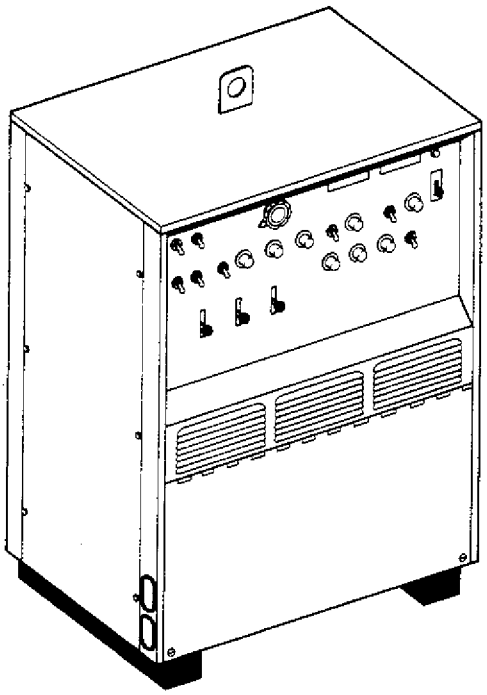
April 1980 FORM: OM-350H

Effective With Serial No. JA378493

MODEL

Syncrowave 300 (Basic)
Syncrowave 300 W/Pulser
Syncrowave 500 (Basic)
Syncrowave 500 W/Pulser



OWNER'S MANUAL

miller

MILLER ELECTRIC MFG. CO.
718 S. BOUNDS ST. P.O. Box 1079
APPLETON, WI 54912 USA

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PRINTED IN U.S.A.

LIMITED WARRANTY

EFFECTIVE: JUNE 1, 1979

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

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Miller shall be required to honor 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
5. Replacement or repair parts, exclusive of labor . 60 days
6. Batteries . . . . . 6 months

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In the case of Miller's breach of warranty or any other duty with respect to the quality of any goods, the exclusive remedies therefore 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.

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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 2 - INTRODUCTION

Amend Figure 2-1. Specifications

The 300 ampere model can be equipped with an optional 2-37 ampere low range in place of the standard 5-75 ampere low range.

