Such engines, trade accessories and other items are sold subject to the warranties of their respective manufacturers, if any. At the present time, the manufacturer's warranty on the Mag-Diesel engine on DEL-200 is limited to six months and on all other engines to one year.

MILLER warranty does not apply to components having normal useful life of less than one (1) year, such as spot welder tips, relay and contactor points, MILLERMATIC parts that come in contact with the welding wire including nozzles and nozzle insulators where failure does not result from defect in workmanship or material.

In the case of Miller's breach of warranty or any other duty with respect to the quality of any goods, the exclusive remedies therefor shall be, at Miller's option, (1) repair or (2) replacement or, where authorized in writing by Miller in appropriate cases, (3) the reasonable cost of repair or replacement at an authorized Miller service station or (4) payment of or credit for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at Customer's risk and expense. Upon receipt of notice of apparent defect or failure, Miller shall instruct the claimant on the warranty claim procedures to be followed.

As a matter of general policy only, Miller may honor an original user's warranty claims on warranted Equipment in the event of failure resulting from a defect within the following periods from the date of delivery of Equipment to the original user:

1. Arc welders, power sources, and components ... 1 year
2. Original main power rectifiers ..... 3 years
   (Labor — 1 year only)
3. All welding guns and feeder/guns ..... 90 days
4. All other Millermatic Feeders ..... 1 year

provided that the user so notifies Miller in writing within thirty (30) days of the date of such failure.

5. Replacement or repair parts exclusive of labor .. 60 days

ANY EXPRESS WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY OR REPRESENTATION AS TO PERFORMANCE, AND ANY REMEDY FOR BREACH OF CONTRACT WHICH, BUT FOR THIS PROVISION, MIGHT ARISE BY IMPLICATION, OPERATION OF LAW, CUSTOM OF TRADE OR COURSE OF DEALING, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PARTICULAR PURPOSE, WITH RESPECT TO ANY AND ALL EQUIPMENT FURNISHED BY MILLER IS EXCLUDED AND DISCLAIMED BY MILLER.

EXCEPT AS EXPRESSLY PROVIDED BY MILLER IN WRITING, MILLER PRODUCTS ARE INTENDED FOR ULTIMATE PURCHASE BY COMMERCIAL/INDUSTRIAL USERS AND FOR OPERATION BY PERSONS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT AND *NOT* FOR CONSUMERS OR CONSUMER USE. MILLER' WARRANTIES DO NOT EXTEND TO, AND NO RESELLER IS AUTHORIZED TO EXTEND MILLER'S WARRANTIES TO, ANY CONSUMER.

ERRATA SHEET

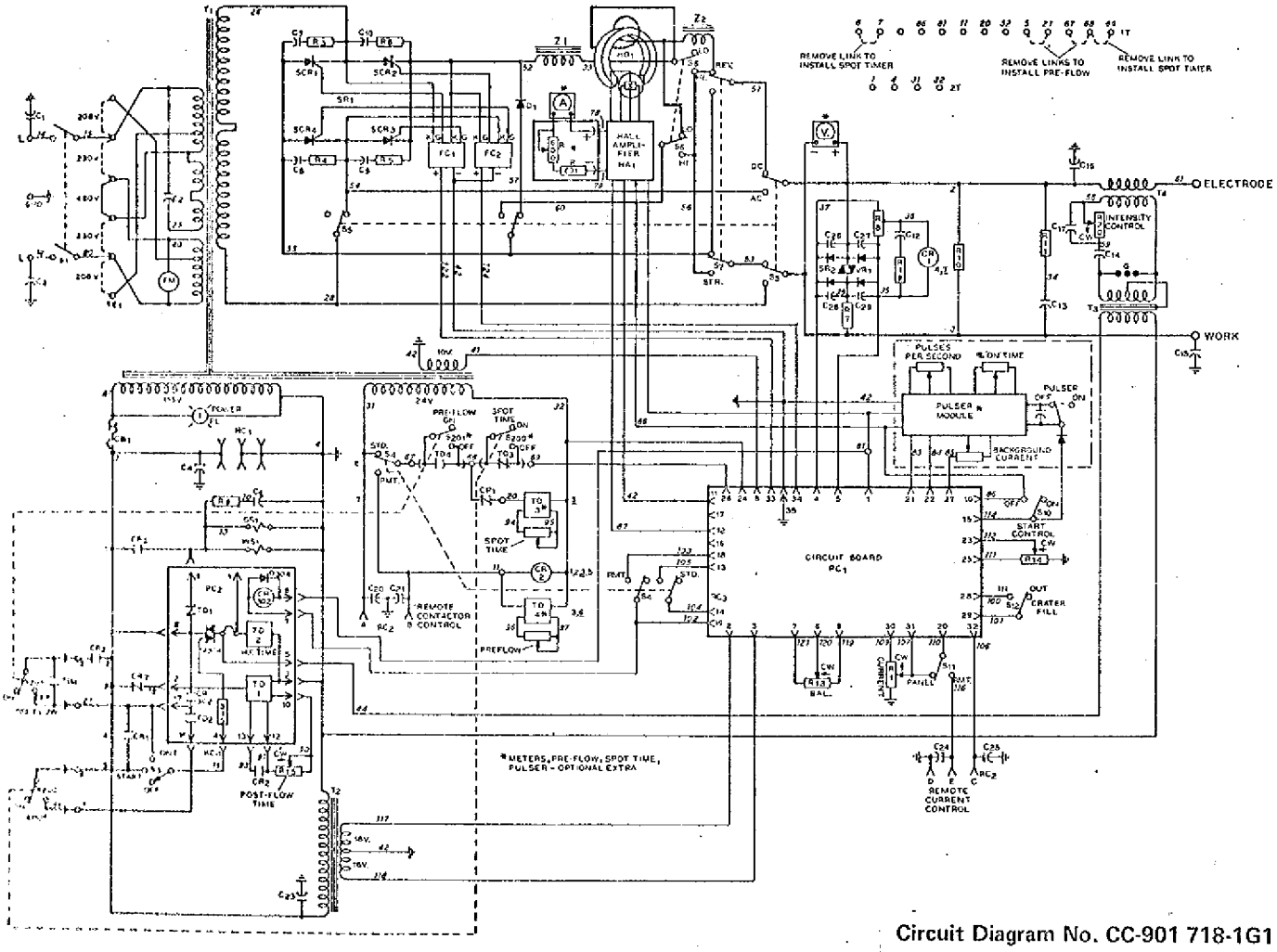
After this manual was printed, refinements in equipment design occurred. This sheet lists exceptions to data appearing later in this manual.

AMENDMENT TO SECTION 7 – TROUBLESHOOTING:

NOTE

The circuit diagram(s) on this supplement replace any other circuit diagram(s) appearing later in this manual.

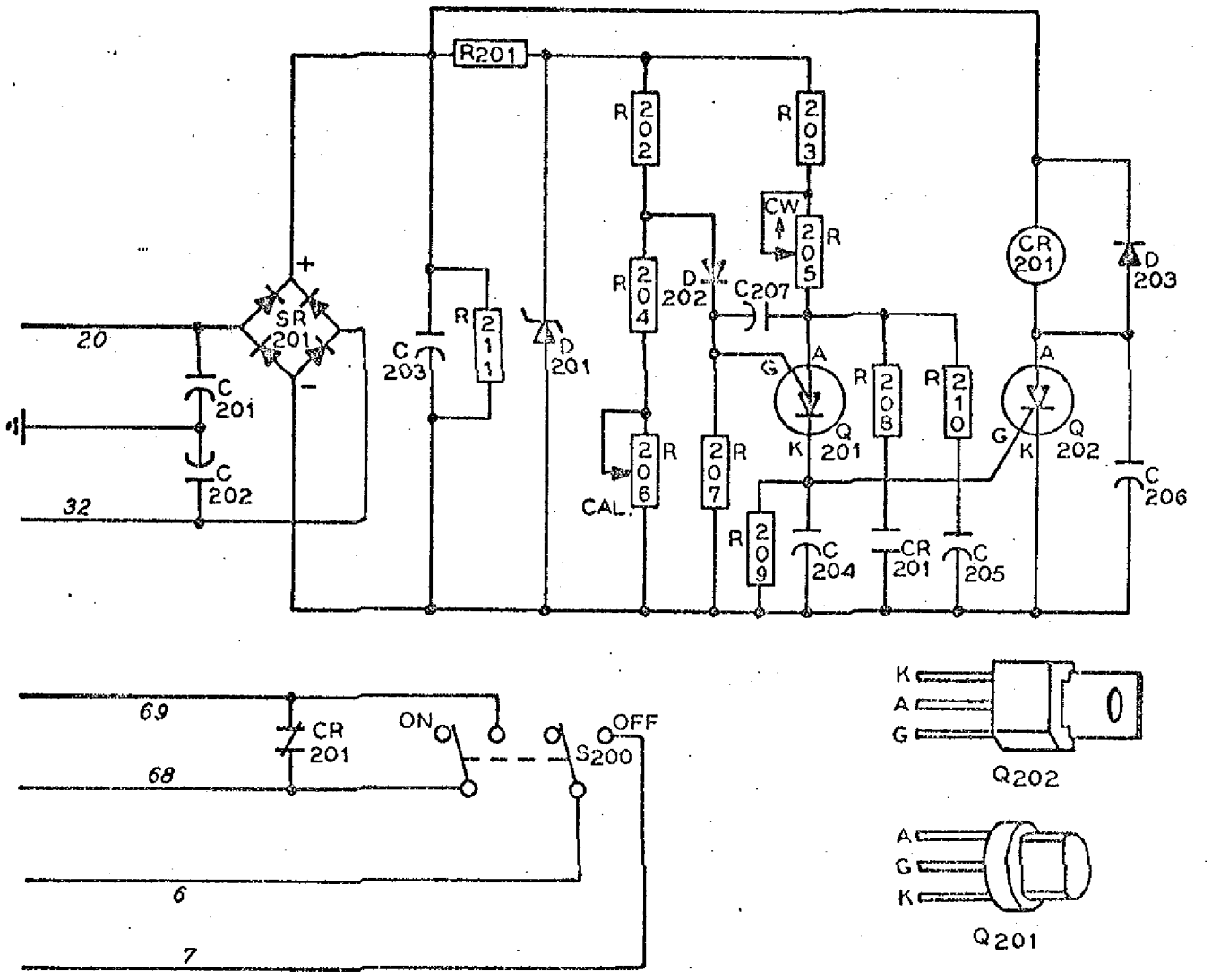
Amend Figure 7-2. as follows:



Circuit Diagram No. CC-901 718-1G1

Figure 7-2. Circuit Diagram For Basic Model

Amend Figure 7-6. as follows:



Circuit Diagram No. CA-041 171-1E

Figure 7-6. Circuit Diagram For Spot Timer

Item No.	Dia. Mkgs.	Part No. Listed In Parts List	Replaced With Part No.	Description	Quantity
124		006 941	052 469	PANEL, front (Eff with S/N HH058741)	1
125		039 047	039 047	TERMINAL, power - output - red (quantity change)	2
132 thru 138		039 046	Deleted		
152		019 070	052 467	DOOR, access (Eff with S/N HH058741)	1

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

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

Section No. Page No.

SECTION 1 - SAFETY RULES FOR OPERATION OF ARC WELDING POWER SOURCE

1-1. INTRODUCTION

We learn by experience. Learning safety through personal experience, like a child touching a hot stove is harmful, wasteful, and unwise. Let the experience of others teach you.

Safe practices developed from experience in the use of welding and cutting are described in this manual. Research, development, and field experience have evolved reliable equipment and safe installation, operation, and servicing practices. Accidents occur when equipment is improperly used or maintained. The reason for the safe practices may not always be given. Some are based on common sense, others may require technical volumes to explain. It is wiser to follow the rules.

Read and understand these safe practices before attempting to install, operate, or service the equipment. Comply with these procedures as applicable to the particular equipment used and their instruction manuals, for personal safety and for the safety of others.

Failure to observe these safe practices may cause serious injury or death. When safety becomes a habit, the equipment can be used with confidence.

These safe practices are divided into two Sections: 1 - General Precautions, common to arc welding and cutting; and 2 - Arc Welding (and Cutting)(only).

Reference standards: Published Standards on safety are also available for additional and more complete procedures than those given in this manual. They are listed in the Standards Index in this manual. ANSI Z49.1 is the most complete.

The National Electrical Code, Occupational Safety and Health Administration, local industrial codes, and local inspection requirements also provide a basis for equipment installation, use, and service.

1-2. GENERAL PRECAUTIONS

A. Burn Prevention

Wear protective clothing - leather (or asbestos) gauntlet gloves, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Wear helmet with safety goggles or glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a MUST for welding or cutting, (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered. See 1-3A.2.

Avoid oily or greasy clothing. A spark may ignite them.

Hot metal such as electrode stubs and workpieces should never be handled without gloves.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

Flammable hair preparations should not be used by persons intending to weld or cut.

B. Toxic Fume Prevention

Adequate ventilation. Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation as described in ANSI Standard Z49.1 listed 1 in Standards index. NEVER ventilate with oxygen.

Lead -, cadmium -, zinc -, mercury -, and beryllium - bearing and similar materials, when welded (or cut) may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area as well as the operator must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated, or the operator wears an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source to prevent possible accumulation of gases in the space if downstream valves have been accidently opened or left open. Check to be sure that the space is safe before re-entering it.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. DO NOT WELD or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to atmospheres containing even minute amounts of trichloroethylene or perchloroethylene.

C. Fire and Explosion Prevention

Causes of fire and explosion are: combustibles reached by the arc, flame, flying sparks, hot slag or heated material; misuse of compressed gases and cylinders; and short circuits.

BE AWARE THAT flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks and slag can fly 35 feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do NOT weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work cannot be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

a. appreciable combustibles (including building construction) are within 35 feet
b. appreciable combustibles are further than 35 feet but can be ignited by sparks
c. openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks
d. combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned as described in AWS Standard A6.0, listed 3 in Standards index.

This includes: a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see paragraph above). Do NOT depend on sense of smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. Never weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

D. Compressed Gas Equipment

Standard precautions. Comply with precautions in this manual, and those detailed in CGA Standard P-1, PRECAUTIONS FOR SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, listed 6 in Standards index.

1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from overpressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks - if gas leaks externally.
Excessive Creep - if delivery pressure continues to rise with downstream valve closed.
Faulty Gauge - if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt repair. Send faulty regulators for repair to manufacturer's designated repair center, where special techniques and tools are used by trained personnel.

2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C.)

ICC or DOT marking must be on each cylinder. It is an assurance of safety when the cylinder is properly handled.

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Passageways and work areas. Keep cylinders clear of areas where they may be struck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 130°F. Cool with water spray where such exposure exists.

Protect cylinders particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or wrench to open a cylinder valve that can not be opened by hand. Notify your supplier.

Mixing gases. Never try to mix any gases in a cylinder.

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, slag, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing (1-2D3). Do NOT use tape.

4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily, pointing outlet away from people and sources of ignition. Wipe with a clean lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking agree, and that the regulator inlet and cylinder outlet match. NEVER CONNECT a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten using properly fitting wrench.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) leave cylinder valve in following position: For oxygen, and inert gases, open fully to seal stem against possible leak. For fuel gas, open to less than one turn to permit quick emergency shutoff.

Use pressure charts (available from your supplier) for safe and efficient, recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly thereafter. Brush with soap solution (capful of Ivory Liquid* or equivalent per gallon of water). Bubbles indicate leak. Clean off soapy water after test; dried soap is combustible.

E. User Responsibilities

Remove leaky or defective equipment from service immediately for repair. See User Responsibility statement in equipment manual.

F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

1-3. ARC WELDING

Comply with precautions in 1-1, 1-2, and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents. Precautions are described here and in standards referenced in index.

A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn, those from gas-shielded arcs are more severe and painful. DON'T GET BURNED; COMPLY WITH PRECAUTIONS.

1. Protective Clothing

Wear long-sleeve clothing (particularly for gas-shielded arc) in addition to gloves, hat, and shoes (1-2A). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outergarments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck and button pockets to prevent entry of sparks.

2. Eye and Head Protection

Protect eyes from exposure to arc. NEVER look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 12 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should NOT be worn; radiation can pass through to cause burns.

Cracked, broken, or loose filter plates must be replaced IMMEDIATELY. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields MUST be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

3. Protection of Nearby Personnel

Enclosed welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, non-combustible screens or panels. Allow for free air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture later under rough handling.

D. Compressed Gas Equipment

Comply with precautions in 1-2D.

E. Shock Prevention

Exposed hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT equipment can fatally shock a person whose body becomes a conductor. DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH a wet surface when welding, without suitable protection.

To protect against shock:

Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat can not be avoided. Sweat, sea water, or moisture between body and an electrically HOT part - or grounded metal - reduces the body surface electrical resistance, enabling dangerous and possibly lethal currents to flow through the body.

1. Grounding the Equipment

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made electrically HOT by stray current may shock, possibly fatally. Do NOT GROUND to electrical conduit, or to a pipe carrying ANY gas or a flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirement of equipment before installing. If only 3-phase power is available, connect single-phase equipment to only two wires of the 3-phase line. Do NOT connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT - a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground prong.

*Trademark of Proctor & Gamble.

2. Electrode Holders

Fully insulated electrode holders should be used. Do NOT use holders with protruding screws.

3. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

4. Cables

Frequently inspect cables for wear, cracks and damage. IMMEDIATELY REPLACE those with excessively worn or damaged insulation to avoid possibly - lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

5. Terminals And Other Exposed Parts

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

6. Electrode Wire

Electrode wire becomes electrically HOT when the power switch of gas metal-arc welding equipment is ON and welding gun trigger is pressed. Keep hands and body clear of wire and other HOT parts.

7. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service, of equipment, shut OFF all power and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns, or flash from switch arcing.

Leaving equipment unattended. Always shut OFF and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

1-4. STANDARDS BOOKLET INDEX

For more information, refer to the following standards or their latest revisions and comply as applicable:

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING obtainable from the American Welding Society, 2501 NW 7th St., Miami, Fla. 33125.

2. ANSI Standard Z87.1, SAFE PRACTICE FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

3. American Welding Society Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable same as item 1.

4. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

5. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable same as item 4.

6. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 500 Fifth Avenue, New York, N. Y. 10036.

7. OSHA Standard 29 CFR, Part 1910, Subpart Q, WELDING, CUTTING AND BRAZING.

Rated Welding Current Amperes	Welding Current Ranges Amperes	Max. Open-Circuit Voltage	Amperes Input At Various Load Outputs						Dimensions (Inches)	Weight (Pounds)	
			Load Output	60 Hz. Single-Phase						Net	Ship
				200(208) Volts	230 Volts	460 Volts	KVA	KW			
300 @ 32 Volts 60% Duty Cycle	AC & DC Low 5-75 High 15-375	80	300 Amps @ 32 Volts AC - Balanced - - SMAW (Rated Load Output)	106	96	48	21	12.8	Height - 46-7/8 Width - 31-1/8 Depth - 22-3/4	670 lbs.	690 lbs.
			300 Amps @ 22 Volts AC - Balanced-Argon - GTAW	144	131	65	30	9.2			
			375 Amps @ 22 Volts AC - Balanced-Argon - GTAW	185	168	84	38	13.6			
			300 Amps @ 22 Volts AC - Fully Unbalanced (Max. Penetration) - Argon - GTAW	156	141	70	32	9.6			
			375 Amps @ 23 Volts AC - Fully Unbalanced (Max. Penetration) - Argon - GTAW	187	170	85	39	14.4			
			300 Amps @ 25 Volts AC - Max. Cleaning-Argon - GTAW	142	129	65	29	11.2			
			300 Amps @ 15 Volts DC - Argon - GTAW	69	63	32	14	8.8			
			300 Amps @ 32 Volts DC - SMAW	88	80	40	18	12.4			
			300 Amps @ 29 Volts DC - Straight Polarity-Helium - GTAW	77	70	35	16	11.6			

SMAW - Shielded Metal-Arc (SMAW) Welding
GTAW - Gas Tungsten-Arc (GTAW) Welding

Figure 2-1. Specifications

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 Description and/or Stock Number and Serial (or Style) Numbers of the equipment be supplied.

2 - 3. DESCRIPTION

This single-phase input welding power source is designed to be used for alternating current (ac) or direct current (dc) Shielded Metal-Arc (SMAW) Welding, Gas Tungsten-Arc (GTAW) Welding, or Spot Welding

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

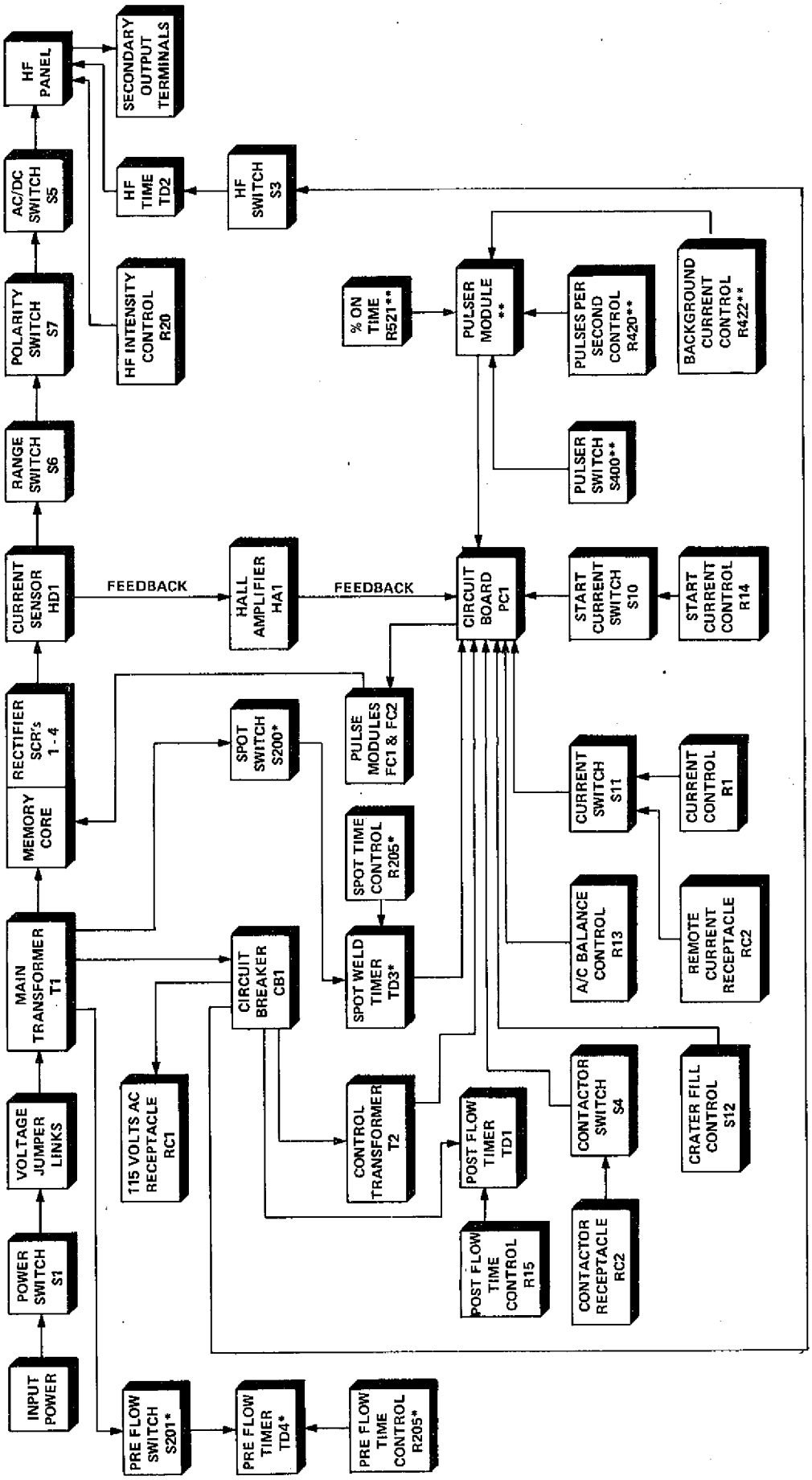
Under this heading, installation, operating, and maintenance procedures or practices will be found that if not carefully followed may create a hazard to personnel.