AMENDMENT TO SECTION 3 - INSTALLATION

Amend IMPORTANT block in Section 3-4. GAS AND COOLANT CONNECTIONS

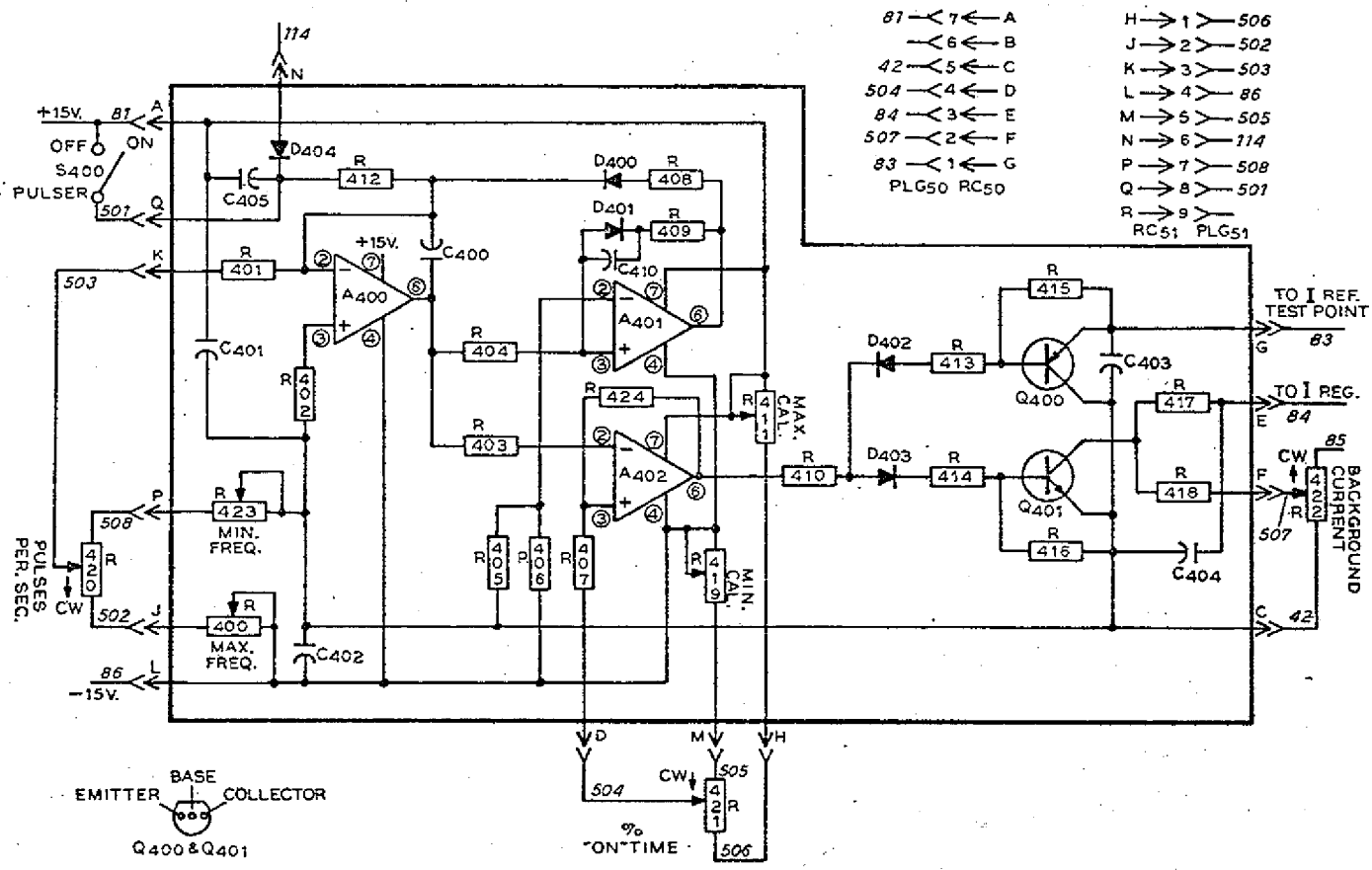
IMPORTANT: *The water solenoid valve should be used only when the water is exhausted down a drain. When a recirculating coolant system is used, the water solenoid valve should be bypassed.*

Amend Section 3-7. 115 VOLTS AC RECEPTACLE

A grounded duplex receptacle, located behind the lower front access door, provides up to 15 amperes of 115 volts ac to operate external accessories. A 15 ampere circuit breaker limits receptacle output to 2 kva.

AMENDMENT TO SECTION 7 - TROUBLESHOOTING

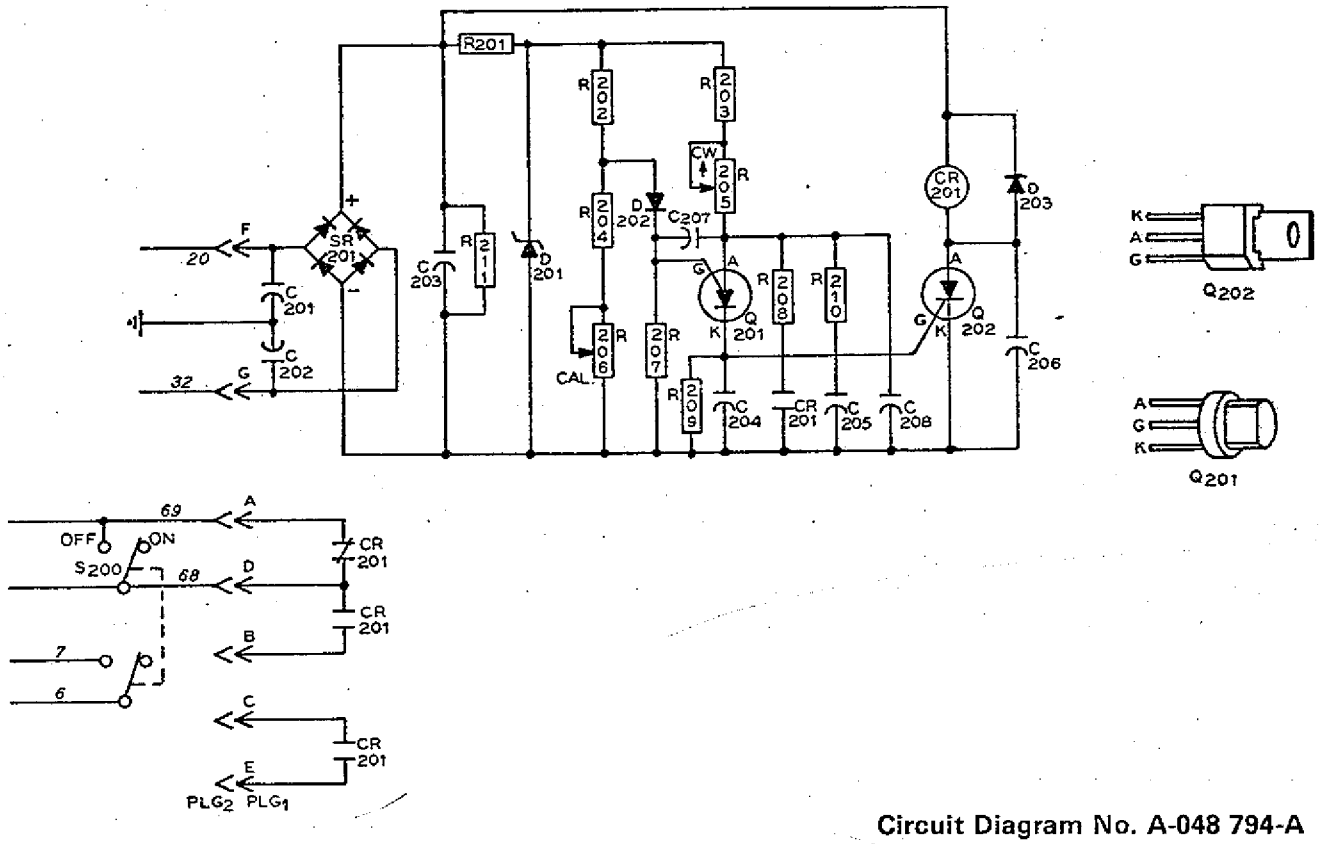
Amend Figure 7-5. Circuit Diagram For Pulser



Circuit Diagram No. A-072 931

Figure 7-5. Circuit Diagram For Pulser

Amend Figure 7-7. Circuit Diagram For Spot Timer



Circuit Diagram No. A-048 794-A

Figure 7-7. Circuit Diagram For Spot Timer

Item No.	Dia. Mkgs.	Part No.	Replaced With	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
142	CB1	011 972	Deleted	(Eff W/JA464637)		
173	R14	035 897	035 897	POTENTIOMETER (qty chg)	1	1
194	PC1	048 024	046 985	CIRCUIT CARD, control - main (Eff W/JA446501)	1	1
210	A	080 310	+049 639	METER, amp ac/dc 0-400/0-40	1	1
349	C405	031 670	031 670	CAPACITOR (now part of 072 810)	1	1
Pg 16	D404	026 202	026 202	DIODE (now part of 072 810)	1	1
	RC50		048 105	TERMINAL HEADER, 7 post	1	1
	RC51		072 670	TERMINAL HEADER, 9 post	1	1
			048 104	HOUSING, terminal 7 position	1	1
			072 669	HOUSING, terminal 9 position	1	1
361	R3-6					-
	C7-10	005 264	044 604	SUPPRESSOR, 0.5 uf 200 volts (Eff W/JA426383)	4	
361	R3-6					
	C7-10	059 079	044 603	SUPPRESSOR, 0.5 uf 200 volts (Eff W/JA426383)		4
362	R3-6	030 055	Deleted	(Eff W/JA426383)		
363	C7-10	031 683	Deleted	(Eff W/JA426383)		
	R1		072 462	POTENTIOMETER, w/shaft lock (consisting of)	1	1
			072 590	. LOCK, shaft 3/8-32 x 1/4 shaft	1	1

BE SURE TO PROVIDE 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_____

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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 seat 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.