IMPORTANT

Under this heading, installation, operating, and maintenance procedures or practices will be found that if not carefully followed may result in damage to equipment.

NOTE

Under this heading, explanatory statements will be found that need special emphasis to obtain the most efficient operation of the equipment.



TB-007 538

Figure 2-2. Functional Diagram

SECTION 3 - INSTALLATION

3-1. LOCATION (Figure 3-1)

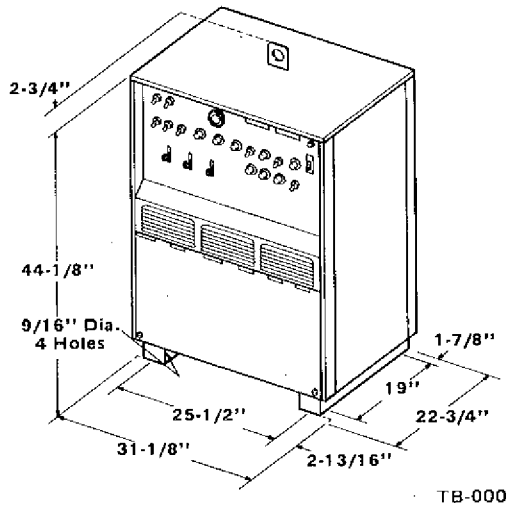


Figure 3-1. Overall Dimensions and Mounting Hole Layout

A proper installation site should be selected for the welding power source if the unit is to provide dependable service, and remain relatively maintenance free.

A proper installation site permits freedom of air movement into and out of the welding power source, and also least subjects the unit to dust, dirt, moisture, and corrosive vapors. A minimum of 18 inches of unrestricted space must be maintained between the welding power source front and rear panels and the nearest obstruction. Also, the underside of the welding power source must be kept completely free of obstructions. The installation site should also permit easy removal of the welding power source outer enclosure for maintenance functions.

IMPORTANT

Do not place any filtering device over the intake air passages of the welding power source as this would restrict the volume of intake air and thereby subject the welding power source internal components to an overheating condition and subsequent failure. Warranty is void if any type of filtering device is used.

Holes are provided in the welding power source base for mounting purposes. Figure 3-1 gives overall dimensions and the base mounting hole layout.

On most welding power sources a lifting device is provided for moving the unit. However, if a fork lift vehicle is used for lifting the unit, be sure that the lift forks are long enough to extend completely under the base.

IMPORTANT

The use of lift forks too short to extend out of the opposite side of the base will expose internal components to damage should the tips of the lift forks penetrate the bottom of the unit.

3-2. ELECTRICAL INPUT CONNECTIONS

NOTE

It is recommended that a line disconnect switch be installed in the input circuit to the welding power source. This would provide a safe and convenient means to completely remove all electrical power from the welding power source whenever it is necessary to perform any internal function on the unit.

CAUTION

Before making electrical input connections to the welding power source, "machinery lockout procedures" should be employed. If the connection is to be made from a line disconnect switch, the switch should be padlocked in the open position. If the connection is made from a fuse box, remove the fuses from the box and padlock the cover in the closed position. If the unit is connected to a circuit breaker, or other disconnecting device without locking facilities, attach a red tag to the device to warn others that the circuit is being worked on.

A. Electrical Input Requirements

This welding power source is designed to be operated from a single-phase, 60 Hertz, ac power supply which has a line voltage rating that corresponds with one of the electrical input voltages shown on the welding power source nameplate. Consult the local electric utility if there is any question about the type of electrical system available at the installation site or how proper connections to the welding power source are to be made.

B. Input Conductor Connections

CAUTION

Do not connect the input conductors to the single-phase power supply until all electrical input connections have been made to the welding power source.

The input conductors should be covered with an insulating material which conforms to local electrical standards. Table 3-1 is provided only as a guide for selecting the proper size input conductors and fuses.

Table 3-1. Input Conductor and Fuse Size

Input Conductor Size – AWG*			Fuse Size – Amps		
200(208)V	230V	460V	200(208)V	230V	460V
2 (6)	2 (6)	6 (8)	200	175	90

*Input conductor sizes are based on allowable ampacities of insulated copper conductors, having a temperature rating of 75°C, with not more than three conductors in a raceway or cable. Numbers in ( ) are equipment ground conductor sizes.

Insert the two input conductors plus one ground conductor through the access hole on the rear panel. This hole will accept standard conduit fittings. See Figure 3-2 for hole location and size.

NOTE

It is recommended that a terminal lug of adequate amperage capacity be attached to the ends of the input and ground conductors. The hole diameter in the terminal lug must be of proper size to accommodate the line and ground terminal studs.

CAUTION

The ground terminal is connected to the welding power source chassis and is for grounding purposes only. Do not connect a conductor from the ground terminal to any one of the line terminals as this will result in an electrically energized welding power source chassis.

Connect the two input conductors to the terminals on the primary terminal board line and connect the ground conductor to the ground terminal. (Refer to the input voltage label for identification of these terminals. See Figure 3-2 for loca-

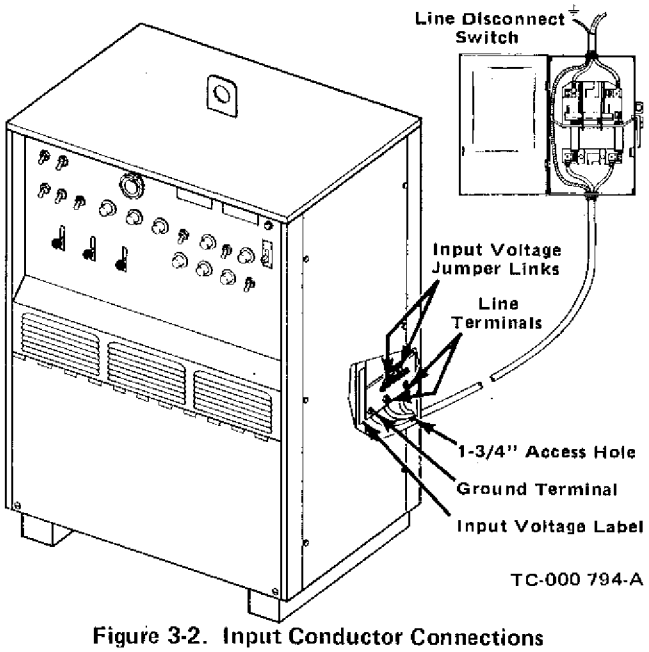


Figure 3-2. Input Conductor Connections

tion of this label.) The remaining end of the ground conductor should be connected to a proper ground. Use whatever grounding method that is acceptable to the local electrical inspection authority.

C. Matching The Welding Power Source To The Available Input Voltage

The input voltage jumper links provided on the primary terminal board permit the welding power source to be operated from various line voltages. The various voltages from which this welding power source may be operated are stated on the welding power source nameplate and on the input voltage label. See Figure 3-2 for location of this label. The input voltage jumper links on this welding power source are positioned for the highest of the voltages stated on the nameplate. If the welding power source is to be operated from a line voltage which is lower than the highest voltage for which the unit was designed, the jumper links will have to be moved to the proper positions before operation of the welding power source commences. Figure 3-3 shows the various positions for which the jumper links may be set on the standard welding power source. If the input voltages on the welding power source nameplate differ from those shown in Figure 3-3, the input voltage jumper links must be positioned as shown on the input voltage label.

NOTE

If only one jumper link is required on each of the grouped terminals, it is recommended that the unused jumper links be placed across the terminals which are to be used. This will prevent losing the jumper links which are not required for this connection.

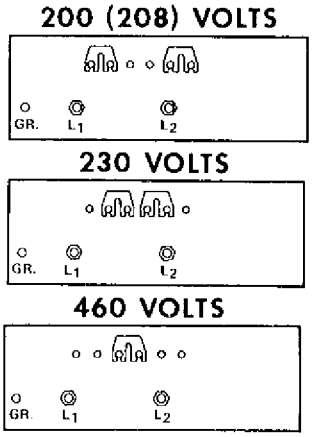


Figure 3-3. Input Voltage Jumper Link Arrangement

3-3. SECONDARY CONNECTIONS (Figure 4-1)

The secondary terminals are located behind the lower front access door and are labeled ELECTRODE and WORK. See Figure 4-1 for the location of these terminals.

A. Welding Cables

It is recommended that the welding cables be kept as short as possible, be 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 of the welding power source as well as reducing the maximum current output of which the welding power source is capable. The proper operation of any 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

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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 or ground cable between the welding power source and the workpiece. 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 a 100 foot weld circuit, where the maximum anticipated weld current is 300 amperes, 1/0 weld cable would be recommended for both the electrode and work cables.

3-4. GAS AND COOLANT CONNECTIONS (Figure 4-1)

The gas and coolant valves, located behind the lower front access door, provide on-off control of gas and coolant to the electrode holder (Gas Tungsten-Arc Welding Process). The gas valve fittings have right-handed threads, while the coolant fittings have left-handed threads.

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

3-5. REMOTE CONTACTOR AND CURRENT CONTROL RECEPTACLE (Figure 4-1)

NOTE

The use of the word CONTACTOR is superficial only in that there is no physical contactor within the welding power source but rather a semi-conductor device which functions as a normal contactor.

The REMOTE CONTACTOR AND CURRENT CONTROL receptacle, located behind the lower front access door on the welding power source, provides a junction point for connecting a remote contactor control and/or a remote current control to the internal circuitry within the welding power source. To connect the remote contactor and/or current control to the REMOTE CONTACTOR AND CURRENT CONTROL receptacle, insert the five-pin plug from the remote control fully into the receptacle. Ensure that the plug keyway aligns with the receptacle key. Rotate the plug threaded collar clockwise as far as possible onto the receptacle threaded body to secure the plug in the receptacle. (See Section 4 for CONTACTOR and CURRENT switches which operate in conjunction with this receptacle.)

3 - 6. CONTACTOR CONTROL SWITCH

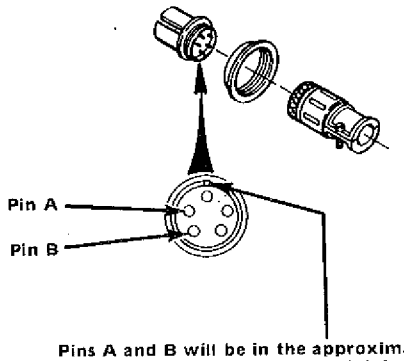
Remote control of the solid-state contactor in the welding power source can be achieved through use of the supplied maintained-contact rocker switch. An 18/2 conductor cord of desired length will have to be supplied for making connections between the rocker switch leads and pins A and B of the supplied amphenol plug. See Figure 3-4 for location of pins.

CAUTION

Ensure that all leads are properly insulated and taped before resuming operation.

NOTE

When remote contactor control via the supplied switch is utilized, remote current control capability is relinquished. If both remote contactor and current control are desired, the appropriate switch will have to provided (optional).



Pins A and B will be in the approximate location as shown when the notch in the connector body is on top.

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Figure 3-4. Contactor Control Switch Connections

IMPORTANT

Do not attempt to inject 115 volts into the Remote Contactor And Current Control receptacle, as 24 volts is present. Failure to comply will result in damage to the welding power source.

3 - 7. 115 VOLTS AC RECEPTACLE (Figure 4-1)

A grounded duplex receptacle, located behind the lower front access door, is provided to furnish 115 volts ac to operate external accessories. A 10 ampere circuit breaker (see Figure 4-1) limits the current obtainable from the duplex receptacle.

SECTION 4 - FUNCTION OF CONTROLS

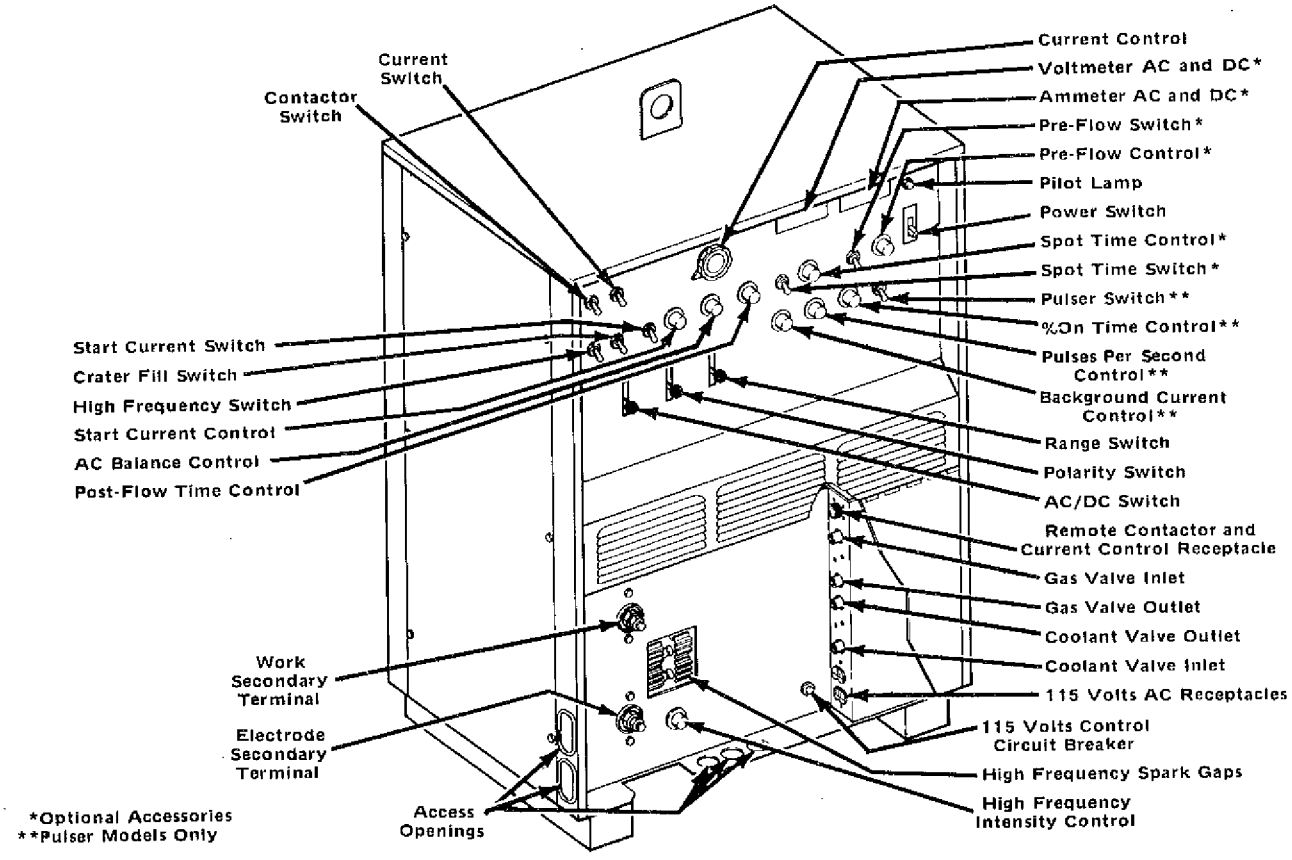

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Figure 4-1. Front Panel View

4 - 1. POWER SWITCH (Figure 4-1)

CAUTION

Even though the POWER switch is in the OFF position and the welding power source is apparently electrically shut down, electrical input 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 remove the line fuses.

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.

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

A. Range Switch

The RANGE switch provides the capability of selecting from two ac or dc coarse amperage ranges: HIGH and LOW. 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 is obtained in the lower of the two ranges.

Fine amperage adjustment within the coarse range selected is accomplished by the CURRENT CONTROL. The complete function of this control is explained in Section 4-2B.

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. Current Control

The CURRENT CONTROL provides a means of selecting the exact amperage desired within the entire range being used. Rotating the control in a clockwise direction increases the amperage output.

NOTE

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

The scales surrounding the CURRENT CONTROL are calibrated in amperes ac or dc, depending on the position of the AC/DC switch. Ensure that the scale being read corresponds to the position of the RANGE switch.

C. Current Switch

If a remote current control is to be used, make connections from the remote current control to the REMOTE CONTACTOR AND CURRENT CONTROL receptacle as instructed in Section 3-5.

When remote control of the current is desired, it is essential that the CURRENT switch be placed in the REMOTE position. Likewise, if a remote current control is not to be utilized, the switch must be in the PANEL position. When in the PANEL position, only the CURRENT CONTROL on the front panel will control the amperage.

D. Polarity Switch

The POLARITY switch provides a means of selecting either dc-straight or dc-reverse polarity without having to change the secondary cable connections.

Placing the POLARITY switch in the STRAIGHT position causes the ELECTRODE secondary terminal to be of negative polarity and the WORK secondary terminal to be of positive polarity. Conversely, if the POLARITY switch is placed in the REVERSE position, the ELECTRODE secondary terminal is of positive polarity and the WORK secondary terminal is of negative polarity. The POLARITY switch has no effect on the welding operations when the AC/DC switch is in the AC position.

IMPORTANT

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.

E. AC/DC Switch

The AC/DC switch provides a means of selecting whether the welding power source output will be alternating current (ac) or direct current (dc).

IMPORTANT

Do not change the position of the AC/DC 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 - 3. START CURRENT CONTROL (Figure 4-1)

The START CURRENT control 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 CURRENT CONTROL. The starting current selected is in effect for approximately the first second of the weld. After this time period, the weld current goes to the setting of the CURRENT CONTROL.

A. Start Current Switch

A two-position toggle switch is provided to determine whether or not the start circuit is functional. Placing the START CURRENT switch in the ON position will make the START CURRENT control operative. The OFF position makes the START CURRENT control inoperative thereby causing the weld current to go immediately to the setting of the CURRENT CONTROL at arc initiation.

B. Start Current Control

The START CURRENT control provides fine current selection within the minimum to maximum capabilities of the range being used for the initial one-second time period of the weld. After this initial time period, the weld current either slopes up or down to the setting of the CURRENT CONTROL.

The scale surrounding the START CURRENT control is calibrated arbitrarily and should not be misconstrued as an amperage or voltage reading. It is recommended that meters be read whenever it is necessary to know the amperage and voltage output.

4 - 4. CONTACTOR SWITCH (Figure 4-1)

The contactor control circuitry in this welding power source enables the operator to remotely control the availability of weld output from the work station provided that the POWER switch is in the ON position.

If a remote contactor control is to be used, make connections to the REMOTE CONTACTOR AND CURRENT CONTROL receptacle as instructed in Section 3-5.

If a remote contactor control is not to be used, place the CONTACTOR switch in the STANDARD position. When in

the STANDARD position, weld output is available as soon as and for as long as the POWER switch is ON.

When a remote contactor control is to be used, the CONTACTOR switch must be placed in the REMOTE position. With a remote contactor control, weld output is available whenever, and for as long as, the remote contactor control switch is closed.

CAUTION

Whenever the CONTACTOR switch is in the STANDARD position, open-circuit voltage will be present at the secondary terminals as long as the POWER switch is ON.

4 - 5. REMOTE CONTACTOR CONTROL SWITCH

Remote control of the solid-state contactor in the welding power source can be achieved through use of the supplied maintained-contact rocker switch. The switch has been designed to be taped to the electrode holder handle.

See Section 3-5 and the instructions supplied with the switch for installation procedures. When installed, the switch provides fingertip control of the contactor circuit by the operator while welding as long as the CONTACTOR CONTROL switch is in the REMOTE position.

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

CAUTION

Ensure that the HIGH-FREQUENCY switch is in the OFF position before performing Shielded Metal Arc (SMAW) Welding. The attempted use of high frequency to establish an arc with a stick electrode could cause an arc to form between the electrode holder and the operator, which could result in serious injury.

The HIGH-FREQUENCY switch provides three positions which determine the length of time the high frequency is either on or off.

A. Start Position

When in the START position, high frequency is present at the welding electrode when the arc is initiated and for approximately 2.5 seconds thereafter. Once the 2.5 second time interval has expired, and even though the remote contactor control switch is closed, the high-frequency is deenergized. High-frequency is present again automatically whenever the arc requires high-frequency.

B. Continuous Position

When the HIGH-FREQUENCY switch is in the CONTINUOUS position, high frequency will be present whenever weld current is available at the output terminals.

If the CRATER FILL switch is in the OUT position, high frequency will be shut down when the remote control switch is released.

If the CRATER FILL switch is in the IN position and the remote control switch is released, high frequency will continue to be present until the end of the crater fill period.

C. Off Position

High frequency is not available when in the OFF position, even if the remote contactor control switch is closed.

4 - 7. COOLANT-GAS POST-FLOW CONTROL (Figure 4-1)

An adjustable 6 to 60 second coolant-gas POST-FLOW TIME control is provided for controlling the period of time shielding gas and coolant is allowed to flow after the arc is extinguished. The POST-FLOW TIME control governs the operation of a post-flow timer within the welding power source.

Rotating the control in a clockwise direction increases the post-flow time. The scale surrounding the POST-FLOW TIME control is calibrated in seconds to aid in the selection of a post-flow time period suited to the individual welding operation.

As soon as the arc has been extinguished, the post-flow timer begins to time out the selected period of post-flow time. Once the timer has timed out, the gas and coolant valves close and thereby cut-off shielding gas and coolant flow. The timer automatically resets and is ready for another weld cycle.

NOTE

The post-flow timer is automatically disabled whenever the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source, despite the position of the POST-FLOW TIME control. To prevent the gas/coolant valves from being operable when the Shielded Metal-Arc (SMAW) Welding process is used, ensure that the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source.

4 - 8. CRATER FILL SWITCH (Figure 4-1)

The CRATER FILL switch provides a means for selecting whether the crater-fill circuit is operative or not. Placing the CRATER FILL switch in the IN position allows the crater-fill circuit to be operative, whereas placing the switch in the OUT position disables the crater-fill circuitry.

The crater-fill circuitry provides a gradual decline of weld current from the selected weld current to a low level of weld current. This weld output declination occurs over an approximate five-second time interval. By utilizing the crater-fill circuitry in the Gas Tungsten-Arc (GTAW) Welding process, better weld-puddle solidification at the end of the weld is achieved.

Whenever the CRATER FILL switch is in the IN position, the CURRENT switch should be placed in the PANEL position and the CONTACTOR switch should be placed in the REMOTE position.

If the START CURRENT switch is in the ON position and the CRATER FILL switch is in the IN position, about seven seconds must be allowed between the time the remote contactor control switch is opened and the time the remote contactor control switch is again closed. This time delay is to assure proper reset of the start control circuitry.

When utilizing the crater-fill mode, ensure that the POST-FLOW TIME control is adjusted to a time longer (8-10 seconds) than the crater-fill time. If the POST-FLOW TIME control is adjusted to a time less than 5 seconds, the shielding gas and coolant flow ceases before the end of the crater-fill current decline.

NOTE

The CRATER-FILL switch should be placed in the OUT position when employing the Shielded Metal-Arc (SMAW) Welding process.

4 - 9. AC BALANCE CONTROL (Figures 4-1 & 4-2)

The AC BALANCE control alters the basic Gas Tungsten-Arc (GTAW) Welding output wave shape to provide either better cleaning action or deeper penetration. Rotating the control clockwise towards the MAX. PENETRATION position yields deeper penetration. Rotating the control counterclockwise towards the MAX. CLEANING position yields more cleaning action of the workpiece - a definite asset when welding oxide-forming materials such as aluminum or magnesium.

When the control is in the BALANCED position, the basic weld output wave shape is unaltered and a compromise between good penetration and good cleaning action will be achieved.

NOTE

The contacts of the AC BALANCE control are of the continuous type, thereby making it possible to adjust this control while welding.

The scale surrounding the AC BALANCE control is calibrated arbitrarily and should not be miscontrued as an amperage or voltage reading. It is recommended that meters be read whenever it is necessary to know the amperage and voltage output.

NOTE

When employing the DC Gas Tungsten-Arc (GTAW) Welding process, the AC BALANCE control should be rotated to the BALANCED position.

IMPORTANT

For the AC BALANCE control to work properly, it is required that the electrode and work welding cables be connected to the proper terminals on the welding power source (electrode cable to the ELECTRODE terminal and work cable to the WORK terminal). The POLARITY switch is imoperative in the AC mode and cannot be used to correct reversed connections. If the cables are reversed, the AC BALANCE control will work backwards.

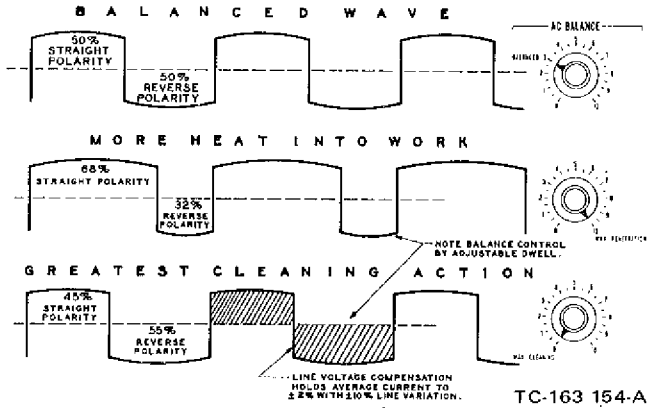

Figure 4-2. Square Wave Function Of The AC Balance Control

4-10. PILOT LAMP (Figure 4-1)

The pilot lamp, when illuminated, is a warning that the welding power source is energized.

4-11. HIGH-FREQUENCY INTENSITY CONTROL (Figure 4-1)

The HIGH-FREQUENCY INTENSITY control governs the strength of the high frequency. Rotating the control in a clockwise direction increases the intensity of the high frequency.

NOTE

As the high-frequency intensity is increased, the possibility of interfering with local electronic apparatus, especially communication equipment, also increases. It is recommended that the HIGH-FREQUENCY INTENSITY control be set at as low a position as practical in order to avoid such interference.

4-12. DUTY CYCLE (Figure 4-3)

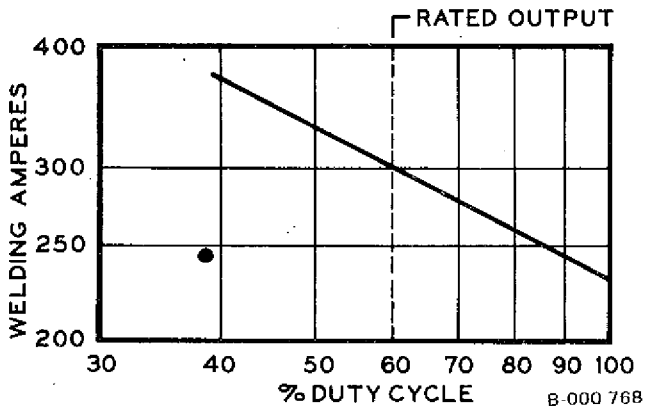

Figure 4-3. Duty Cycle Chart

The duty cycle of the welding power source is the percentage of a ten minute period that a welding power source can safely be operated at a given output current. This welding power source is rated 300 amperes, 60 percent duty cycle. This means the welding power source can be safely operated at 300 amperes welding current for six minutes out of every ten. If the welding current is decreased, the duty cycle will increase. Figure 4-3 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 welding power source to overheat thereby causing damage to the welding power source.

4-13. VOLT-AMPERE CURVES (Figure 4-4)

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

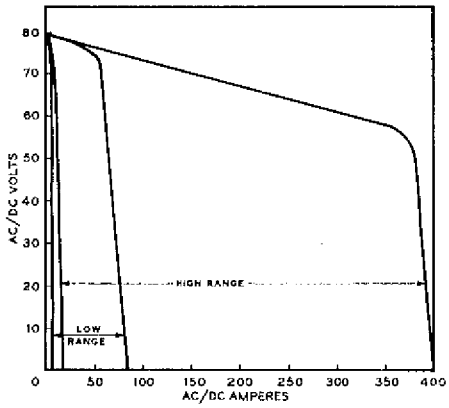

Figure 4-4. Volt-Ampere Curves

4-14. METERS (Optional)(Figure 4-1)

The meters can be mounted on the front panel of the welding power source and are for monitoring the welding operation and serve as an indication of the welding process. The meters are not intended for exact current or voltage measurements. These meters are internally connected to the welding power source output terminals. The voltmeter will indicate the dc voltage at the secondary terminals, but will not necessarily indicate the actual voltage at the welding arc. The ammeter will indicate the current output of the welding power source.

4-15. PULSER SWITCH (Pulser Model Only)(Figure 4-1)

The PULSER switch governs the operation of the pulse unit

within the welding power source. By placing the PULSER switch in the ON position, the welding power source output current will pulse between the background current level and the peak current level. By placing the PULSER switch in the OFF position, the welding power source output will not pulse, but rather remain at the peak current level.

The PULSER switch may be placed in either the ON or OFF position prior to or during welding operations. If the PULSER switch is placed in the ON position prior to welding operations, the output current may be at either the peak or background current level. If the PULSER switch is placed in the ON position during weld operations, the pulsing begins with the output current remaining at the peak current level, then upsloping or downsloping to the background current level.

There is no interaction between the BACKGROUND CURRENT control, PULSES PER SECOND control, % ON TIME control, or the PULSER switch and any of the other welding power source controls, including the start current controls. If the CRATER FILL switch is in the IN position, both the peak and background output currents decrease by the same proportion.

Pulsing operations may be performed when the AC/DC switch is in either the AC or DC position.

When remote control of the output current is employed, only the peak current level is remotely controlled; the background current level is still established by the position of the BACKGROUND CURRENT control.

4-16. % ON TIME CONTROL (Pulser Model Only)(Figure 4-1)

The % ON TIME control provides pulse width selection of the welding power source output current. The % ON TIME control is operational only when the PULSER switch is in the ON position.

Rotating the % ON TIME control in a clockwise direction increases the peak current "on-time" relative to the entire pulse time; the balance of the time is background current. Hence, this control establishes the peak current pulse width relative to the entire pulse width, and is adjustable from 5% peak ON TIME to 95% peak ON TIME.

The scale surrounding the % ON TIME control is calibrated in percentage and should not be misconstrued as a time indication.

NOTE

The contacts of the % ON TIME control are of the continuous type, thereby making it possible to adjust this control while welding.

4-17. PULSES PER SECOND CONTROL (Pulser Model Only)(Figure 4-1)

The PULSES PER SECOND control provides pulse frequency selection of the welding power source output current. The PULSES PER SECOND control is operational only when the PULSER switch is in the ON position.

Rotating the PULSES PER SECOND control in a clockwise direction increases the pulse frequency, and is adjustable from 0.5 PPS to 10 PPS.

The scale surrounding the PULSES PER SECOND control is calibrated in pulses per second to aid in the selection of a pulse frequency suitable for the application.

NOTE

The contacts of the PULSES PER SECOND control are of the continuous type, thereby making it possible to adjust this control while welding.

4-18. BACKGROUND CURRENT CONTROL (Pulser Model Only)(Figure 4-1)

The BACKGROUND CURRENT and CURRENT CONTROL provide current selection within the welding power source output current range being used. The setting of the BACKGROUND CURRENT control establishes the output current background level from which the output current travels to the output current pulse level established by the setting of the CURRENT CONTROL. If the CURRENT CONTROL is adjusted to a setting below the BACKGROUND CURRENT control, there will be negative pulse peaking from the background reference level. Similarly, if the CURRENT CONTROL is adjusted to a setting above the BACKGROUND CURRENT control, there will be positive pulse peaking from the background reference level. Rotating the CURRENT CONTROL and BACKGROUND CURRENT control in a clockwise direction increases the output current.

The scale surrounding the BACKGROUND CURRENT control is calibrated in percentage and should not be misconstrued as an amperage or voltage reading. It is recommended that meters be read whenever it is necessary to know the amperage and voltage output.

NOTE

The contacts of the CURRENT CONTROL and BACKGROUND CURRENT control are of the continuous type, thereby making it possible to adjust these controls while welding.

4-19. COOLANT-GAS PRE-FLOW CONTROL & SWITCH (Optional)(Figure 4-1)

An adjustable 0 to 15 second coolant-gas PRE-FLOW TIME control can be provided for controlling the period of time shielding gas and coolant flows before the arc is initiated. The PRE-FLOW TIME control governs the operation of a pre-flow timer within the welding power source.

Rotating the control in a clockwise direction increases the pre-flow time. The scale surrounding the PRE-FLOW TIME control is calibrated in seconds to aid in the selection of a pre-flow time period suited to the individual welding operation.

As soon as the remote contactor control switch has been closed, the pre-flow timer begins to time out the selected period of pre-flow time. Once the timer has timed out, the gas and coolant valves remain open and the contactor closes providing weld power. The timer then automatically resets and is ready for another weld cycle.

When coolant-gas pre-flow is desired, the PRE-FLOW TIME switch must be placed in the ON position. Conversely, by placing the PRE-FLOW TIME switch in the OFF position, coolant-gas pre-flow is not available, despite the position of the PRE-FLOW TIME control.

NOTE

The Pre-Flow Timer is automatically disabled whenever the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source, despite the position of the PRE-FLOW TIME control or switch. To prevent the coolant-gas valves from being operable when the Shielded Metal-Arc (SMAW) Welding process is used, ensure that the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source.

4-20. SPOT TIME CONTROL AND SWITCH (Optional) (Figure 4-1)

An adjustable 0 to 5 second SPOT TIME control can be provided for controlling the period of time weld power is available for spot welding. The SPOT TIME control governs the operation of a spot timer within the welding power source.

Rotating the control in a clockwise direction increases the spot time. The scale surrounding the SPOT TIME control is calibrated in seconds to aid in the selection of a spot time period suited to the individual welding operation.

When spot welding is desired, the SPOT TIME switch must be placed in the ON position. Conversely, by placing the SPOT TIME switch in the OFF position, time government of spot welding is not available, despite the position of the SPOT TIME control.

The spot weld timer begins to time out as soon as an arc is initiated. When the time set on the SPOT TIME control has elapsed, weld current is cut off and the post-flow timer starts.

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 begins timing out. The remote contactor control switch must remain closed throughout the entire spot welding time interval. If the remote contactor control switch is released prior to the completion of the spot weld cycle, spot weld current ceases and the spot weld timer will recycle.

Whenever the SPOT TIME switch is in the ON position, the CURRENT switch should be placed in the PANEL position and the CONTACTOR switch should be placed in the REMOTE position.

When the HIGH-FREQUENCY switch is in the CONTINUOUS position, high frequency is present at the secondary terminals for as long as the remote contactor control switch is closed.

If the SPOT TIME control is set at one second or less and the START CURRENT switch is in the ON position, the spot weld current is governed by the setting of the START CURRENT control. This is in spite of the position of the CURRENT CONTROL.

NOTE

The spot timer is automatically disabled whenever the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source, despite the position of the SPOT TIME control or switch. To prevent the spot weld timer from being operable when the Shielded Metal-Arc (SMAW) Welding process is used, ensure that the CONTACTOR switch is in the STANDARD position and the remote contactor control is disconnected from the welding power source.

SECTION 5 - SEQUENCE OF OPERATION

CAUTION

Never, under any circumstances, operate the welding power source with any portion of the outer enclosure removed. In addition to being a 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 any portion of the outer enclosure removed.

5 - 1. SHIELDED METAL-ARC (SMAW) WELDING

CAUTION

Ensure that the HIGH-FREQUENCY switch is in the OFF position before performing Shielded Metal Arc (SMAW) Welding. The attempted use of high frequency to establish an arc with a stick electrode could cause an arc to form between the electrode holder and the operator, which could result in serious injury.

1. Make all necessary connections as instructed in Section 3.
2. Place the CONTACTOR switch in the STANDARD position and disconnect the remote contactor control from the welding power source. Under these circumstances the POST-FLOW TIME, the PRE-FLOW TIME and SPOT TIME functions (if the unit is so equipped) are automatically disabled.
3. If a remote current control is not to be used, place the CURRENT switch in the PANEL position. If a remote current control is to be used, place the CURRENT switch in the REMOTE position.
4. Place the CRATER FILL switch in the OUT position.
5. Place the START CURRENT switch in the desired position. If this switch is placed in the ON position rotate the START CURRENT control to the desired position.
6. Rotate the AC BALANCE control to the BALANCED position.
7. Place the AC/DC switch in the desired position.
8. If the AC/DC switch has been placed in the DC position, place the POLARITY switch in the desired position. (The POLARITY switch is disabled when the AC/DC switch is placed in the AC position.)
9. Place the RANGE switch in the desired position; HIGH position being preferred for most welding applications.
10. Rotate the CURRENT CONTROL or remote current control, if used, to the desired position.
11. If the welding power source is a PULSER equipped model, and the arc pulsing function is desired, set the PULSER controls as instructed in Section 5-3. If arc pulsing is not desired, place the PULSER switch in the OFF 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 (GTAW) WELDING

1. Make all necessary connections as instructed in Section 3.
2. Place the CONTACTOR switch in the REMOTE position.
3. If a remote current control is not to be used, place the CURRENT switch in the PANEL position. If a remote current control is to be used, place the CURRENT switch in the REMOTE position.
4. Place the HIGH-FREQUENCY switch in the desired position and rotate the HIGH-FREQUENCY INTENSITY control to the desired position.
5. Place the CRATER FILL switch in the desired position. If the CRATER FILL switch is placed in the IN position, the CURRENT switch should be placed in the PANEL position and the CONTACTOR switch should be placed in the REMOTE position.
6. Place the START CURRENT switch in the desired position. If this switch is placed in the ON position, rotate the START CURRENT control to the desired position.
7. Rotate the AC BALANCE control to the desired position:
   a. BALANCED for dc welding.
   b. Towards MAX. PENETRATION for less cleaning action and more penetration, or towards MAX. CLEANING for more cleaning action and less penetration when ac welding.
8. Rotate the POST-FLOW TIME control to the desired coolant-gas post-flow time. If the welding power source is equipped with a PRE-FLOW TIME control

(optional) set the PRE-FLOW TIME controls as instructed in Item 4-19. If coolant-gas pre-flow is not desired, place the PRE-FLOW TIME switch in the OFF position.

9. Place the AC/DC switch in the desired position.

10. If the AC/DC switch has been placed in the DC position, place the POLARITY switch in the desired position. (The POLARITY switch is disabled when the AC/DC switch is placed in the AC position.)

11. Place the RANGE switch in the desired position.

12. Rotate the CURRENT control or remote current control, if used, to the desired position.

13. If the welding power source is a PULSER equipped model, and the arc pulsing function is desired, set the PULSER controls as instructed in Section 5-3. If arc pulsing is not desired, place the PULSER switch in the OFF position.

14. If the welding power source is equipped with a SPOT TIME function (optional) and spot welding capability is not desired, place the SPOT TIME switch in the OFF position. If spot welding capability is desired, make necessary adjustments as instructed in Section 4-20 and Section 5-4.

15. 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.

16. Commence welding.

5 - 3. PULSER OPERATION (Pulser Models Only)

1. Make all necessary connections as instructed in Section 3.

2. Place the CONTACTOR switch in the desired position.

3. If a remote current control is not to be used, place the CURRENT switch in the PANEL position. If a remote current control is to be used, place the CURRENT switch in the REMOTE position. During pulsing operation, the panel CURRENT CONTROL becomes the "peak" current control. If a remote current control is used, it becomes a vernier percent peak current setting of the panel CURRENT CONTROL.

4. Place the HIGH-FREQUENCY switch in the desired position and rotate the HIGH-FREQUENCY INTENSITY control to the desired position.

5. Place the CRATER FILL switch in the desired position. If the CRATER FILL switch is placed in the IN position, the CURRENT switch should be placed in the PANEL position and the CONTACTOR switch should be placed in the REMOTE position.

6. Place the START CURRENT switch in the desired position. If this switch is placed in the ON position, rotate the START CURRENT control to the desired position.

7. Rotate the AC BALANCE control to the desired position:

   a. BALANCED for dc welding.

   b. Towards MAX. PENETRATION for less cleaning action and more penetration, or towards MAX. CLEANING for more cleaning action and less penetration when ac welding.

8. Rotate the POST-FLOW TIME (and the PRE-FLOW TIME, if the unit is so equipped) controls to the desired coolant-gas flow time.

9. Place the AC/DC switch in the desired position.

10. If the AC/DC switch has been placed in the DC position, place the POLARITY switch in the desired position. (The POLARITY switch is disabled when the AC/DC switch is placed in the AC position.)

11. Place the RANGE switch in the desired position.

12. Rotate the panel CURRENT CONTROL to the peak current desired.

13. If the welding power source is equipped with a SPOT TIME function (optional), place the SPOT TIME switch in the OFF position.

14. Rotate the BACKGROUND CURRENT control to the desired position. (The 0-100 graduations represent minimum to maximum of the range in use, and are approximately linear.)

15. Rotate the PULSES PER SECOND control to the desired number of pulses per second.

16. Rotate the % ON TIME control to the desired ratio of peak current time to background current time.

17. Place the PULSER switch in the ON position. Place the POWER switch in the ON position.

18. If the machine is equipped with meters and it is desired to observe the pulsing action, background current set point, etc.:

   a. Set the PULSES PER SECOND control to .5 pulse per second.

   b. Short the electrode to the work.

   c. Set the % ON TIME control to 95%.

   d. Energize the contactor and observe the peak current.

   e. Rotate the % ON TIME control to 5%, and observe the background current level; adjust to desired position.

   f. Remove short circuit, return the PULSES PER SECOND and % ON TIME controls to their respective proper set points.

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.

NOTE

All pulser controls may be adjusted while welding.

19. Commence welding.

5 - 4. SPOT WELDING

1. Make all necessary connections as instructed in Section 3.

2. Place the CONTACTOR switch in the REMOTE position.

3. Place CURRENT switch in the PANEL position.

4. Place the HIGH-FREQUENCY switch in the START position and rotate the HIGH-FREQUENCY INTENSITY control to the desired position.

5. Place the CRATER FILL switch in the OFF position.

6. Place the START CURRENT switch in the desired position. If this switch is placed in the ON position,

rotate the START CURRENT control to the desired position. The start current time (1 second) occurs within the spot time set. (Spot time is unchanged by the start control.)

7. Rotate the AC BALANCE control to the desired position:

   a. BALANCED for dc welding.

   b. Towards MAX. PENETRATION for less cleaning action and more penetration, or towards MAX. CLEANING for more cleaning action and less penetration when ac welding.

8. Rotate the POST-FLOW TIME (and PRE-FLOW TIME, if unit is so equipped) controls to the desired coolant-gas flow time.

9. Place the AC/DC switch in the desired position.

10. If the AC/DC switch has been placed in the DC position, place the POLARITY switch in the desired position. (The POLARITY switch is disabled when the AC/DC switch is placed in the AC position.)

11. Place the RANGE switch in the desired position.

12. Rotate the CURRENT CONTROL to the desired position.

13. If the welding power source is a PULSER equipped model, place the PULSER switch in the OFF position.

14. Place the SPOT TIME switch in the ON position and rotate the SPOT TIME control to the desired position.

15. 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.

16. Commence welding.

5 - 5. SHUTTING DOWN

1. Cease welding.
2. Allow the welding power source to idle for three minutes with no load being applied.
3. Place the POWER switch in the OFF position.
4. Turn the shielding gas supply off if used.

CAUTION

If welding is performed in a confined area, failure to turn off gas supply could result in a build up of gas fumes, endangering personnel reentering the welding area.

SECTION 6 - MAINTENANCE

CAUTION

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

6 - 1. FAN MOTOR

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

6 - 2. INTERNAL CLEANING

Depending on the location of this unit and the amount of dust and dirt in the atmosphere, periodic internal cleaning of this unit may be necessary. This cleaning process may be accomplished by removing the outer enclosure and blowing with compressed air or using vacuum suction around the internal components.

6 - 3. SPARK GAP ADJUSTMENT (Figures 4-1 & 6-1)

The spark gaps can be inspected by opening the high frequency access door located behind the lower front access door (See Figure 4-1).

The spark gaps are normally set at .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 indicated when intermittent operation of the gaps is noted. Usually this occurs when the setting has increased to .013" or greater.

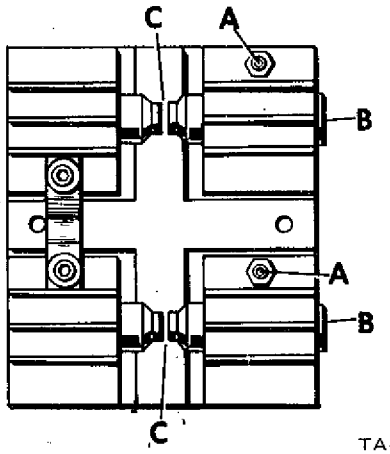

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Figure 6-1. Spark Gap Adjustment

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 has completely disappeared.