Model	Rated Welding Current Amperes	Welding Current Ranges Amperes	Max. Open-Circuit Voltage	Input At Various Load Outputs 60 Hz. Single-Phase								Dimensions (Inches)	Weight (Pounds)	
				Load Output	PFC*	Amperes At 200(208)V	230V	460V	575V	kva	kw		Net	Ship
300 Ampere	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)	Without PFC	138	120	60	48	28	12.8	Height - 44-1/4** Width - 31-1/4 Depth - 22-3/4	670	690
					With PFC	106	96	48	38.5	21				
				300 Amps @ 15 Volts DC - Argon - GTAW	Without PFC	86	75	38	30	17	8.8			
					With PFC	69	63	32	25.2	14				
				375 Amps @ 23 Volts AC - Fully Unbalanced (Max. Penetration) - Argon - GTAW	Without PFC	224	204	102	82	47	14.4			
					With PFC	187	170	85	68	39				
500 Ampere	500 @ 40 Volts 60% Duty Cycle	AC & DC 25-625	80	500 Amps @ 40 Volts AC - Balanced - SMAW (Rated Load Output)	Without PFC	235	204	102	82	47	26	Height - 44-1/4** Width - 31-1/4 Depth - 22-3/4	857	877
					With PFC	206	180	90	72	41				
				500 Amps@ 15 Volts DC - Argon - GTAW	Without PFC	241	188	94	75	43	25			
					With PFC	186	162	81	65	37				
				625 Amps @ 26 Volts AC - Fully Unbalanced (Max. Penetration) - Argon - GTAW	Without PFC	501	480	240	192	110	36			
					With PFC	354	308	154	123	71				

SMAW — Shielded Metal-Arc Welding
GTAW — Gas Tungsten-Arc Welding
*Power Factor Correction
**Add 2-3/4" For Lifting Eye

Figure 2-1. Specifications

For power factor correction models only:

NOTE

"The power factor correcting capacitors supplied in these products contain no PCB's. The dielectric material is an OSHA Class III B fluid having a flash point of 440°F. (227°C.). Each individual capacitor is protected by an internal UL recognized pressure sensitive disconnect and an internal fuse."

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

These single-phase input welding power sources are designed to be used for alternating current (ac) or direct current (dc) Shielded Metal-Arc Welding (SMAW), Gas Tungsten-Arc Welding (GTAW), 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.

SECTION 3 - INSTALLATION

3-1. LOCATION (Figure 3-1)

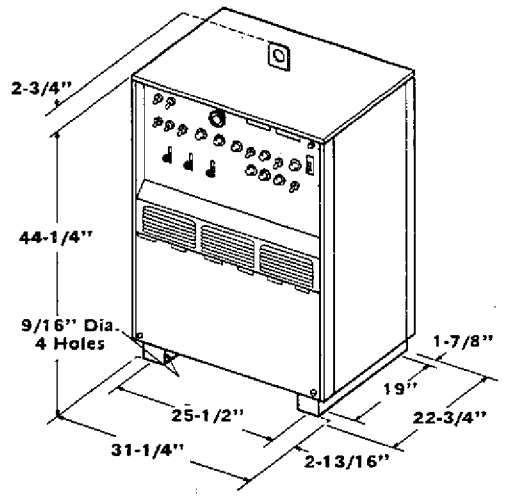

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Figure 3-1. Overall Dimensions and Mounting Hole Layout

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

Model	PFC**	Input Conductor Size - AWG*				Fuse Size In Amperes			
		200(208)V	230V	460V	575V	200(208)V	230V	460V	575V
300 Ampere	Without PFC	2/0 (No. 4)	1/0 (No. 6)	6 (No. 8)	6 (No. 8)	250	225	110	90
	With PFC	1/0 (No. 6)	1 (No. 6)	6 (No. 8)	6 (No. 8)	250	225	100	90
500 Ampere	Without PFC	250 MCM (No. 2)	3/0 (No. 4)	3 (No. 8)	4 (No. 8)	350	300	175	125
	With PFC	3/0 (No. 4)	2/0 (No. 4)	3 (No. 8)	6 (No. 8)	300	300	150	110

*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.

**Power Factor Correction.

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 location 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.