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".

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.

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.

6-4. 115 VOLTS CONTROL CIRCUIT OVERLOAD PROTECTION (Figure 4-1)

The 115 volts control circuitry in this welding power source is protected from current overload by a 10 ampere circuit breaker (CB1) located on the lower portion of the front panel (see Figure 4-1). If any of the control circuits and/or the 115 VOLTS AC receptacle are overloaded, this breaker will open and the welding functions of the unit will cease.

The pilot light remains on, indicating the presence of line voltage up to the main transformer, and the fan continues to operate.

If this circuit breaker should open, depress the breaker button protruding from the front panel. This action resets the breaker. If continual opening of this breaker is observed, determine and remove or correct the cause of the overload condition.

6-5. HALL AMPLIFIER

The hall amplifier (HA1) provides a signal which represents the magnitude of the weld current, for use in the regulation portion of the control system. A single turn of heavy cable carries the high range current through the toroid core, and four additional turns of light cable carry the low range current. The output signal to be expected is one volt dc (negative) per 100 amps of welding current on the high range and one volt dc (negative) per 20 amps on the low range. The signal appears at wire 87 with respect to frame ground (42).

The trimmer resistors on the hall amplifier are factory set and should not be adjusted.

SECTION 7 - TROUBLESHOOTING

CAUTION

Hazardous voltages are present on the internal circuitry of the welding power source as long as power is connected to the unit. Disconnect power before attempting any inspection or work on the inside of the unit. Troubleshooting of internal circuitry should be performed by qualified personnel only.

The following chart is designed to diagnose and provide remedies for some of the troubles that may develop in this welding power source.

It is assumed that proper installation has been made, according to Section 3 of this manual, and that the welding power source has been functioning properly until this trouble developed.

Use this chart in conjunction with the circuit diagram while performing troubleshooting procedures. If the trouble is not remedied after performing these procedures, the nearest Factory Authorized Service Station should be contacted. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly followed.

TROUBLE	PROBABLE CAUSE	REMEDY
No weld output; fan inoperative.	Open line fuse.	Check for and replace open line fuse.
	Improper electrical input connections.	Refer to Section 3-2 for proper input connections.
	Input voltage jumper links not in proper configuration.	Refer to Section 3-2C for proper input voltage jumper link configuration.
No weld output; fan operative.	Improper electrical input and/or secondary connections.	Refer to Sections 3-2 and 3-3 for proper electrical input and secondary connections.
	CONTACTOR switch (S4) in REMOTE position without a remote contactor control connected to the welding power source.	If remote contactor control is not desired, place the CONTACTOR switch (S4) in the STANDARD position. If remote contactor control is desired, retain the CONTACTOR switch (S4) in the REMOTE position and make remote contactor control connections as instructed in Section 3-5.
	Overloading of the 115 volts control circuits and/or the 115 VOLTS AC receptacle (RC1) has caused circuit breaker (CB1) to open.	Depress circuit breaker (CB1) button to reset. If continual reopening of the breaker is observed, determine and remove or correct the cause of the overload condition.
Low weld output; fan operative.	Improper electrical input and/or secondary connections.	Refer to Sections 3-2 and 3-3 for proper electrical input and secondary connections.
	Input voltage jumper links not in proper configuration.	Refer to Section 3-2C for proper input voltage jumper link configuration.
High or low weld output; CURRENT CONTROL (R1) inoperative.	CURRENT switch (S11) in REMOTE position without a remote current control connected to the welding power source.	If remote current control is not desired, place the CURRENT switch (S11) in the PANEL position. If remote current control is desired, retain the CURRENT switch (S11) in the REMOTE position, and make remote current control connections as instructed in Section 3-5.
Insufficiency or absense of high frequency.	Improper spark gap.	Check for and correct spark gap as instructed in Section 6-3.
	HIGH-FREQUENCY INTENSITY control (R20) set too low.	Rotate control clockwise to increase high frequency.
Fan inoperative.	Defective fan motor (FM).	Check for and replace defective fan motor (FM).
	Fan motor (FM) leads open or shorted.	Check for and correct open or shorted fan motor (FM) leads.
	Propellor obstructions.	Check for and remove propellor obstructions.

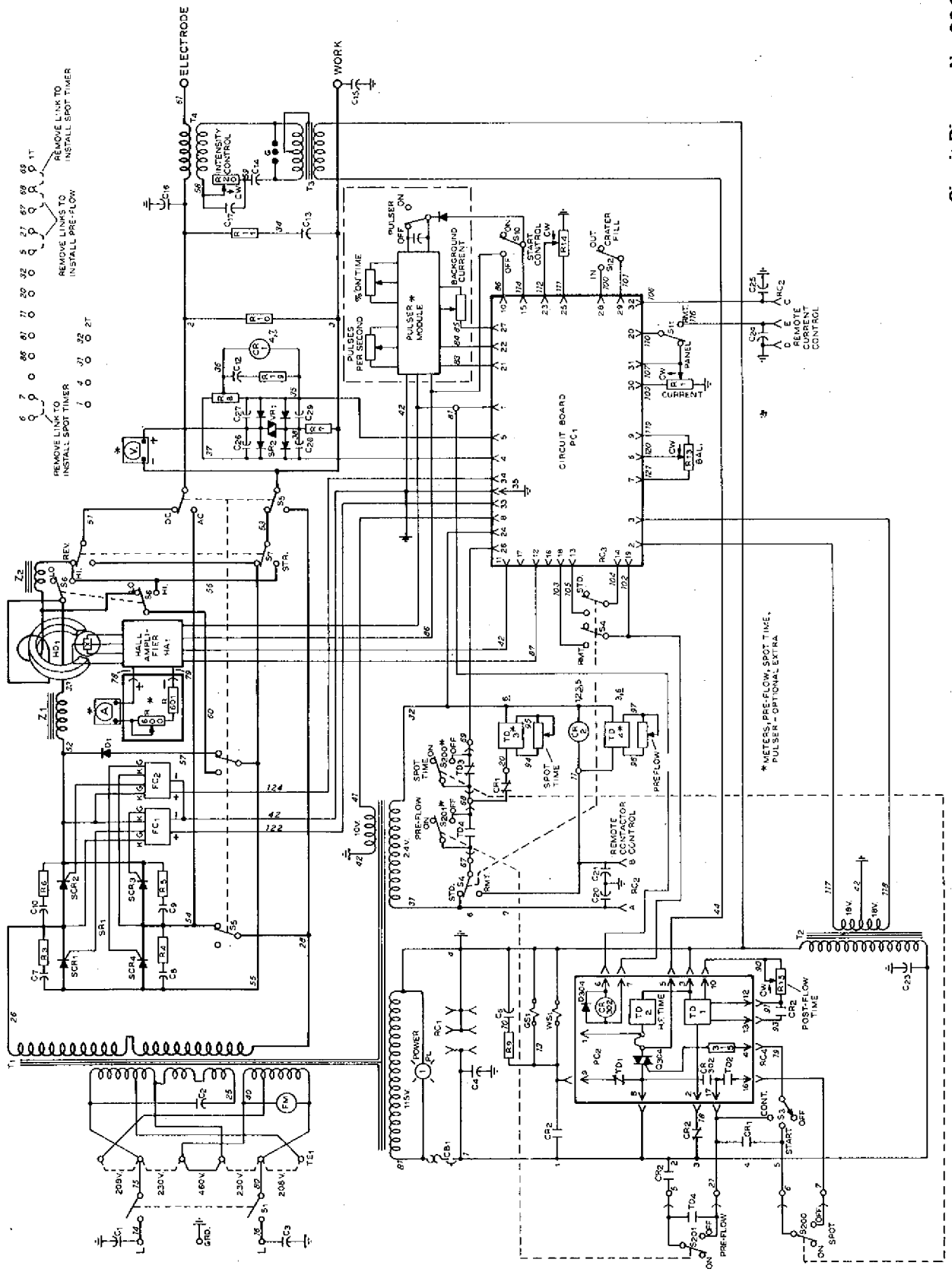
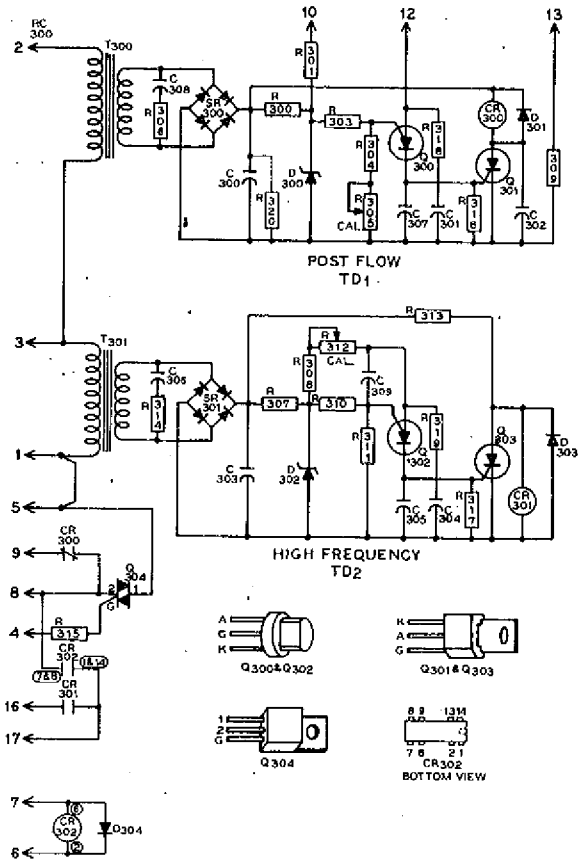


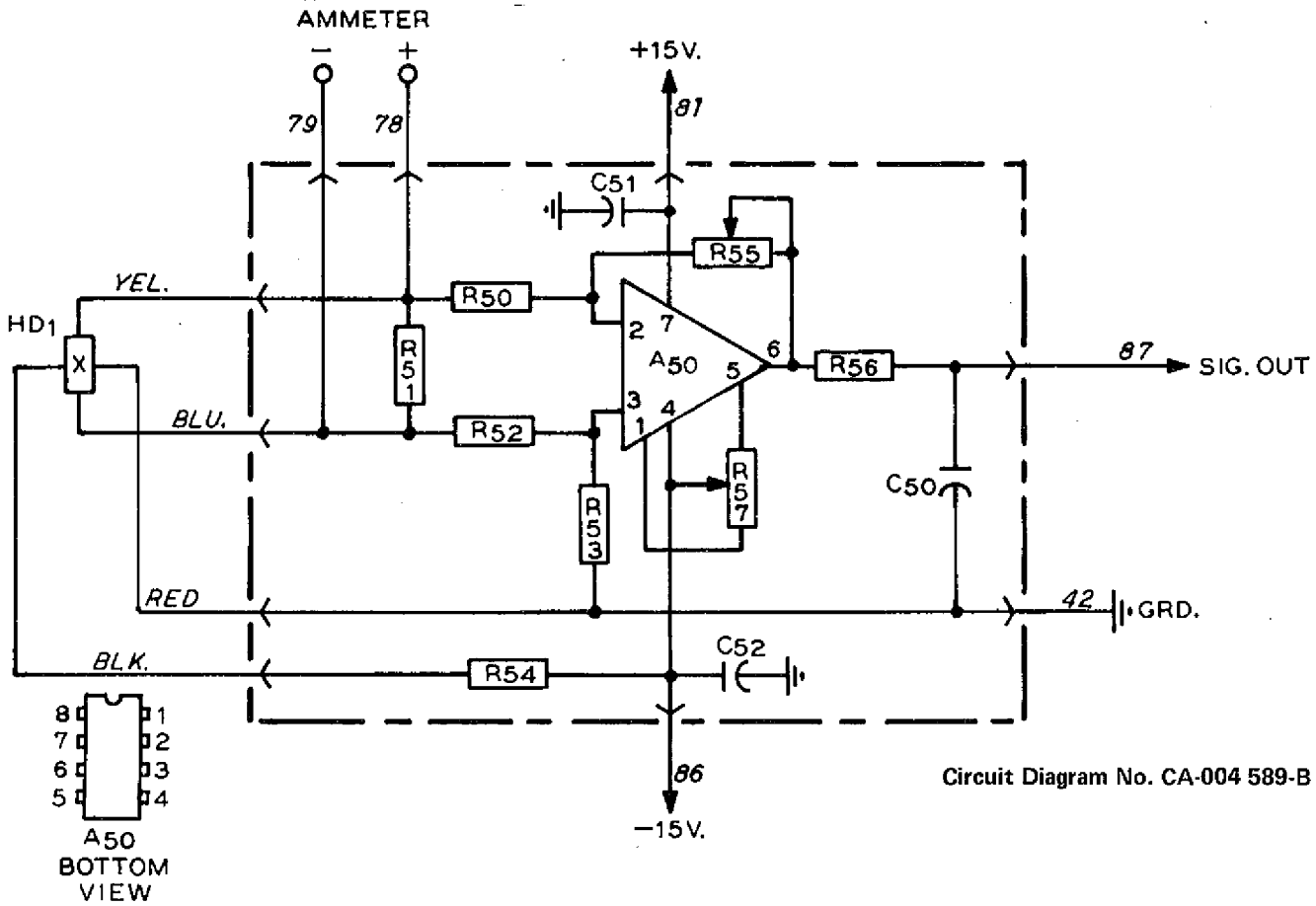
Figure 7-1. Circuit Diagram For Basic Model

Circuit Diagram No. CC-901 718-1G1



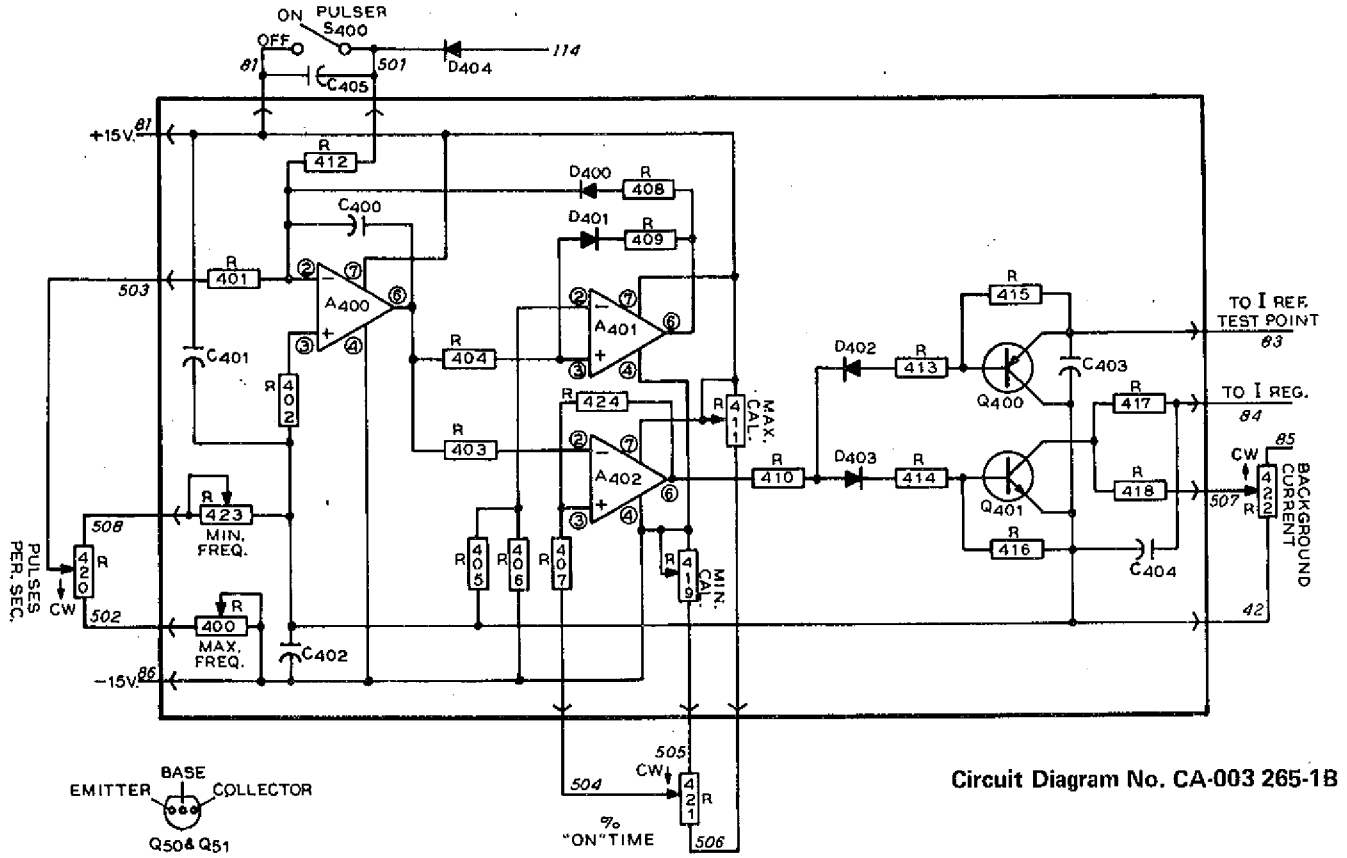
Circuit Diagram No. CA-004 947-1E

Figure 7-2. Circuit Diagram For Post-Flow And High Frequency Timer



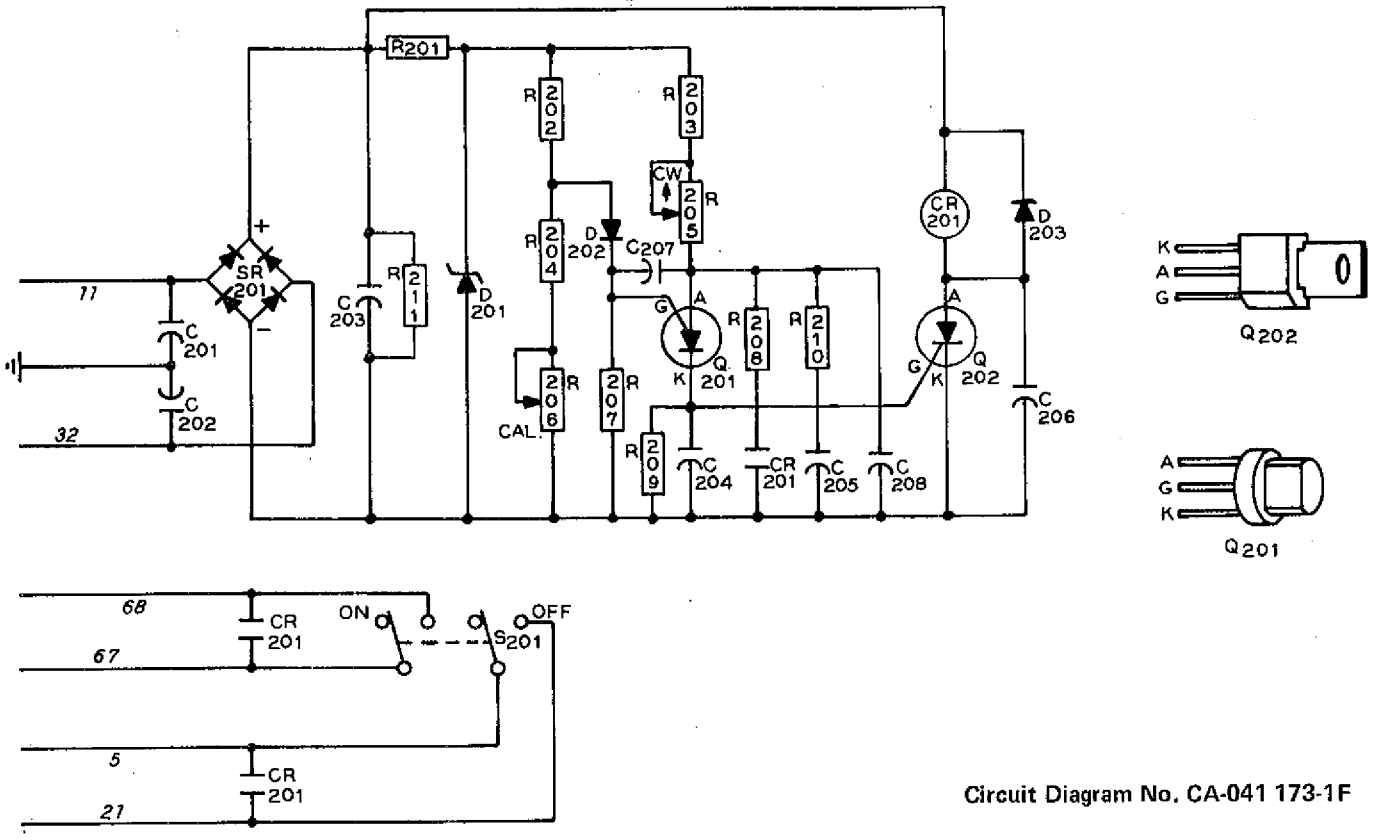
Circuit Diagram No. CA-004 589-B

Figure 7-3. Circuit Diagram For Hall Amplifier



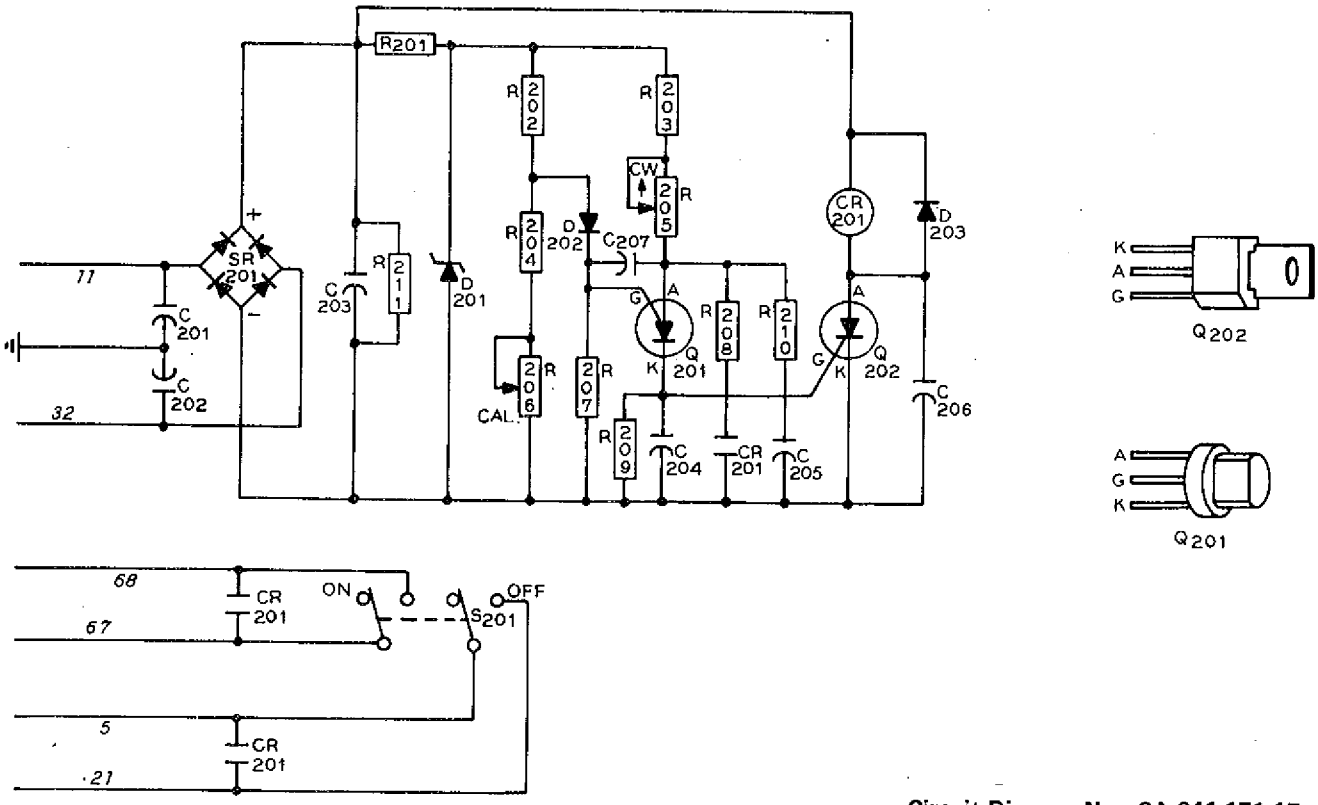
Circuit Diagram No. CA-003 265-1B

Figure 7-4. Circuit Diagram For Pulser



Circuit Diagram No. CA-041 173-1F

Figure 7-5. Circuit Diagram For Pre-Flow Timer



Circuit Diagram No. CA-041 171-1E

Figure 7-6. Circuit Diagram For Spot Timer

Abbreviations Used In Flow Chart

p.u. – pick up
d.o. – drop out
t.o. – times out, time out
ON – component energized
OFF – component de-energized
GS – gas valve (solenoid operated)
WS – coolant valve (solenoid operated)
TD – timer
CR – control relay
OCV – open-circuit volts
HF – high frequency