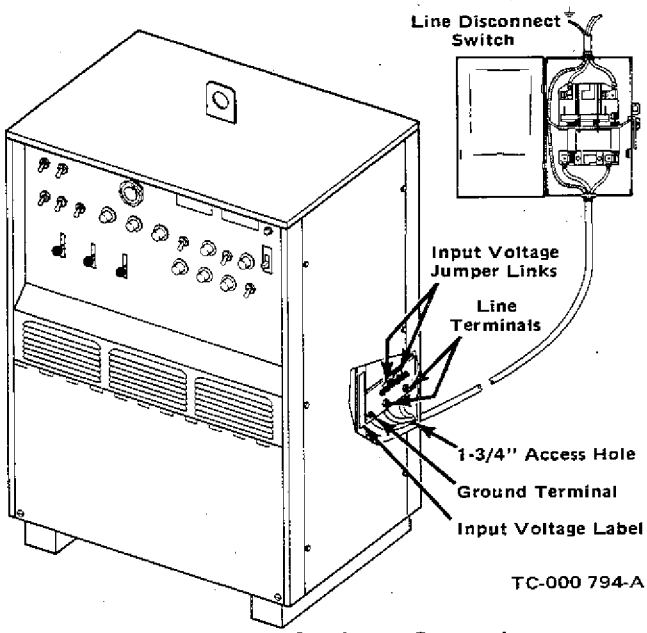
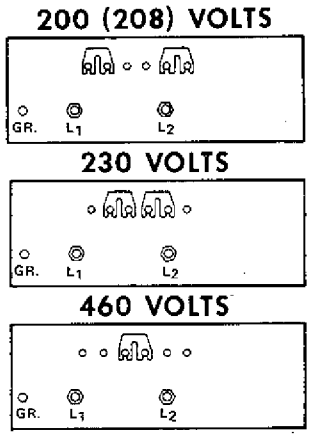
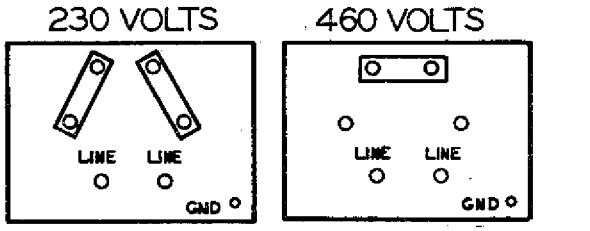


Figure 3-2. Input Conductor Connections

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



300 Ampere Models



500 Ampere Models

Figure 3-3. Input Voltage Jumper Link Arrangement

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.

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 input voltage label (see Figure 3-2) and the specification label on the rear of the welding power source. The input voltage jumper links on this welding power source are positioned for the highest of the voltages stated on the label. 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 specification label differ from those shown in Figure 3-3, the input voltage jumper links must be positioned as shown on the input voltage label.

3-3. WELD OUTPUT CONNECTIONS (Figure 4-1)

To obtain the full rated output from this unit, it is necessary to select, install, and maintain proper welding cables. Failure to comply in any of these areas may result in less than satisfactory welding performance.

CAUTION

Ensure that the unit is completely shut down before making any weld output connections.

A. Location

The ELECTRODE and WORK weld output terminals are located on the lower portion of the front panel.

B. Welding Cables

If welding cables were not ordered with this unit, the steps listed should be followed to ensure the best welding performance:

1. 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 causes a voltage drop which is added to the voltage of the arc. Excessive cable resistance may result in overloading as well as reducing the maximum current output capability of this unit. Proper operation 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 electrode holder must be used to ensure the operator's safety.

2. Use Table 3-2 as a guide for selecting correct cable size for the anticipated maximum weld current which will be used. Table 3-2 shows total cable length, which includes the electrode and work cable. Example: If the electrode holder cable is 75 feet long and the work cable is 25 feet long, select the size cable that is recommended for 100 feet at the maximum weld current that is to be used.

3. Do not use damaged or frayed cables.

4. Follow the electrode holder manufacturer's instructions for installing the electrode holder onto the electrode cable.

5. Use correct lugs on the weld cables to connect the work clamp and to connect the cables to the weld output terminals.

6. Ensure that all connections are clean and tight.

Table 3-2. Welding Cable Size

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
600	4/0	4/0	2-2/0	2-3/0	3-2/0	2-4/0	3-3/0	3-4/0
700	4/0	4/0	2-3/0	2-4/0	3-3/0	3-4/0	4-4/0	4-4/0

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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.

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.

IMPORTANT

If a portable, self-contained coolant system is used with this unit, ensure that the coolant pump has bypass capability to avoid possible damage to the motor when the coolant valve closes and coolant flow stops.

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

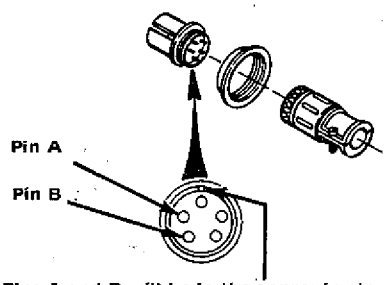
Remote control of the solid-state contactor in the welding power source can be achieved through use of the supplied momentary/maintained-contact rocker switch. An 18/2 conductor cord of desired length will have to be supplied for making connections between the rocker switch leads and pins A and B of 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 be 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 (standard) limits current output to 1.5 kva. An optional 15 ampere circuit breaker limits current output to 2 kva.

SECTION 4 - FUNCTION OF CONTROLS

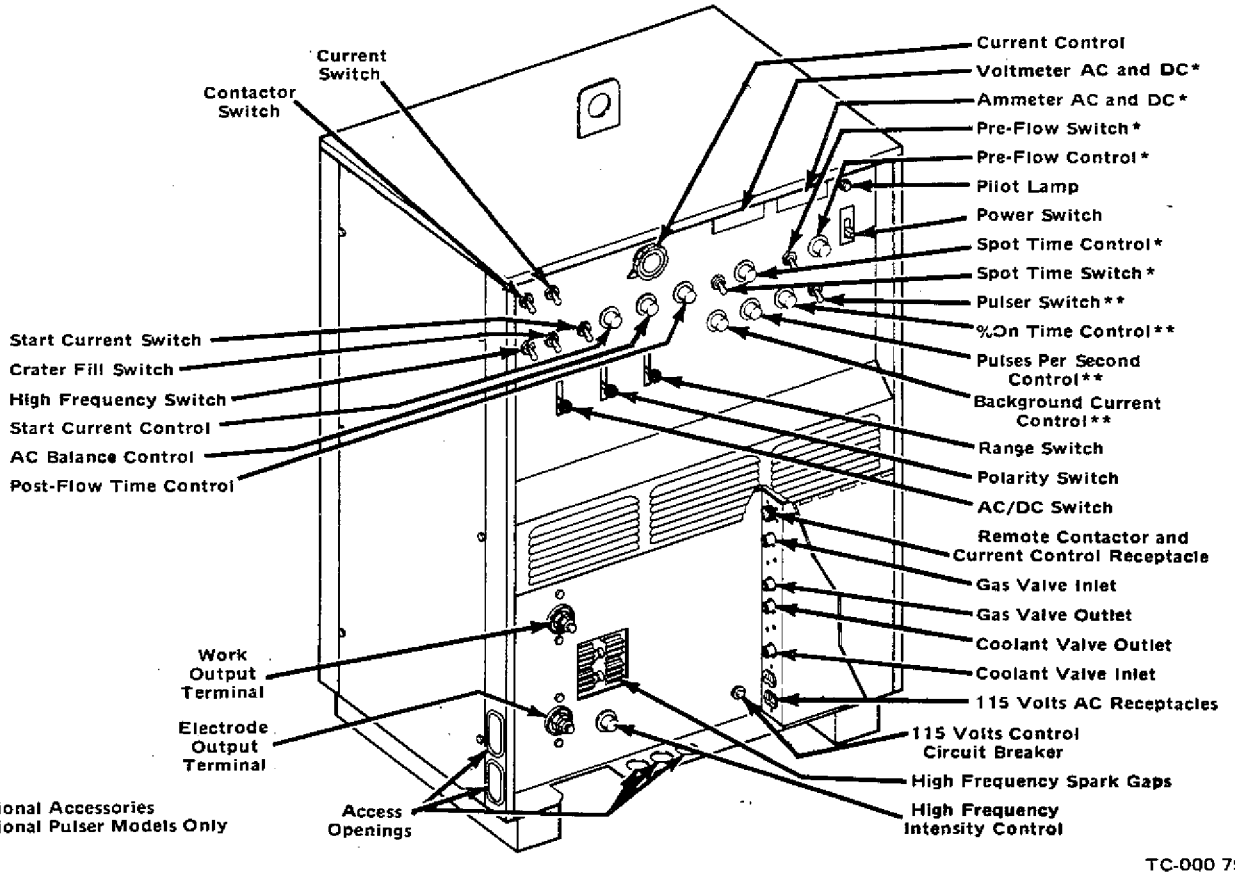

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Figure 4-1. Front Panel View (300 Ampere Model Illustrated)

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 (300 Ampere Models Only)

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 provided 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 (300 Ampere Models Only)

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 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.