PRESUPPOSITIONS: CONTACTOR switch in REMOTE
HIGH-FREQUENCY switch in either CONTINUOUS or START
*CRATER FILL switch ON
START CURRENT switch ON
*PRE-FLOW TIME switch ON
POST-FLOW TIME ON
**PULSER switch ON

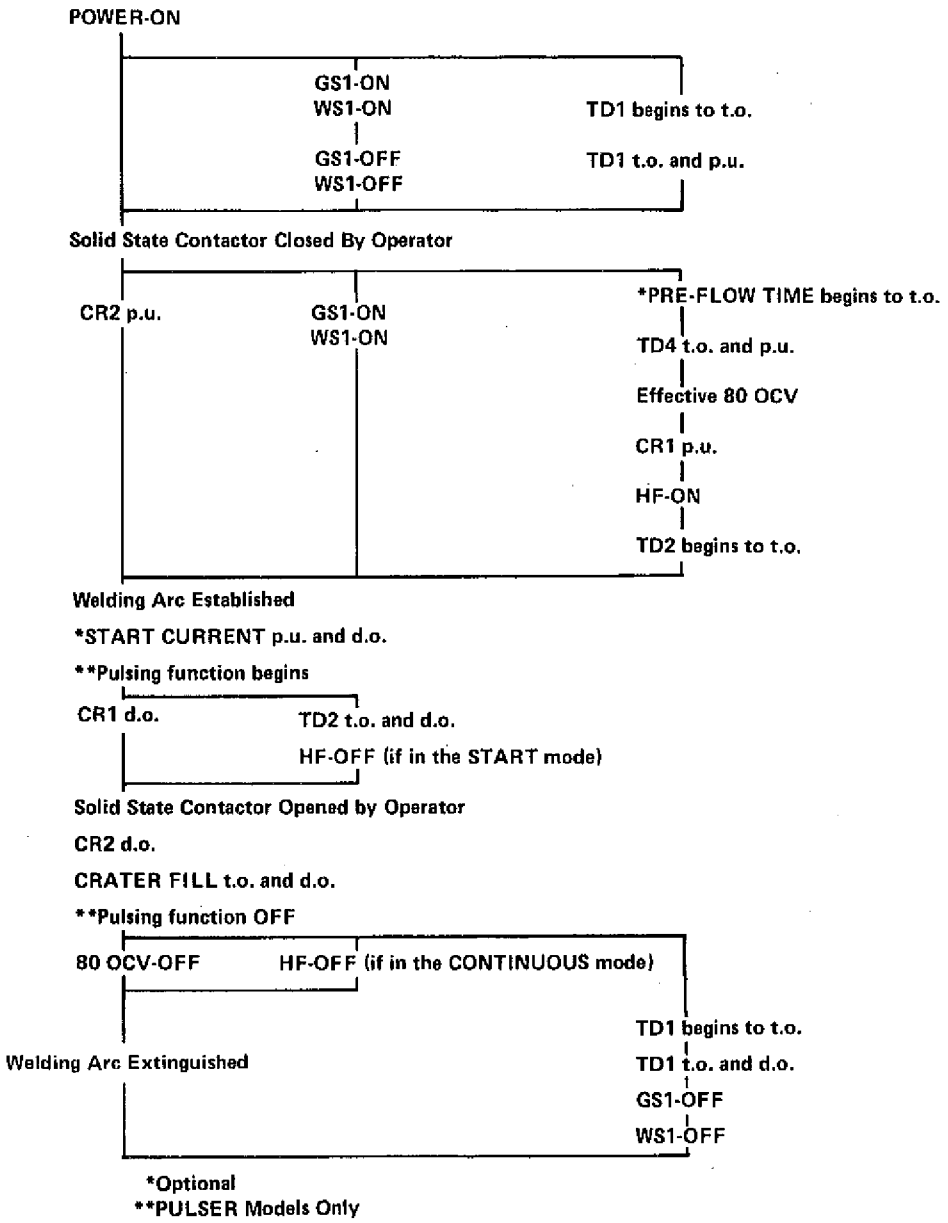


Figure 7-7. AC/DC Gas Tungsten-Arc (GTAW) Welding Flow Chart

PRESUPPOSITIONS: CONTACTOR switch in STANDARD
Remote Contactor Control disconnected from welding power source

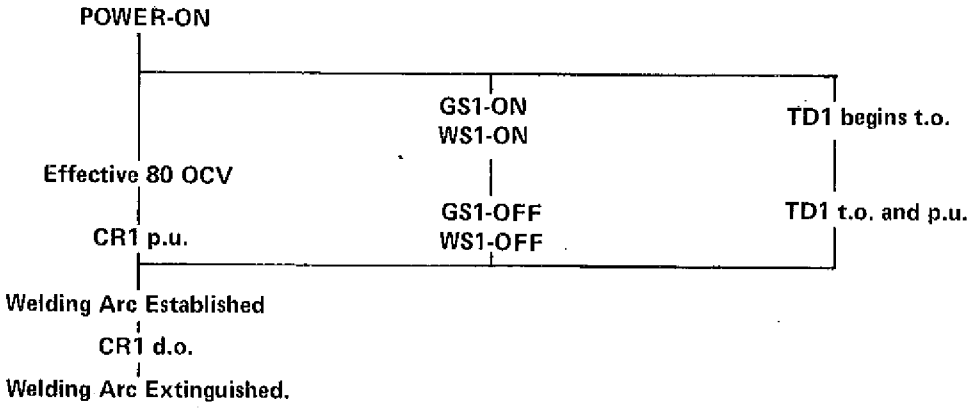


Figure 7-8. AC/DC Shielded Metal-Arc (SMAW) Welding Flow Chart

PRESUPPOSITIONS: CURRENT switch in PANEL
CONTACTOR switch in REMOTE
HIGH-FREQUENCY switch in START
POST-FLOW TIME ON
CRATER FILL switch OFF
Remote Contactor Control connected to welding power source

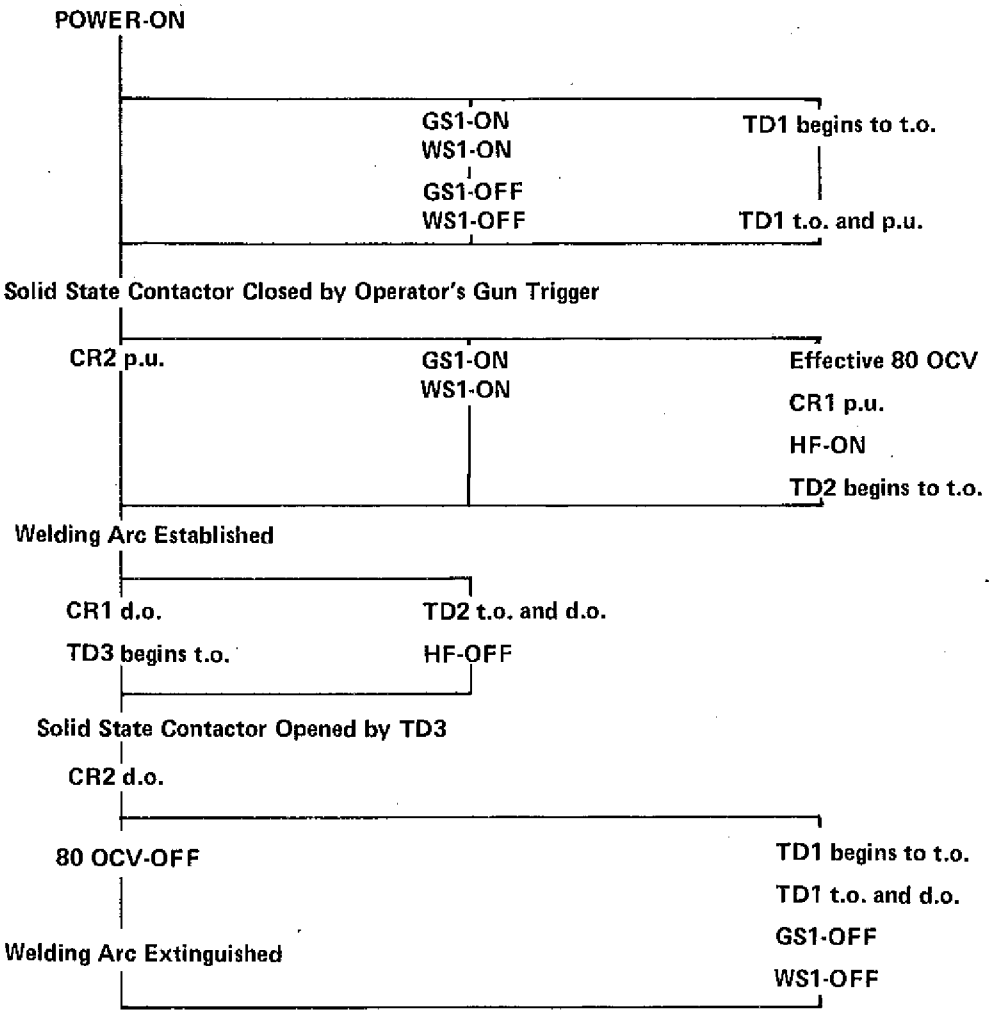


Figure 7-9. AC/DC Spot Welding Flow Chart For Models Equipped With The Optional Spot Time Controls

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 overemphasized 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.

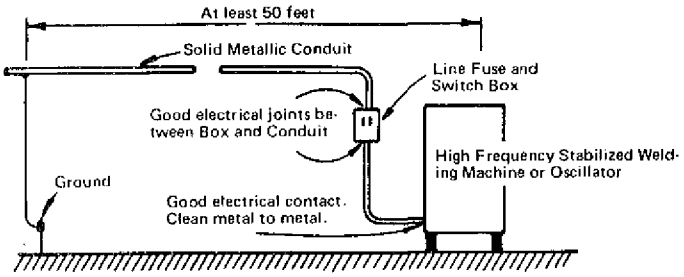


Figure 8-1. Power Service Installation H.F. Stabilized Arc Welding Machine

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 adherences to proper installation procedure as outlined in this booklet will minimize this type of interference.

8 - 3. POWER SERVICE

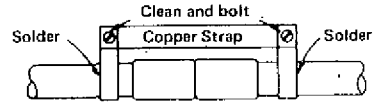
The specific installation instructions for making the proper primary connections to the equipment as outlined in the instruction booklet furnished with the equipment, should be followed carefully with one exception as notted in the following paragraph.

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.

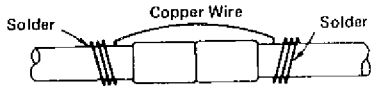
Solid metallic shielding shall enclose the primary power service to the equipment from a point 50 feet from the equipment in a unbroken run.

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.



(a) Demountable Bonding Strap for Conduit Joints



(b) Solid Bonding with Copper Wire for Conduit Joints

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).

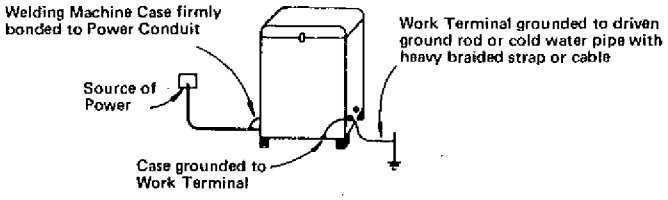


Figure 8-3. Ground Connections At Welding Machine

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).

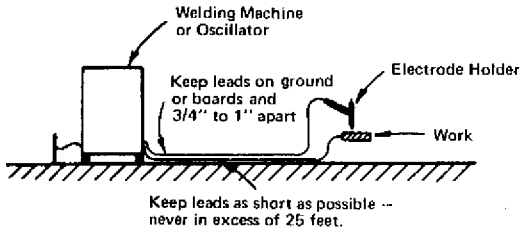


Figure 8-4. General Rules For Welding Leads

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.

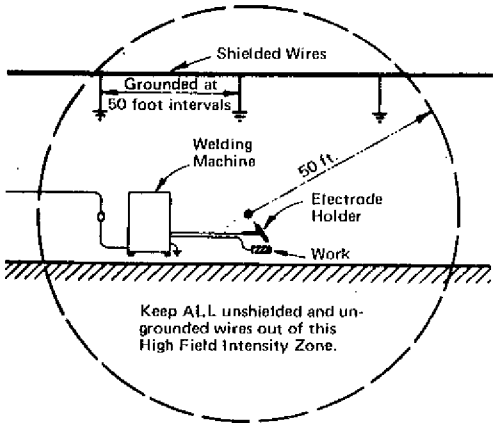


Figure 8-5. General Requirements to Minimize Reradiation Pick-Up In the Vicinity of the Weld Zone

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 through 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

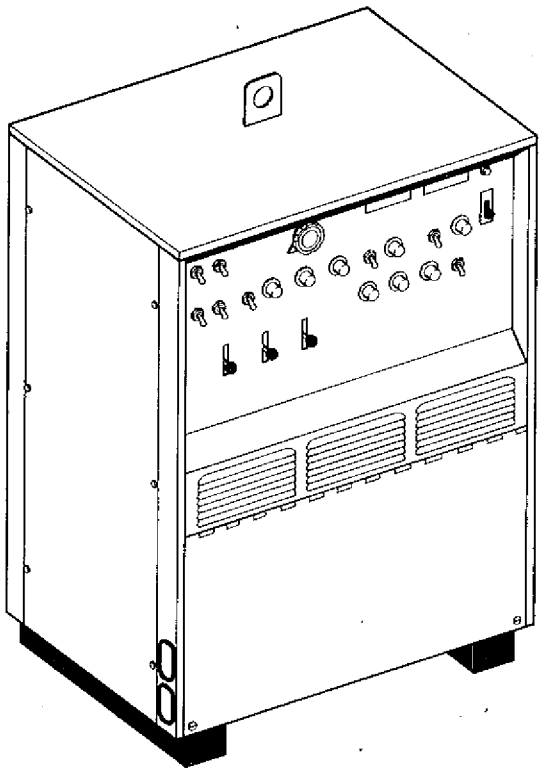
The following questions may be used by the installer as a check to see if all installation requirements have been met:

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 radious 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.

May 1977 FORM: OM-350C

Effective With Serial No. HG076580



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

PARTS LIST

PRINTED IN U.S.A.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure A			**Main Assembly**	
1		039 244	COVER, top	1
2		039 248	PANEL, side	2
3	C15	009 063	CAPACITOR ASSEMBLY	1
4	C16	009 062	CAPACITOR ASSEMBLY	1
5		026 627	GASKET, lifting eye - cover	1
6	HA1,HD1	004 590	SENSOR, current	1
7		Figure B	PANEL, rear - with components (See Page 2)	1
8	TE1	007 928	TERMINAL ASSEMBLY, primary (See Fig. C Page 2)	1
9		006 901	REACTOR & TRANSFORMER, power - main (See Fig. D Page 3)	1
10		025 142	BRACKET, mounting - capacitor	1
11	C4	007 967	CAPACITOR, metalized paper 2 uf 115 volts	1
12	C2	025 315	CAPACITOR, paper oil 30 uf 460 volts ac	2
13		003 034	BASE	1
14	Z2	000 051	REACTOR, square wave - low range	1
15		Figure F & G	PANEL, front - with components (See Pages 5-8)	1
16		004 603	HIGH FREQUENCY PANEL (See Fig. E Page 4)	1

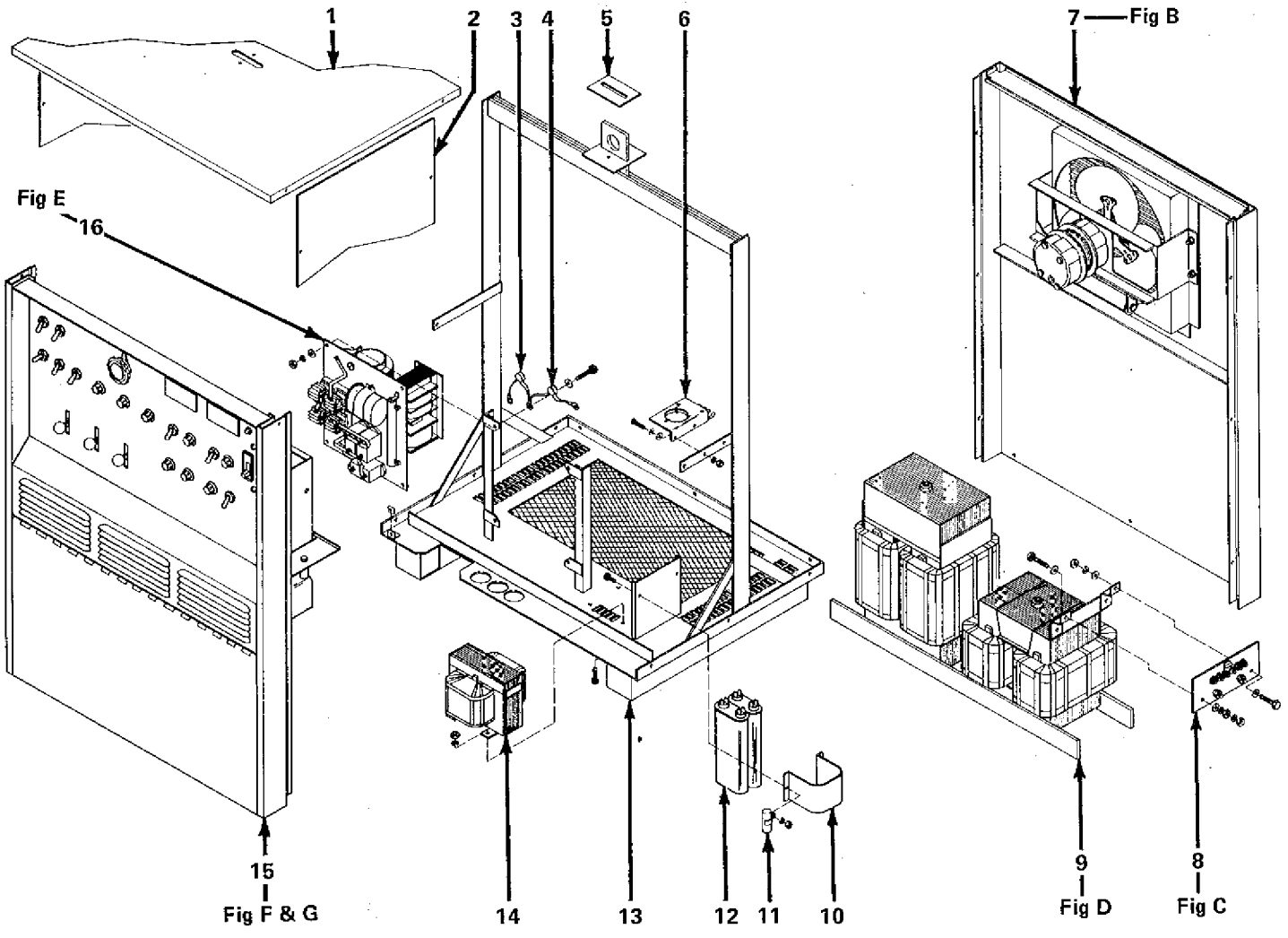


Figure A – Main Assembly

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure B			**Panel, Rear - With Components (See Fig. A Page 1 Item 7)**	
21	FM	032 603	MOTOR, fan 230 volts (consisting of)	1
		024 601	. BEARING	2
22		016 258	CHAMBER, plenum 14 inch	1
23		032 604	BLADE, fan 60 Hz. 14 inch 3 wing 19 deg	1
24		039 247	PANEL, rear	1
25	R10	030 060	RESISTOR, WW adj 375 watt 20 ohm	1