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 Control (500 Ampere Models Only)

The CURRENT CONTROL is used to control the current output of the welding power source. This control will adjust the output within a range of 25 to 625 amperes. The scale surrounding the control is actual current value. The scale is provided to enable the operator to obtain repeatable outputs.

NOTE

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

D. 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.

E. Polarity Switch

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

Placing the POLARITY switch in the STRAIGHT position causes the ELECTRODE output terminal to be of negative polarity and the WORK output terminal to be of positive polarity. Conversely, if the POLARITY switch is placed in the REVERSE position, the ELECTRODE output terminal is of positive polarity and the WORK output 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.

F. 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 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 Welding (SMAW). 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 Welding (SMAW) 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 circuit in the Gas Tungsten-Arc Welding (GTAW) 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 Welding (SMAW) process.

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

The AC BALANCE control alters the basic Gas Tungsten-Arc Welding (GTAW) 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 Welding (GTAW) 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 inoperative in the AC mode and cannot be used to correct reversed connections. If the cables are reversed, the AC BALANCE control will work backwards.

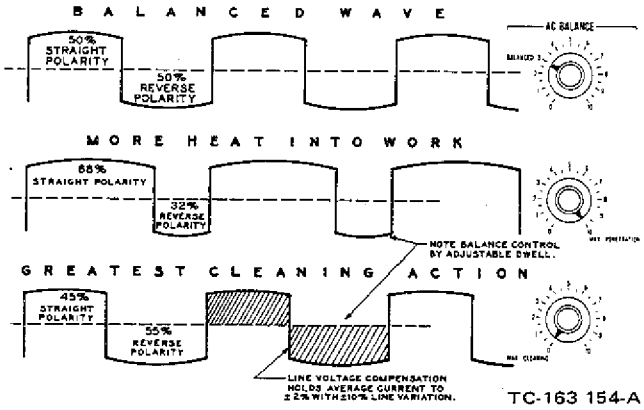


Figure 4-2. Square Wave Function Of The AC Balance Control

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

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

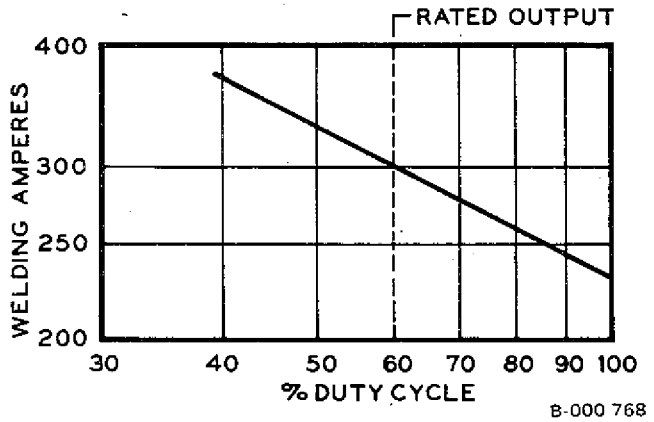
4-11. HIGH-FREQUENCY INTENSITY CONTROL (Figure 4-1)

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.

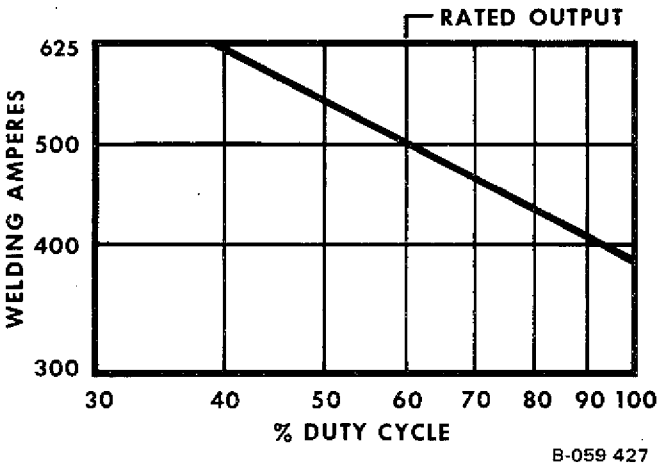
NOTE

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)