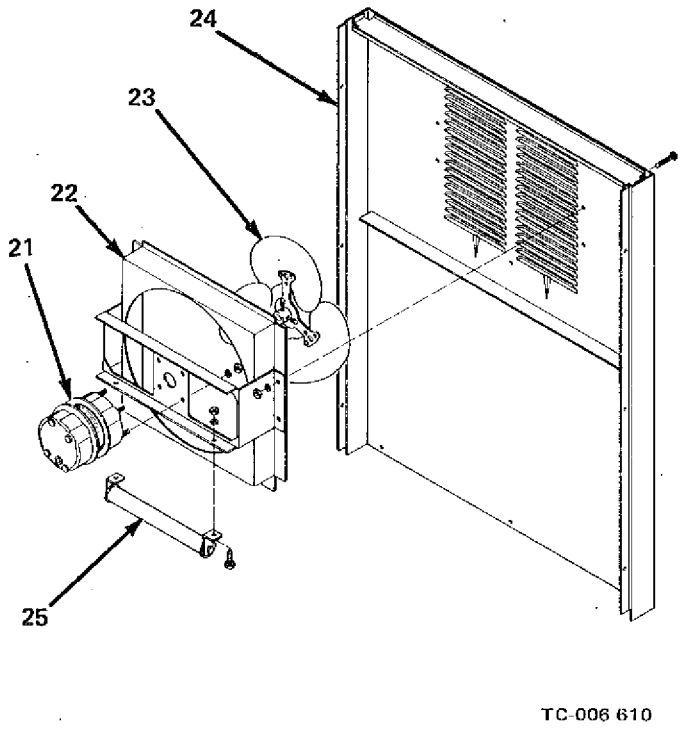


Figure B — Panel, Rear - With Components

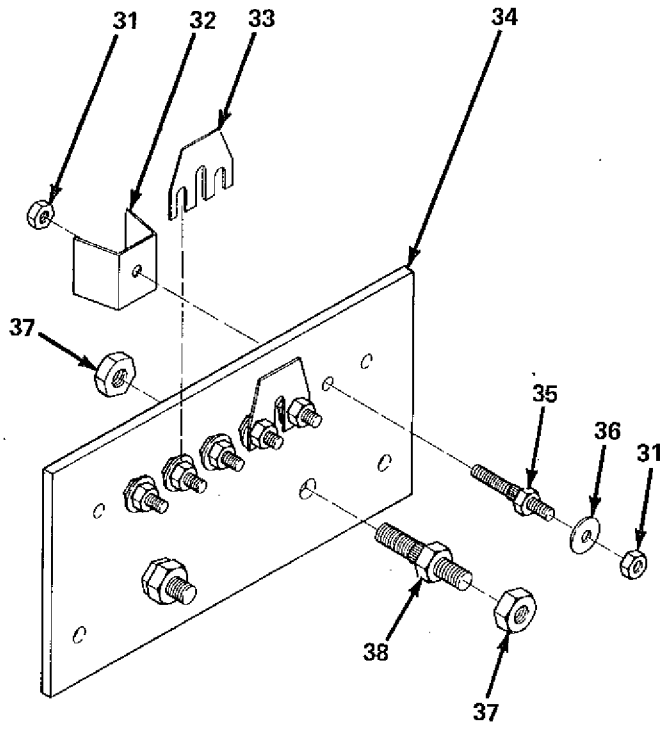


Figure C — Terminal Board Assembly, Primary

Item No.	Factory Part No.	Description	Quantity
Figure C	**007 928**	**Terminal Assembly, Primary (See Fig. A Page 1 Item 8)**	
31	601 835	NUT, brass - hex 10-32	12
32	026 754	INSULATION, primary stud barrier	6
33	038 618	LINK, jumper - terminal primary board	2
34	034 588	TERMINAL BOARD, primary	1
35	038 887	STUD, brass No. 10-32 x 1-3/8 w/hex collar	6
36	010 913	WASHER, flat - brass 3/16 ID x 1/2 OD	6
37	601 836	NUT, brass - hex jam 1/4-20	4
38	038 888	STUD, brass 1/4-20 x 1-1/2 w/hex collar	2

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure D		**006 901**	**Reactor & Transformer, Power - Main (See Fig. A Page 1 Item 9)**	
51	Z1	039 313	REACTOR, square wave (consisting of)	1
52		**000 192	. COIL, reactor - square wave RH	1
53		**039 254	. REACTOR SUBASSEMBLY, square wave (consisting of)	1
54		039 252	. . STRIP, glastic 1/8 x 4-13/32 x 6-1/2	1
55		023 152	. . WEDGE, 5/8 x 1 x 6	4
56		039 253	. . STRIP, phenolic 1/2 x 6 x 9-1/8	1
57		**003 031	. COIL, reactor - square wave LH	1
58	T1	**006 857	TRANSFORMER, power - main (consisting of)	1
59		**006 910	. TRANSFORMER SUBASSEMBLY, power - main (consisting of)	1
60		006 967	. . STRIP, glastic 1/16 x 3-5/8 x 7-1/4	2
61		010 340	. . WEDGE, hardwood 1/2 x 1 x 5-1/2	4
62		**006 859	. COIL, primary/secondary RH	1
63		**006 858	. COIL, primary/secondary LH	1
64		000 194	BAR, steel 3/8 x 2 x 21	2
65		022 113	BAR, steel 1/4 x 1 x 5-7/8	4

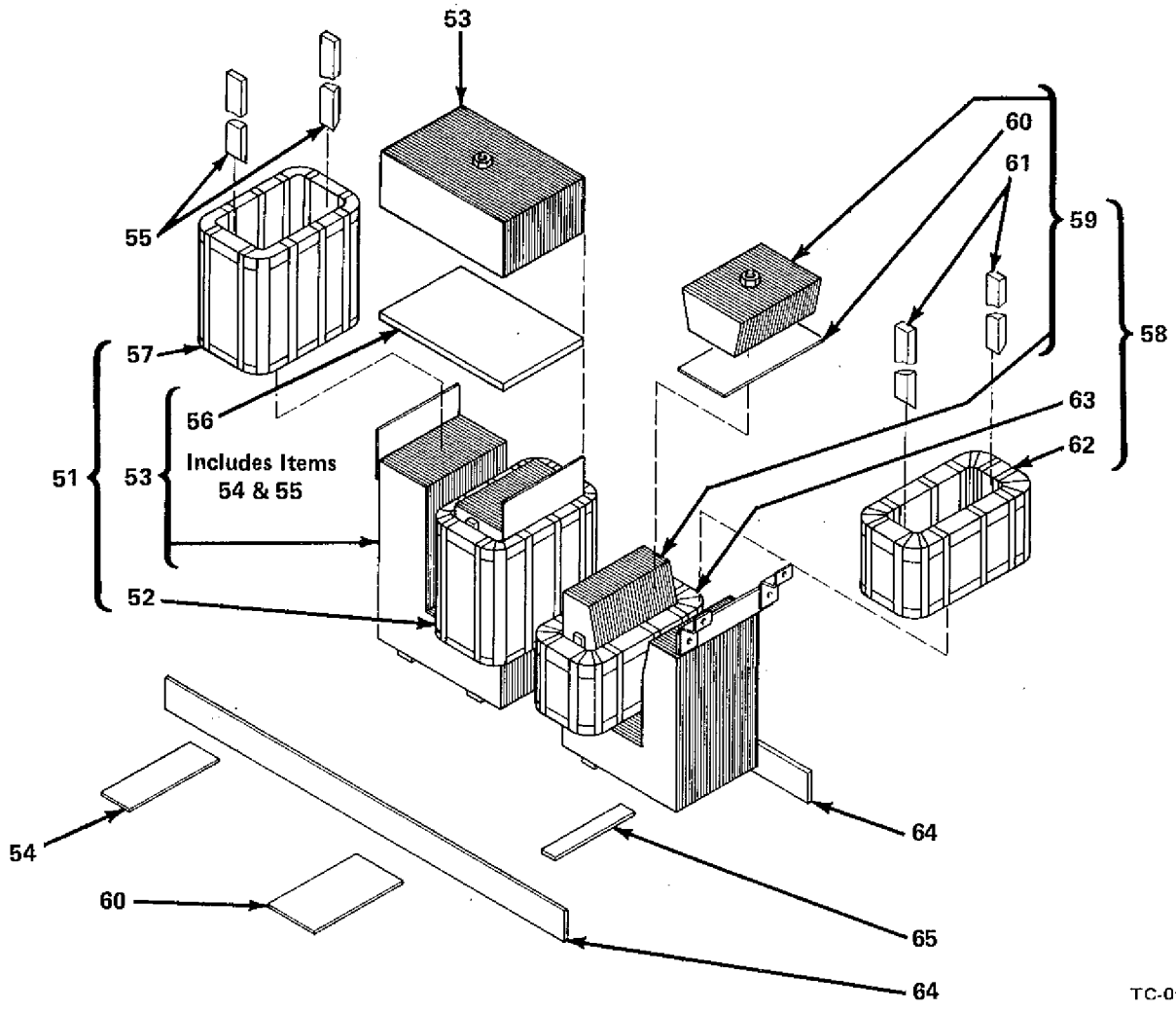


Figure D — Reactor & Transformer, Power - Main

**Replace at Factory or Authorized Service Station.

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure E		**004 603**	**High Frequency Panel (See Fig. A Page 1 Item 16)**	
81		010 885	STRIP, conductor	2
82		603 737	SCREW, machine - brass round hd 3/8-16 x 1-3/4	2
83		005 116	MOUNTING BOARD, component HF	1
84		038 887	STUD, brass No. 10-32 x 1-3/8 w/hex collar	2
85		601 835	NUT, brass - hex 10-32	6
86		601 837	NUT, brass - hex jam 3/8-16	4
87	T4	033 373	COIL, coupling - air (consisting of)	1
88		010 147	. STRIP, conductor	2
89		601 831	. NUT, brass - hex 8-32	2
90		010 913	. WASHER, flat - brass 3/16 ID x 1/2 OD	4
91		602 030	. SCREW, machine - brass round hd 8-32 x 3/8	2
92	T3	036 865	TRANSFORMER, HV 115 volts	1
93	R11	030 602	RESISTOR, WW fixed 100 watt 10 ohm	1
94		602 042	SCREW, machine - brass round hd 10-32 x 1	1
95	C14	031 602	CAPACITOR, mica 0.002 uf 5000 volts dc	3
96		010 884	STRIP, conductor	1
97		025 065	STRIP, conductor	1
98	C13	031 601	CAPACITOR, paper oil 10 uf 600 volts dc	1
99		014 159	BRACKET, mounting - capacitor	1
100		010 883	STRIP, conductor	1
101		020 623	SPARK GAP ASSEMBLY (consisting of)	1
102		010 888	. CONNECTOR, holder - spark gap	1
103		020 622	. HOLDER, points	4
104	G	*020 603	. POINT, spark gap	4
105		020 621	. BASE, spark gap	1

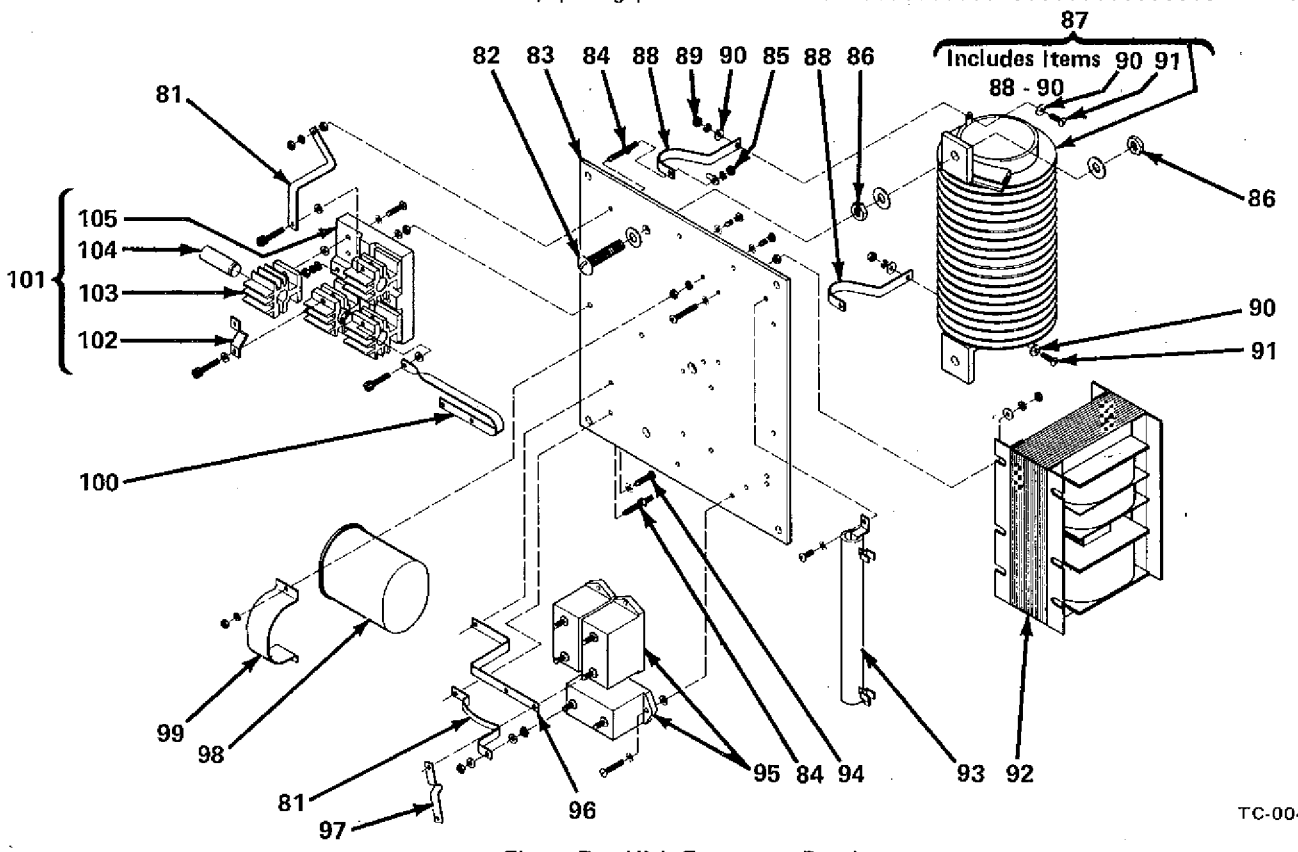


Figure E — High Frequency Panel

*Recommended Spare Parts.

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

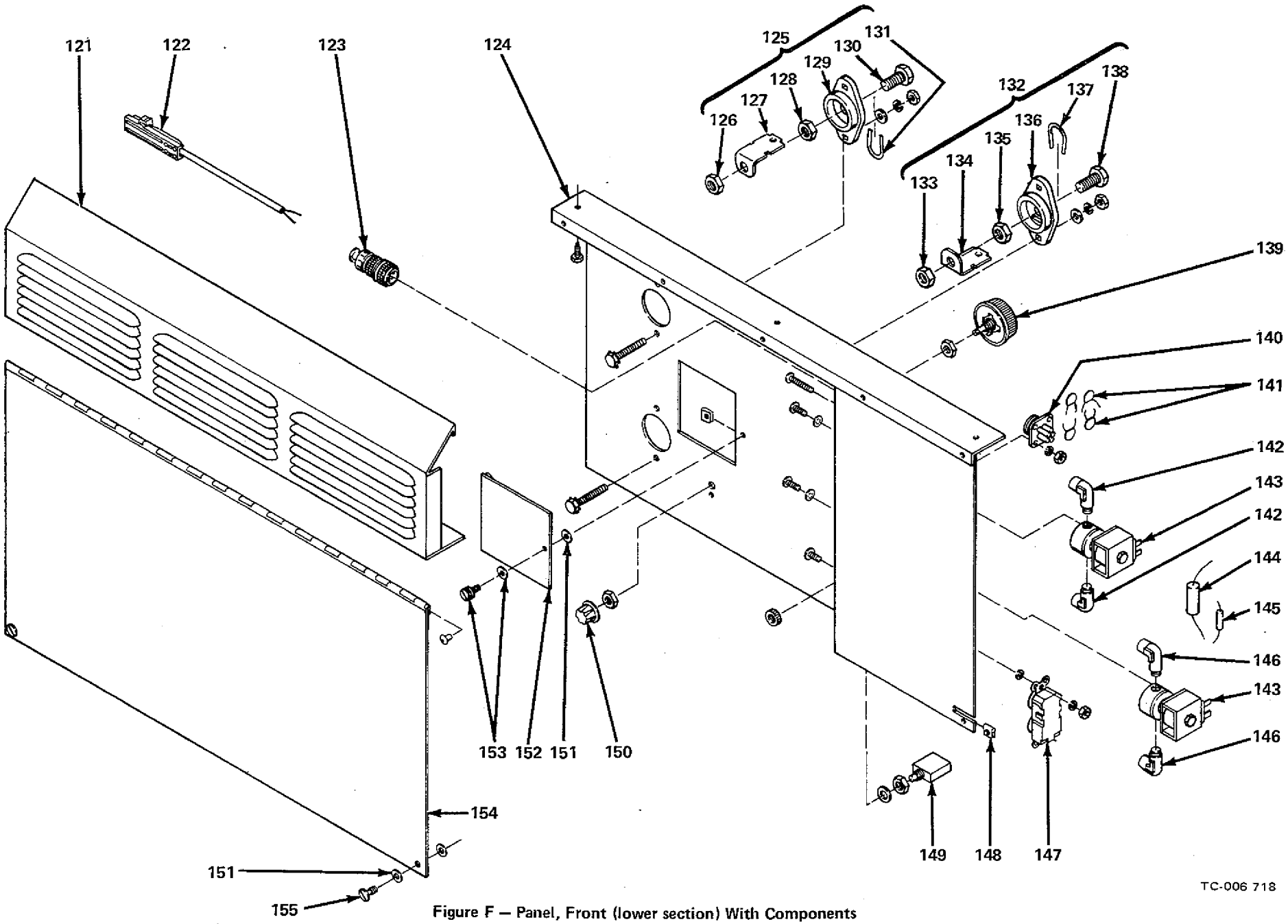


Figure F — Panel, Front (lower section) With Components

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure F			**Panel, Front - (lower section) With Components (See Fig. A Page 1 Item 15)**	
121		003 045	PANEL, front - louvered	1
122		041 203	SWITCH, RHS-24 w/cord 10 inches	1
123		039 273	PLUG, 5 pin MS3106A-16S-8P	1
124		006 941	PANEL, front	1
125		039 047	TERMINAL, power output - red (consisting of)	1
126		601 879	. NUT, steel - hex full 1/2-13	1
127		039 044	. BUS BAR	1
128		601 880	. NUT, steel - hex jam 1/2-13	1
129		039 049	. TERMINAL BOARD, red	1
130		601 976	. SCREW, cap - steel hex hd 1/2-13 x 1-1/2	1
131		039 043	. CLIP, spring - bus bar	1
132		039 046	TERMINAL, power output - black (consisting of)	1
133		601 879	. NUT, steel - hex full 1/2-13	1
134		039 044	. BUS BAR	1
135		601 880	. NUT, steel - hex jam 1/2-13	1
136		039 045	. TERMINAL BOARD, black	1
137		039 043	. CLIP, spring - bus bar	1
138		601 976	. SCREW, cap - steel hex hd 1/2-13 x 1-1/2	1
139	R20	*605 828	RHEOSTAT, WW 50 watt 1.5 ohm	1
140	RC2	035 523	RECEPTACLE, 5 socket MS-3102A-16S-8S	1
141	C20,21,24,25	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	4
142		010 296	FITTING, hose - brass elbow male 1/4 NPT x 5/8-18 RH	2
143	GS1,WS1	003 538	VALVE, 115 volts ac 2 way 1/4 IPS port 1/8 orifice (consisting of)	2
		003 539	. COIL, valve 115 volts ac	1
144	C6	028 294	CAPACITOR, mylar 1 uf 200 volts dc	1
145	R9	030 761	RESISTOR, carbon 1 watt 10 ohm	1
146		010 295	FITTING, hose - brass elbow male 1/4 NPT x 5/8-18 LH	2
147	RC1	604 176	RECEPTACLE, straight - duplex grounded 2P3W	1
148		605 670	NUT, speed 12-24	3
149	CB1	011 972	CIRCUIT BREAKER, 10 amp 250 volts	1
150		019 666	KNOB, line indicator	1
151		010 855	RETAINER, screw No. 2	3
152		019 070	DOOR, access - HF	1
153		602 358	FASTENER, screw - knurled hd No. 2	1
154		003 043	DOOR, access - front	1
155		078 034	FASTENER, screw - slotted hd 0.736 lg	2

*Recommended Spare Parts

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

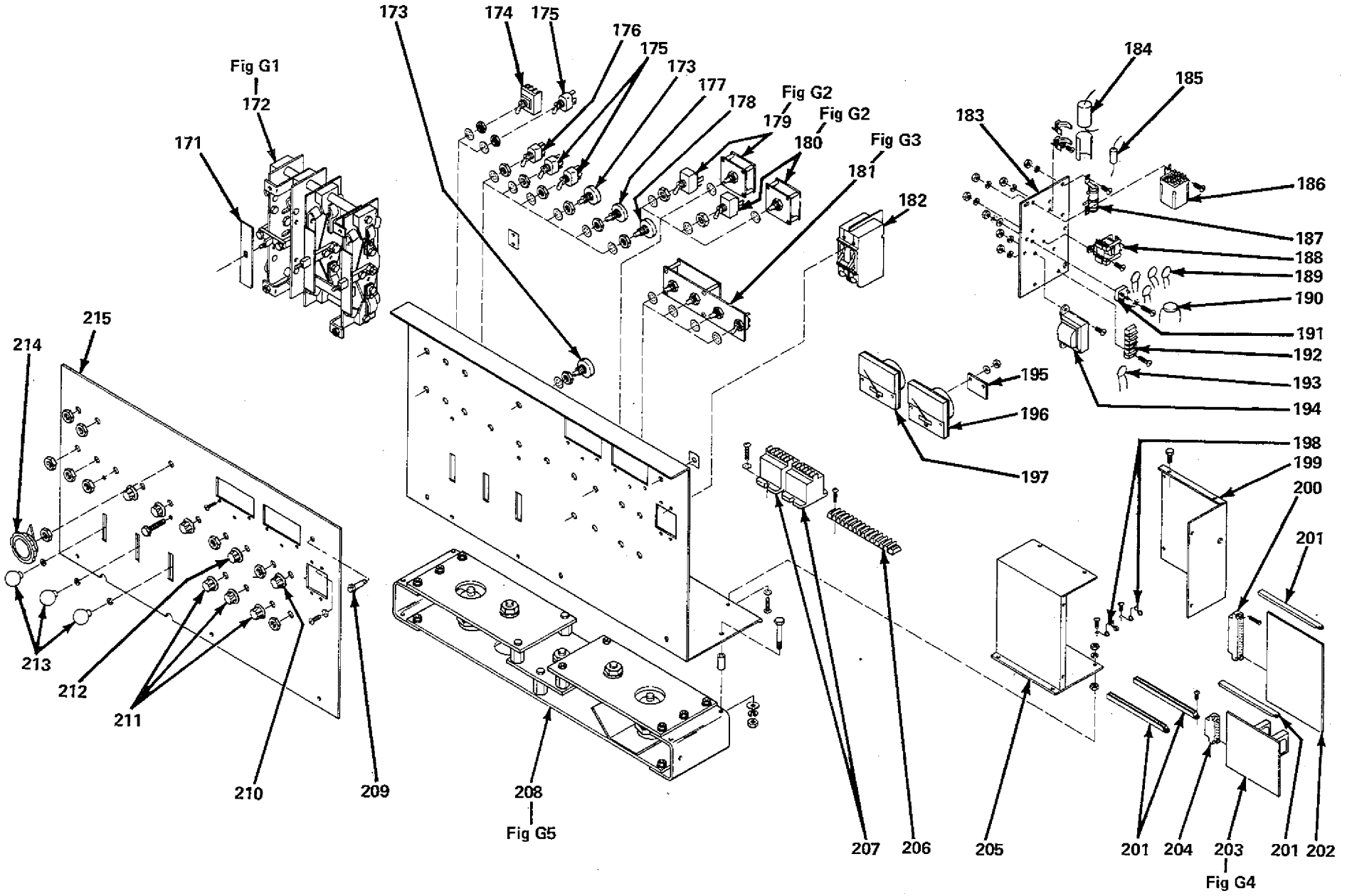


Figure G — Panel, Front (upper section) With Components

TD-006 609-A

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G			**Panel, Front - (upper section) With Components (See Fig. A Page 1 Item 15)**	
171		003 053	GUARD, slot - switch selector	3
172	S5-7	004 266	SWITCH, range/polarity/selector (See Fig. G1 Page 9)	1
173	R1,14	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	2
174	S4	011 622	SWITCH, toggle 3PDT 15 amp 125 volts	1
175	S10-12	011 609	SWITCH, toggle SPDT 10 amp 125 volts	3
176	S3	011 610	SWITCH, toggle SPDT 10 amp 125 volts	1
177	R13	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
178	R15	028 769	POTENTIOMETER, carbon 1 turn 2 watt 750K ohm	1
179		†Figure G2	SPOT TIMER (See Page 14)	1
180		†Figure G2	PRE-FLOW TIMER (See Page 14)	1
181		Figure G3	PULSER CONTROL (See Page 15)	1
182	S1	006 966	CIRCUIT BREAKER, non auto 2P 100 amp 600 volts ac	1
183		039 301	PANEL, mounting - components	1
	R7	030 982	RESISTOR, WW fixed 5 watt 10 ohm	1
		038 784	STRIP, terminal 1 pole	1
184	C12	031 610	CAPACITOR, electrolytic 40 uf 250 volts dc	1
185	R19	604 178	RESISTOR, carbon 2 watt 100 ohm	1
186	CB2	000 174	RELAY, enclosed 24 volts ac 3PDT	1
187	R8	030 601	RESISTOR, WW adj 25 watt 1000 ohm	1
188	CR1	034 601	RELAY, 24 volts dc DPDT	1
189	C26-29	031 643	CAPACITOR, ceramic 0.01 uf 500 volts dc	4
190	VR1	028 001	VARISTOR, 150 volts	1
191	SR2	005 882	RECTIFIER, integrated 6 amp 600 volts	1
192	2T	038 081	BLOCK, terminal 20 amp 4 pole	1
193	C23	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1
194	T2	035 759	TRANSFORMER, control - miniature 115/36	1
195		†000 851	CIRCUIT CARD ASSEMBLY, meter (consisting of)	1
		030 937	. RESISTOR, carbon 0.5 watt 10 ohm	1
		030 019	. POTENTIOMETER, cermet trimmer 15 turn 0.75 watt 100 ohm	1
196	A	†004 188	METER, amp ac/dc 0-400/0-80 scale	1
197	V	†004 189	METER, volts ac/dc 0-100 scale	1
198		039 349	SPRING, retainer - circuit card	2
199		000 020	PANEL, enclosure - circuit card assembly	1
200	RC3	039 358	CONNECTOR, edge 35 socket	1
201		035 506	GUIDE, circuit card 9 inch	4
202	PC1	+004 573	CIRCUIT CARD ASSEMBLY, control - main	1
203	PC2	006 795	CIRCUIT CARD ASSEMBLY, post-flow & HF timer (See Fig. G4 Page 16)	1
204	RC4	039 347	CONNECTOR, edge PC card 17 socket	1
205		000 022	ENCLOSURE, circuit card assembly	1
206	1T	038 833	BLOCK, terminal 20 amp 13 pole	1
207	FC1,2	000 105	PULSE MODULE	2
208	SR1	000 176	RECTIFIER, SCR Main (See Fig. G5 Page 17)	1
209	PL1	027 645	LIGHT, indicator 115 volts ac red lens	1
210		†019 666	KNOB, line - indicator (included with item 180)	1
211		019 666	KNOB, line - indicator	6
212		†019 666	KNOB, line - indicator (included with item 179)	1
213		019 603	KNOB, ball	3
214		019 627	KNOB, pointer	1
215			NAMEPLATE (order by stock, model, and serial number)	1

†Optional Equipment.
+Circuit Card Assembly is available on an exchange basis. Contact Factory Service Department for details.
BE SURE TO PROVIDE STOCK, MODEL, AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G1		**004 266**	**Switch, Range/Polarity/Selector (See Fig. G Page 8 Item 172)**	
231	S5	000 880	CONTACT BOARD ASSEMBLY, switch - selector ac/dc (See Fig. G1A Page 10)	1
232		003 231	TUBING, steel 5/8 OD x 12 ga wall x 1-1/8	2
233		104 935	BRACKET, mounting - switch	2
234	S5	000 879	CONTACT BOARD ASSEMBLY, switch - selector ac/dc (See Fig. G1B Page 11)	1
235		009 229	TUBING, steel 5/8 OD x 12 ga wall x 15/16	2
236	S6	000 878	CONTACT BOARD ASSEMBLY, switch - polarity (See Fig. G1C Page 12)	1
237		003 230	TUBING, steel 5/8 OD x 12 ga wall x 2-5/8	2
238		039 256	STUD, steel 1/4-20 x 9	2
239	S7	004 265	CONTACT BOARD ASSEMBLY, switch - range (See Fig. G1D Page 13)	1
240		004 696	BRACKET, mounting - switch	2
241		004 267	LINK, jumper - switch (ac/dc)	1
242		039 260	HANDLE, switch	1

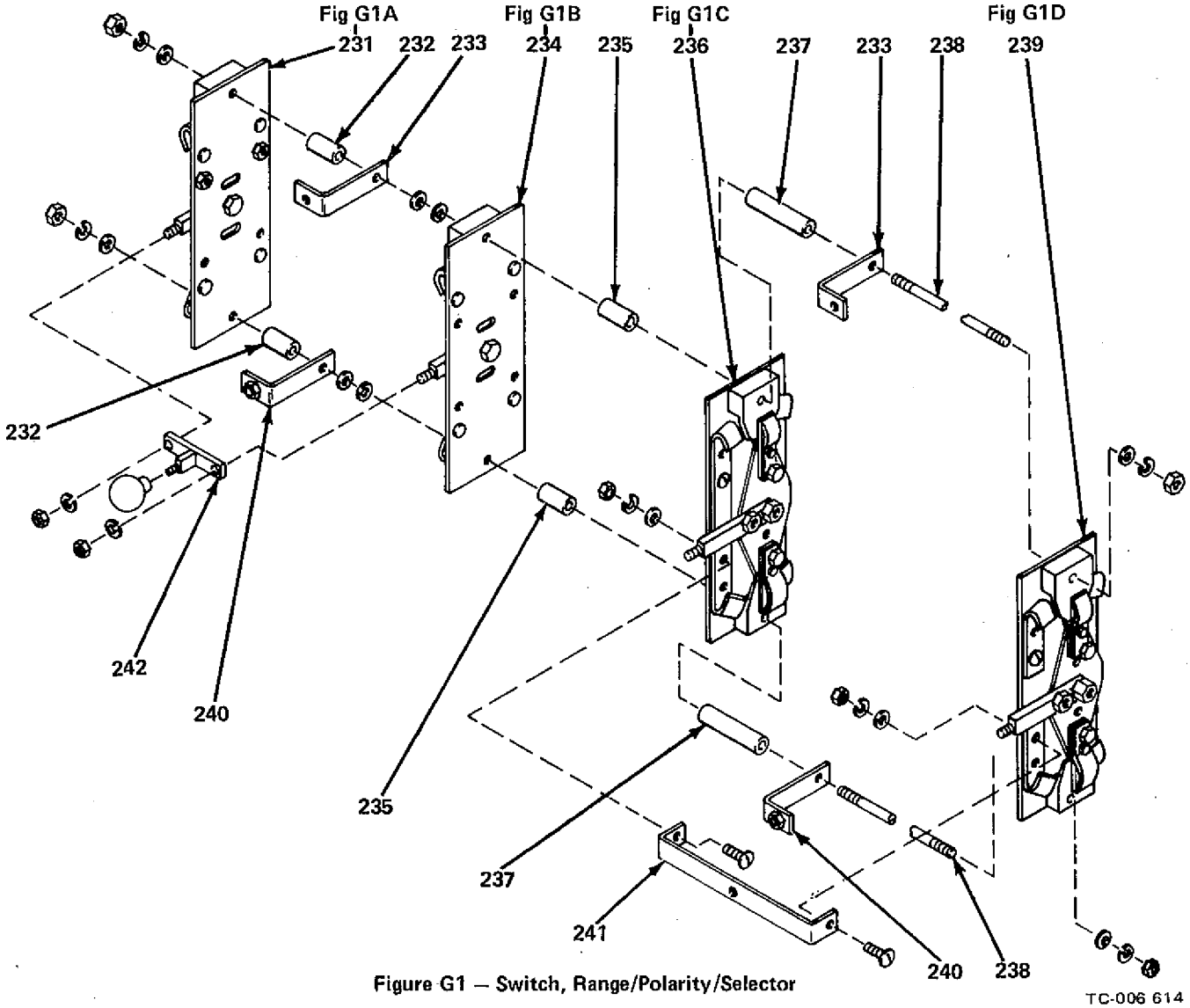


Figure G1 — Switch, Range/Polarity/Selector

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

Item No.	Factory Part No.	Description	Quantity
Figure G1A	**000 880**	**Contact Board Assembly, Switch - Selector ac/dc (See Fig. B1 Page 9 Item 231)**	
251	604 318	NUT, steel - self-locking hex 1/4-20	1
252	039 257	HANDLE, switch	1
253	024 694	BEARING, polarity	1
254	011 948	GUIDE, contact - movable switch	2
255	011 950	CONTACT, switch	1
256	103 634	MOUNTING BOARD, components - polarity switch	1
257	011 951	CONTACT, switch	1
258	103 633	BUS BAR, shorting - switch polarity	1
259	038 769	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1
260	103 632	. PLATE, toggle switch	1
261	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2
262	011 075	.. SPRING, pressure - contact switch	1
263	011 953	.. CONTACT, switch	2
264	011 074	.. SPRING, pressure - contact switch	1

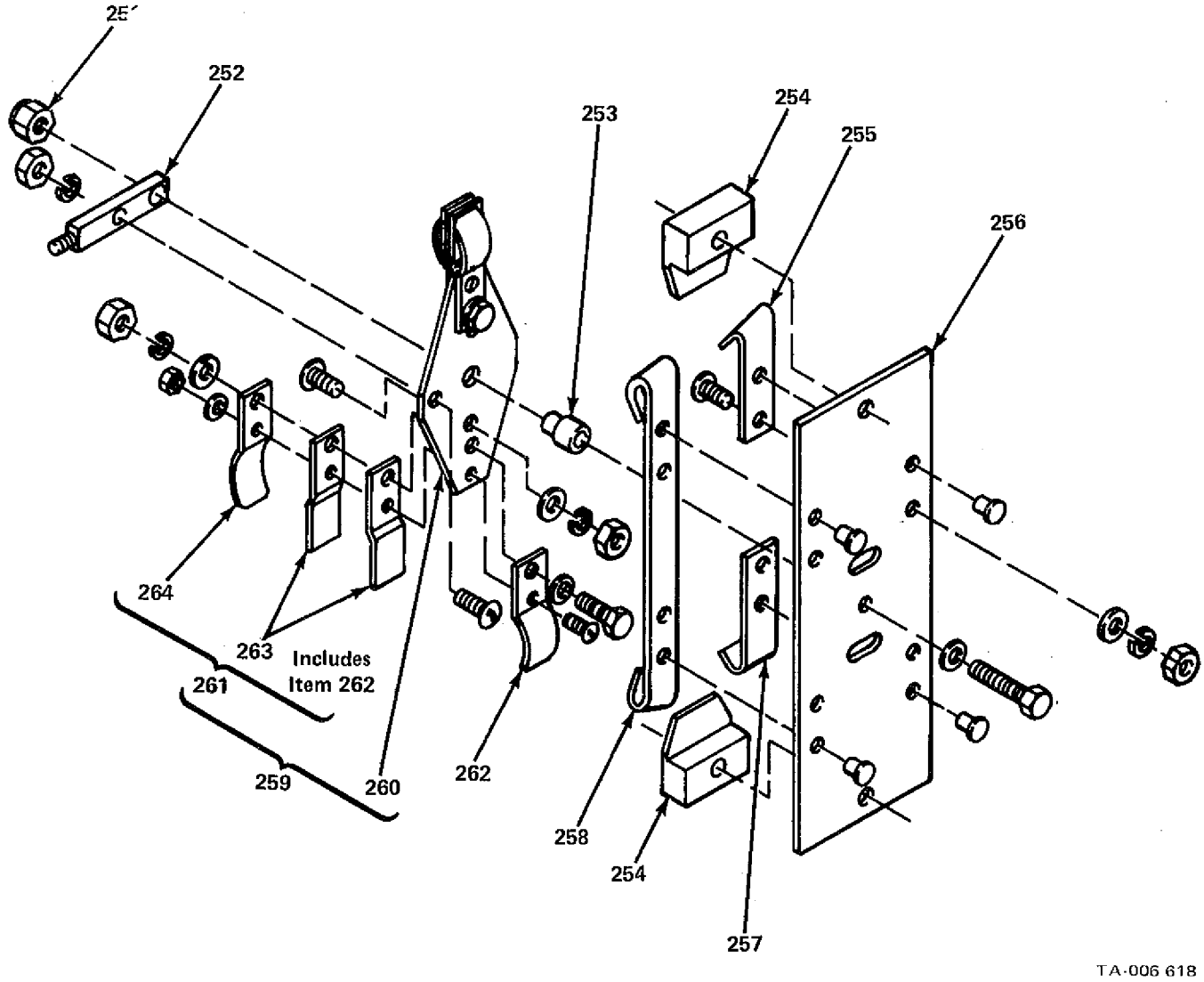

Figure G1A — Contact Board Assembly, AC/DC Selector

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

Item No.	Factory Part No.	Description	Quantity
Figure G1B	**000 879**	**Contact Board Assembly, Switch - Selector ac/dc (See Fig. G1 Page 9 Item 234)**	
271	038 679	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1
272	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2
273	011 074	. . SPRING, pressure - contact switch	1
274	011 953	. . CONTACT, switch	2
275	011 075	. . SPRING, pressure - contact switch	1
276	103 632	. PLATE, toggle switch	1
277	011 948	GUIDE, contact - movable switch	2
278	011 951	CONTACT, switch	2
279	011 950	CONTACT, switch	2
280	103 634	MOUNTING BOARD, component - polarity switch	1
281	024 694	BEARING, polarity	1
282	039 257	HANDLE, switch	1
283	604 318	NUT, steel - self-locking hex 1/4-20	1

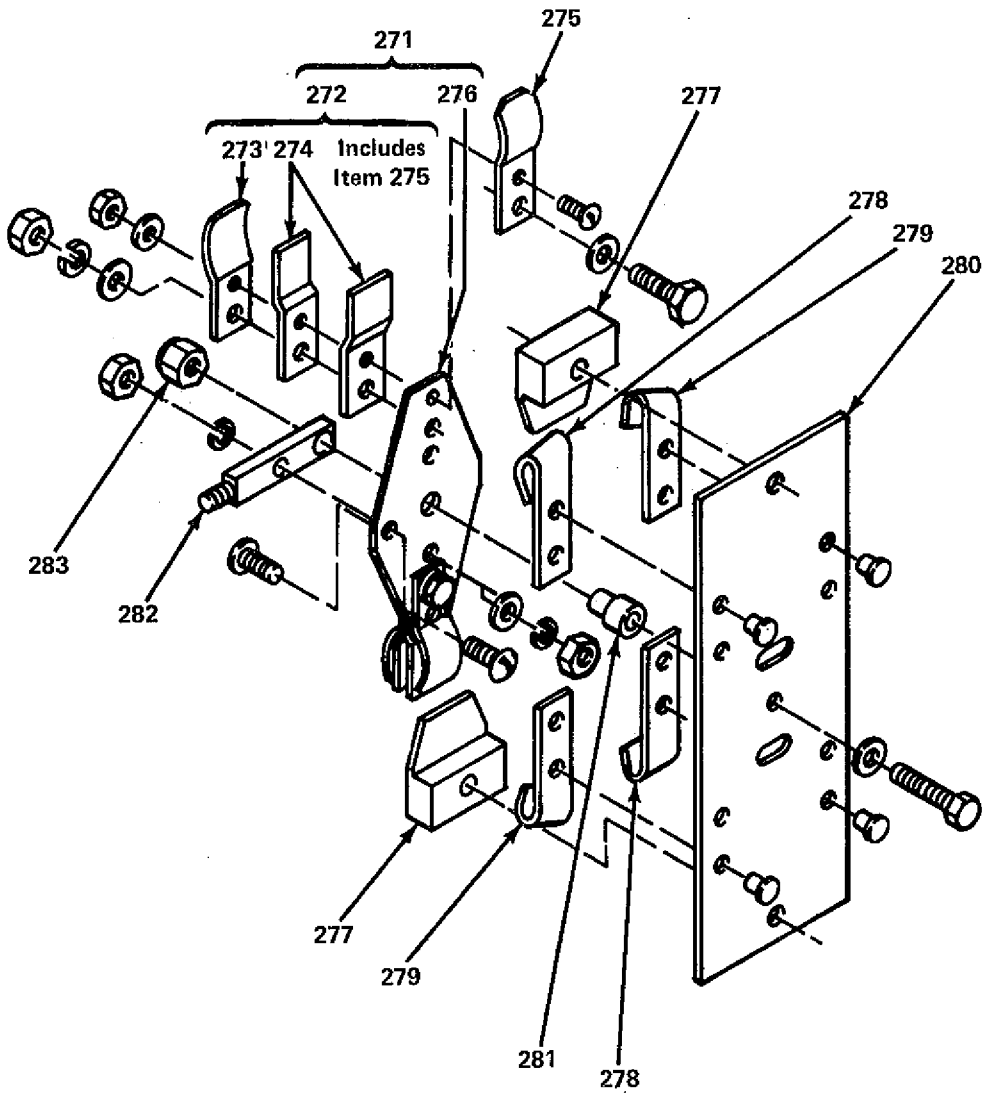

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Figure G1B — Contact Board Assembly, AC/DC Selector

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

Item No.	Factory Part No.	Description	Quantity
Figure G1C 000 878		**Contact Board Assembly, Switch - Polarity (See Fig. G1 Page 9 Item 236)**	
291	103 634	MOUNTING BOARD, component - polarity switch	1
292	011 948	GUIDE, contact - movable switch	2
293	103 633	BUS BAR, shorting - switch polarity	2
294	038 769	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1
295	103 632	. PLATE, toggle switch	1
296	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2
297	011 075	. . SPRING, pressure - contact switch	1
298	011 953	. . CONTACT, switch	2
299	011 074	. . SPRING, pressure - contact switch	1
300	604 318	NUT, steel - self-locking hex 1/4-20	1
301	010 805	HANDLE, switch - polarity	1
302	024 694	BEARING, polarity	1

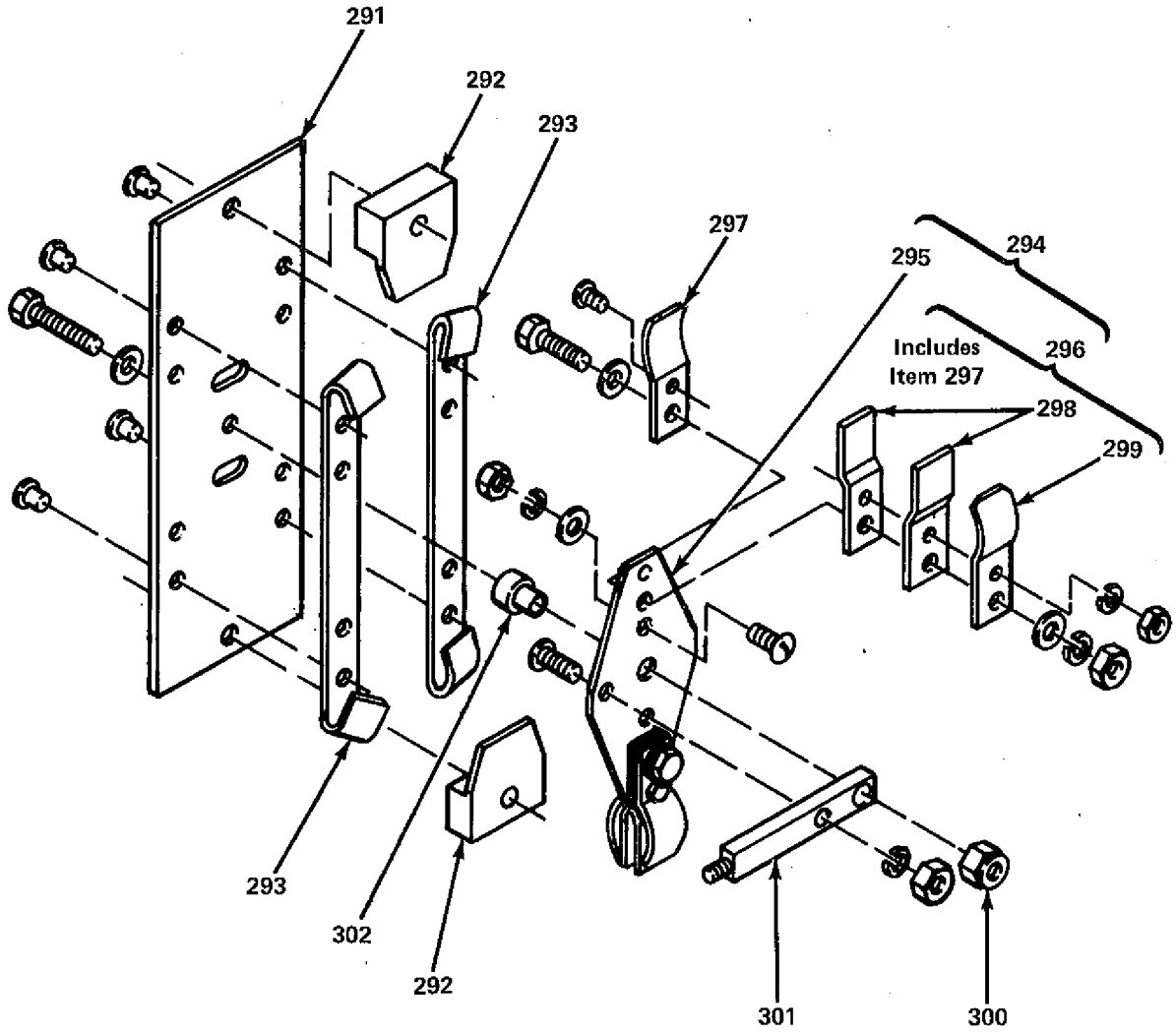

Figure G1C — Contact Board Assembly, Switch - Polarity

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

Item No.	Factory Part No.	Description	Quantity
Figure G1D	**004 265**	**Contact Board Assembly, Switch - Range (See Fig. G1 Page 9 Item 239)**	
311	103 634	MOUNTING BOARD, component - polarity switch	1
312	011 948	GUIDE, contact - movable switch	2
313	011 951	CONTACT, switch	2
314	038 769	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1
315	103 632	. PLATE, toggle switch	1
316	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2
317	011 075	. . SPRING, pressure - contact switch	1
318	011 953	. . CONTACT, switch	2
319	011 074	. . SPRING, pressure - contact switch	1
320	604 318	NUT, steel - self-locking hex 1/4-20	1
321	010 805	HANDLE, switch - polarity	1
322	024 694	BEARING, polarity	1
323	011 950	CONTACT, switch	2

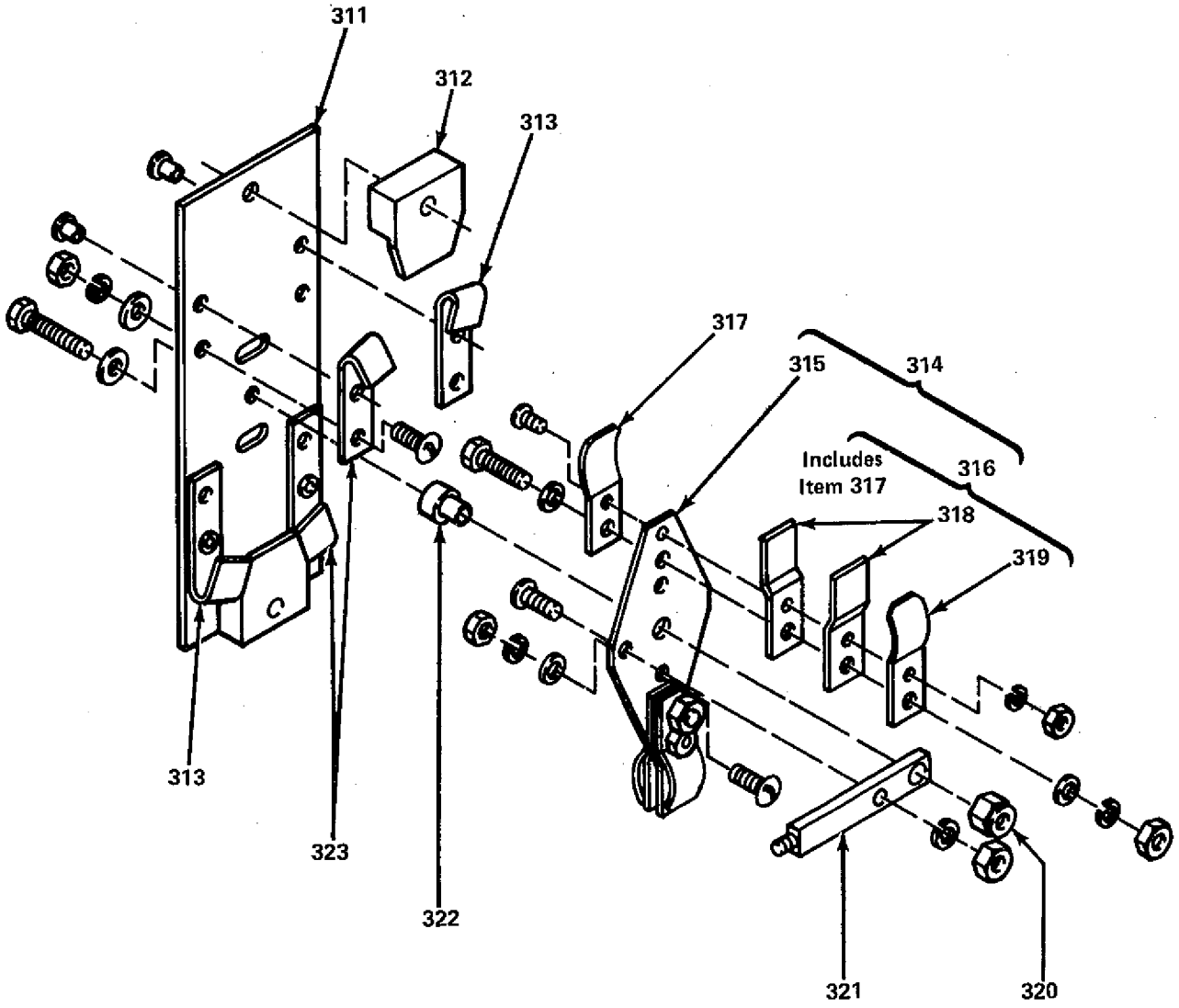

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Figure G1D — Contact Board Assembly, Switch - Range

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Spot Timer	Quantity Pre-flow Timer
Figure G2			**Spot Timer and Pre-flow Timer (See Fig. G Page 8 Items 179 & 180)**	044 170	041 172
331	S200	011 611	SWITCH, toggle DPDT 15 amp 125 volts	1	1
332		000 821	STRIP, mounting - circuit cards	1	1
333		004 883	TUBING, phenolic 1/8 ID x 1/4 OD x 7/8	4	4
334		006 797	CIRCUIT CARD ASSEMBLY, spot timer (consisting of)	1	
334		006 799	CIRCUIT CARD ASSEMBLY, pre-flow timer (consisting of)		1
335	R205	028 767	. POTENTIOMETER, carbon 1 turn .2 watt 75K ohm	1	
335	R205	005 577	. POTENTIOMETER, carbon 1 turn 2 watt 200K ohm		1
	C201,202, 204,206	031 637	. CAPACITOR, cermet 0.02 uf 500 volts	4	4
	C203	031 630	. CAPACITOR, electrolytic 20 uf 50 volts dc	1	1
	C205	031 651	. CAPACITOR, tantalum 68 uf 20 volts dc	1	1
	C207	031 670	. CAPACITOR, ceramic 0.05 uf 500 volts dc	2	2
	CR201	039 346	. RELAY, enclosed 24 volts dc DPDT	1	
	CR201	004 855	. RELAY, enclosed 24 volts dc 4PDT		1
	D201	037 449	. DIODE, zener 15 volts 1 watt	1	1
	D202,203	026 202	. DIODE, rectifier 1 amp 400 volts straight polarity	2	2
	Q201	039 355	. TRANSISTOR, 0.15 amp 40 volts	1	1
	Q202	022 135	. THYRISTOR, 4 amp 200 volts	1	1
	R201	030 819	. RESISTOR, carbon 2 watt 270 ohm	1	1
	R202,204	605 909	. RESISTOR, carbon 0.25 watt 22K ohm	2	2
	R203	030 033	. RESISTOR, carbon 0.5 watt 470 ohm	1	1
	R206	039 361	. POTENTIOMETER, cermet 1 turn 0.25 watt 50K ohm	1	1
	R207	078 433	. RESISTOR, carbon 0.25 watt 1 meg ohm	1	1
	R208	030 937	. RESISTOR, carbon 0.5 watt 10 ohm	1	1
	R209	039 327	. RESISTOR, carbon film 0.25 watt 220 ohm	1	1
	R210	030 025	. RESISTOR, carbon 0.5 watt 100 ohm	1	1
	R211	605 911	. RESISTOR, carbon 0.25 watt 10K ohm	1	1
	SR201	021 939	. RECTIFIER, integrated 1.5 amp 400 volts	1	1
		000 873	. PLUG, protection	1	1

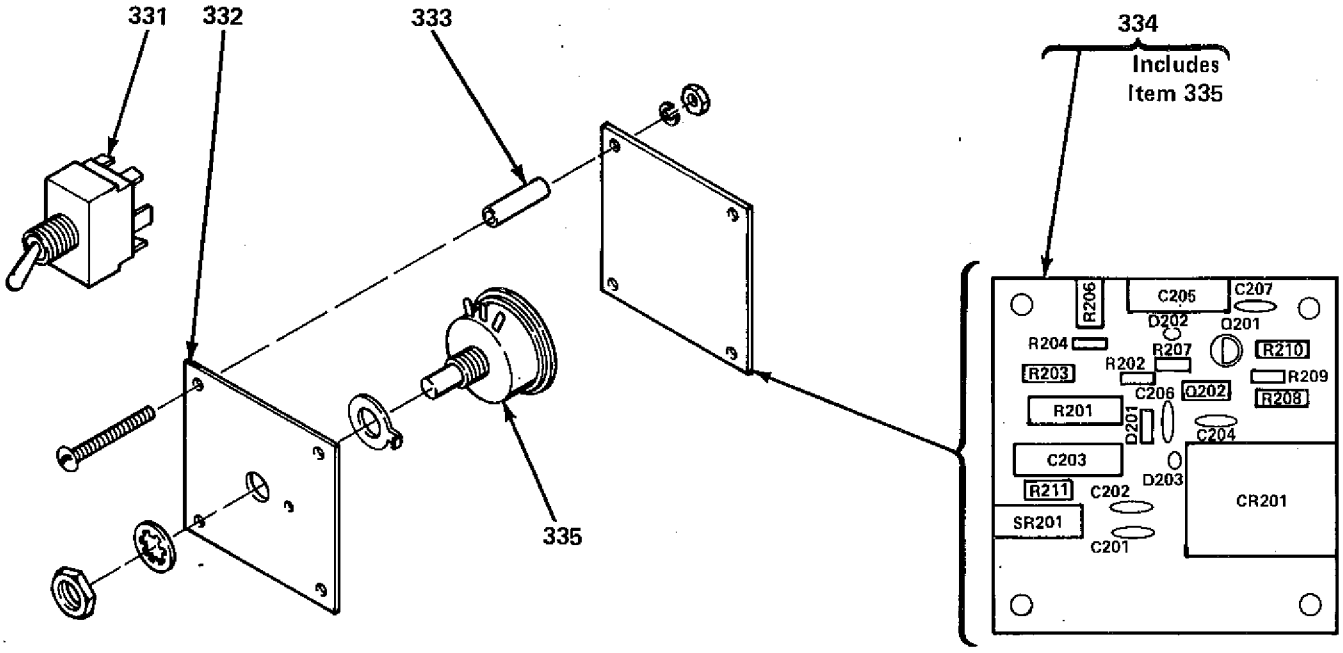

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Figure G2 — Spot Timer and Pre-Flow Timer

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G3			**Pulser Control (See Fig. G Page 8 Item 181)**	
341		003 513	STRIP, mounting - controls pulser	1
342	R422	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	1
343	R420	004 186	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
344		005 302	TUBING, phenolic 9/64 ID x 1/4 OD x 1-5/16	4
345		005 021	CIRCUIT CARD ASSEMBLY, pulser (consisting of)	1
	A400-402	035 845	. AMPLIFIER, operational	3
	C400	003 530	. CAPACITOR, ceramic 1 uf 50 volts	1
	C401,402	031 630	. CAPACITOR, electrolytic 20 uf 50 volts dc	2
	C403,404	031 643	. CAPACITOR, ceramic 0.01 uf 500 volts dc	2
	D400-403	028 351	. DIODE, 10MA 75 volts straight polarity	4
	Q400	037 201	. TRANSISTOR, 200MA 40 volts PNP	1
	Q401	037 200	. TRANSISTOR, 200MA 40 volts NPN	1
	R400,411,419	039 359	. POTENTIOMETER, cermet 20 turn 0.5 watt 5000 ohm	3
	R401	039 335	. RESISTOR, carbon film 0.25 watt 47K ohm	1
	R402	035 884	. RESISTOR, carbon film 0.25 watt 100K ohm	1
	R403-405,407,410	035 827	. RESISTOR, carbon film 0.25 watt 10K ohm	5
	R406	039 332	. RESISTOR, carbon film 0.25 watt 15K ohm	1
	R408,412	605 916	. RESISTOR, carbon, 0.25 watt 1000 ohm	2
	R409,413-416	039 331	. RESISTOR, carbon film 0.25 watt 4700 ohm	5
	R417	035 822	. RESISTOR, carbon film 0.25 watt 10 ohm	1
	R418	035 888	. RESISTOR, carbon film 0.25 watt 2200 ohm	1
	R423	003 913	. POTENTIOMETER, cermet 15 turn 0.5 watt 500 ohm	1
	R424	076 712	. RESISTOR, carbon 0.25 watt 220K ohm	1
346	R421	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
347	S400	011 609	SWITCH, toggle SPDT 10 amp 125 volts	1
348	C405	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1
349	D404	026 202	DIODE, rectifier 1 amp 400 volts straight polarity	1

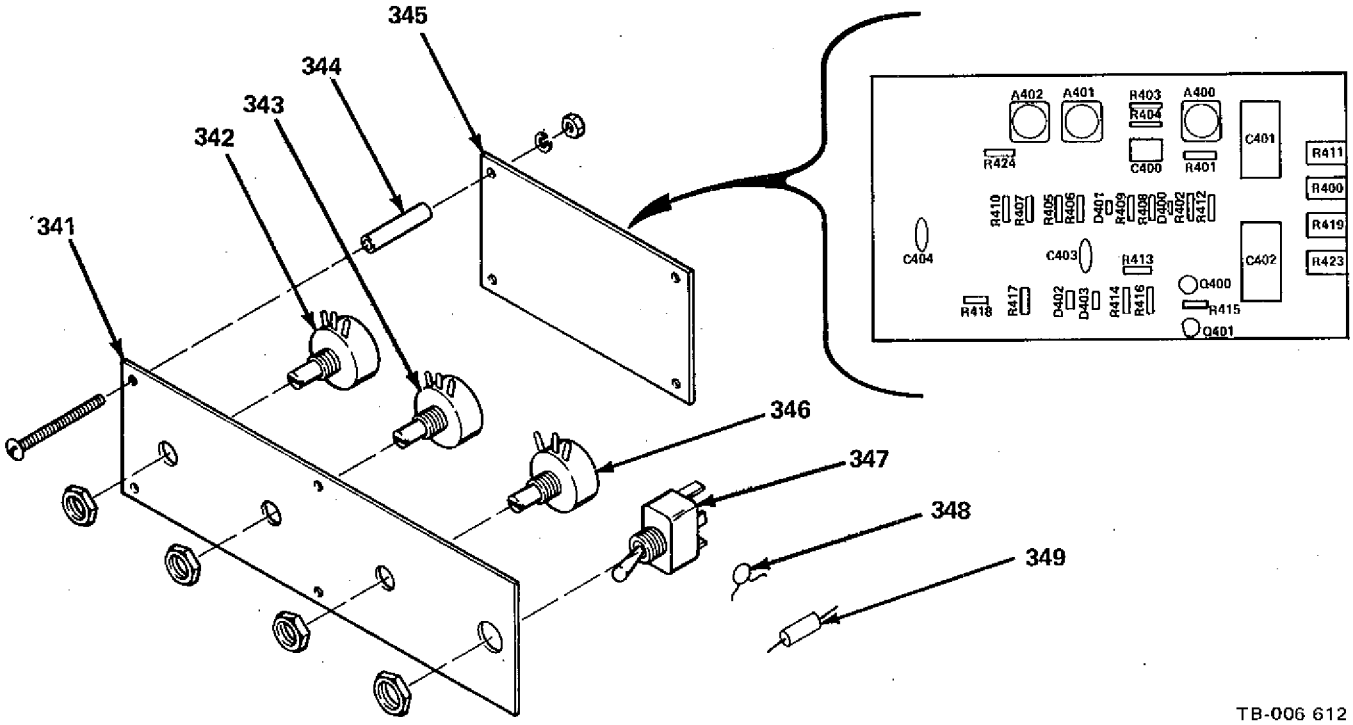

Figure G3 – Pulser Control

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G4		**006 795**	**Circuit Card Assembly, Post-flow & HF Timer (See Fig. G Page 8 Item 203)**	
C300,303		031 630	CAPACITOR, electrolytic 20 uf 50 volts dc	2
C301,304		031 651	CAPACITOR, tantalum 68 uf 20 volts dc	2
C302,305,307		031 637	CAPACITOR, ceramic 0.02 uf 500 volts dc	3
C306,308		034 286	CAPACITOR, poly film 0.1 uf 100 volts	2
C309		031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1
CR300,301		039 346	RELAY, enclosed 24 volts dc DPDT	2
CR302		006 794	RELAY, reed 120 volts dc 1 amp SPST 12 volts coil	1
D300,302		037 449	DIODE, zener 15 volts 1 watt	2
D301,303,304		026 202	DIODE, rectifier 1 amp 400 volts straight polarity	3
Q300,302		039 355	TRANSISTOR, 0.15 amp 40 volts PNP	2
Q301,303		022 135	THYRISTOR, 4 amp 200 volts	2
Q304		605 841	THYRISTOR, triac 6 amp 500 volts	1
R300,307		030 819	RESISTOR, carbon 2 watt 270 ohm	2
R301		074 042	RESISTOR, carbon 0.25 watt 82K ohm	1
R303,304,310,311		605 909	RESISTOR, carbon 0.25 watt 22K ohm	4
R305,312		039 361	POTENTIOMETER, cermet trimmer 1/T 0.25 watt 50K ohm	2
R306,309,314		030 937	RESISTOR, carbon 0.5 watt 10 ohm	3
R308		028 286	RESISTOR, carbon 0.5 watt 33K ohm	1
R313		039 340	RESISTOR, WW fixed 3 watt 250 ohm	1
R315		030 713	RESISTOR, carbon 1 watt 2200 ohm	1
R316,317		039 327	RESISTOR, carbon film 0.25 watt 220 ohm	2
R318,319		030 025	RESISTOR, carbon 0.5 watt 100 ohm	2
R320		605 911	RESISTOR, carbon 0.25 watt 10K ohm	1
RC300		039 348	CONNECTOR, edge 17 pin 5 amp	1
SR300,301		021 939	RECTIFIER, integrated 1.5 amp 400 volts	2
T300,301		006 768	TRANSFORMER, signal 115 volts pri 24 volts CT w/frame	2

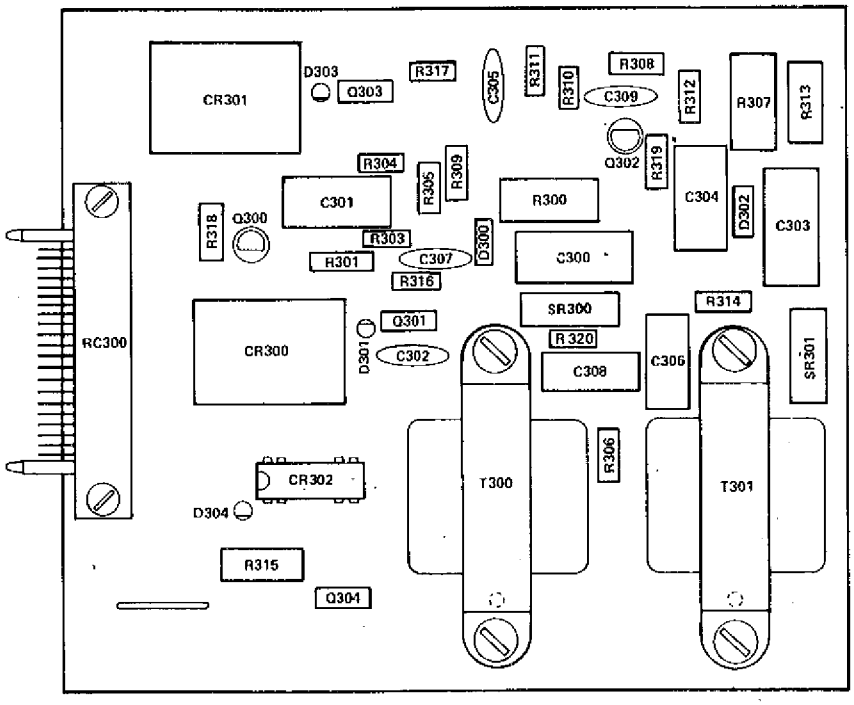

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Figure G4 — Circuit Card Assembly, Post-flow & HF Timer

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G5		**000 176**	**Rectifier, SCR Main (See Fig. G Page 8 Item 208)**	
361		005 264	CAPACITOR/RESISTOR, rectifier (consisting of)	4
362	R3-6	030 055	. RESISTOR, carbon 2 watt 10 ohm	4
363	C7-10	031 683	. CAPACITOR, paper oil 0.5 uf 200 volts dc	4
364		010 311	CLAMP, 3/4 dia x 1/2 wide	4
365	SCR1-4	000 251	THYRISTOR, 250 amp 300 volts	4
366		025 248	INSULATOR, stand-off	6
367	D1	037 957	DIODE, rectifier 275 amp 250 volts	1

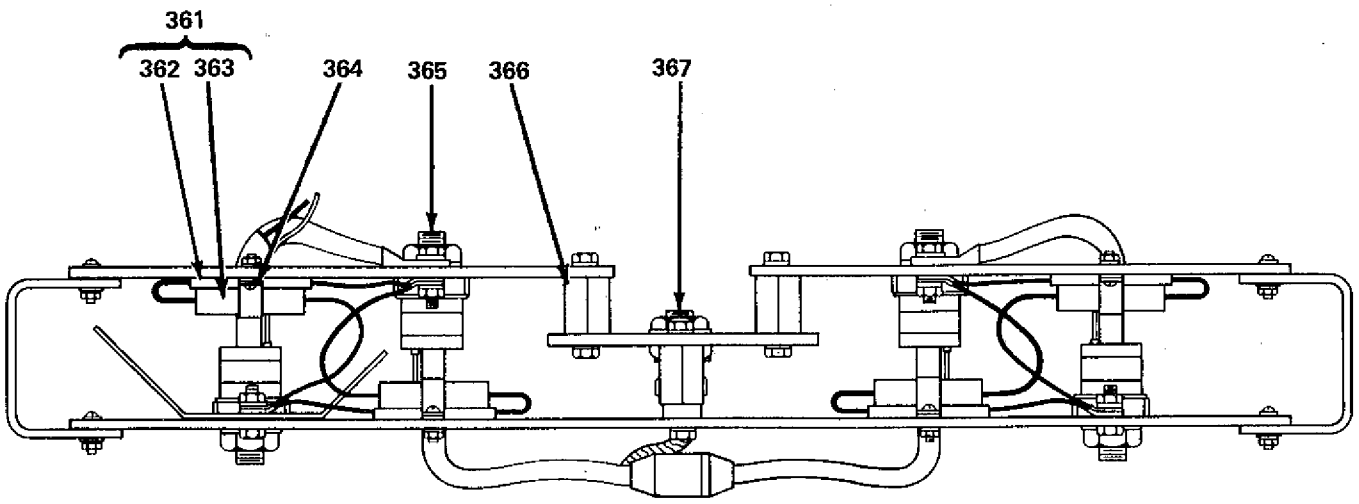

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Figure G5 -- Rectifier, SCR Main

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