300 Ampere Models



500 Ampere Models

Figure 4-3. Duty Cycle Charts

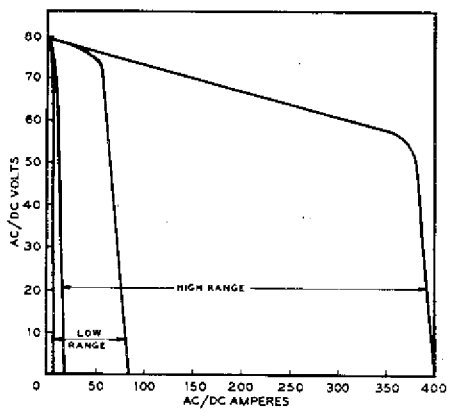
The duty cycle of a welding power source is the percentage of a ten minute period that a welding power source can safely be operated at a given output. This welding power source is rated at 60 percent duty cycle. This means that the welding power source can be safely operated at rated load for six minutes out of every ten. During the remaining four minutes, the unit should idle to permit proper cooling. If the welding amperes are 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

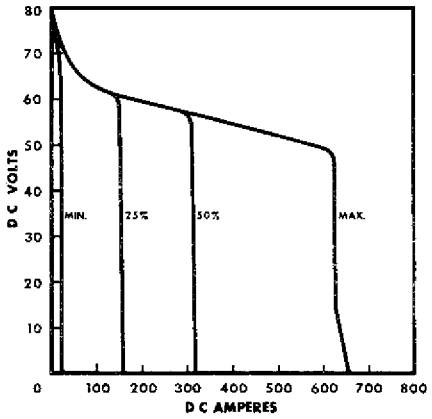
Exceeding the indicated duty cycle will cause the welding power source to overheat thereby causing damage to the welding power source.

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.



300 Ampere Models



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500 Ampere Models

Figure 4-4. Volt-Ampere Curves

4-14. METERS (If Applicable) (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 (Optional 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 (Optional 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 (Optional 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 (Optional 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 Welding (SMAW) 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 output 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.

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 WELDING (SMAW)

CAUTION

Ensure that the HIGH-FREQUENCY switch is in the OFF position before performing Shielded Metal Arc Welding (SMAW). 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.
3. Place the SPOT TIME switch (optional) and PRE-FLOW TIME switch (optional) in the OFF position.
4. 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.
5. Place the CRATER FILL switch in the OUT 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 BALANCED position.
8. Place the AC/DC switch in the desired position.
9. 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.)
10. If the unit is so equipped, place the RANGE switch in the desired position; HIGH position being preferred for most welding applications.
11. Rotate the CURRENT CONTROL or remote current control, if used, to the desired position.
12. 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.
13. 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.

14. Commence welding.

5-2. GAS TUNGSTEN-ARC WELDING (GTAW)

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 Section 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 if applicable.

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 (Optional 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 if applicable.

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 if applicable.
12. Rotate the CURRENT CONTROL 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. 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 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 clean, dry 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.

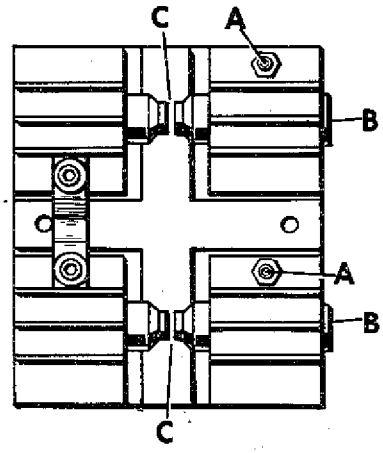

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Figure 6-1. Spark Gap Adjustment

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 screws 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 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. However, the pilot light will remain on, indicating the presence of line voltage up to the main transformer, and the fan will continue 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. For the 300 ampere models, 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. For the 500 ampere models, a single turn of two heavy cables carries the current through the toroid core. The output signal to be expected is .65 volts dc (negative) per 100 amps of welding current. 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

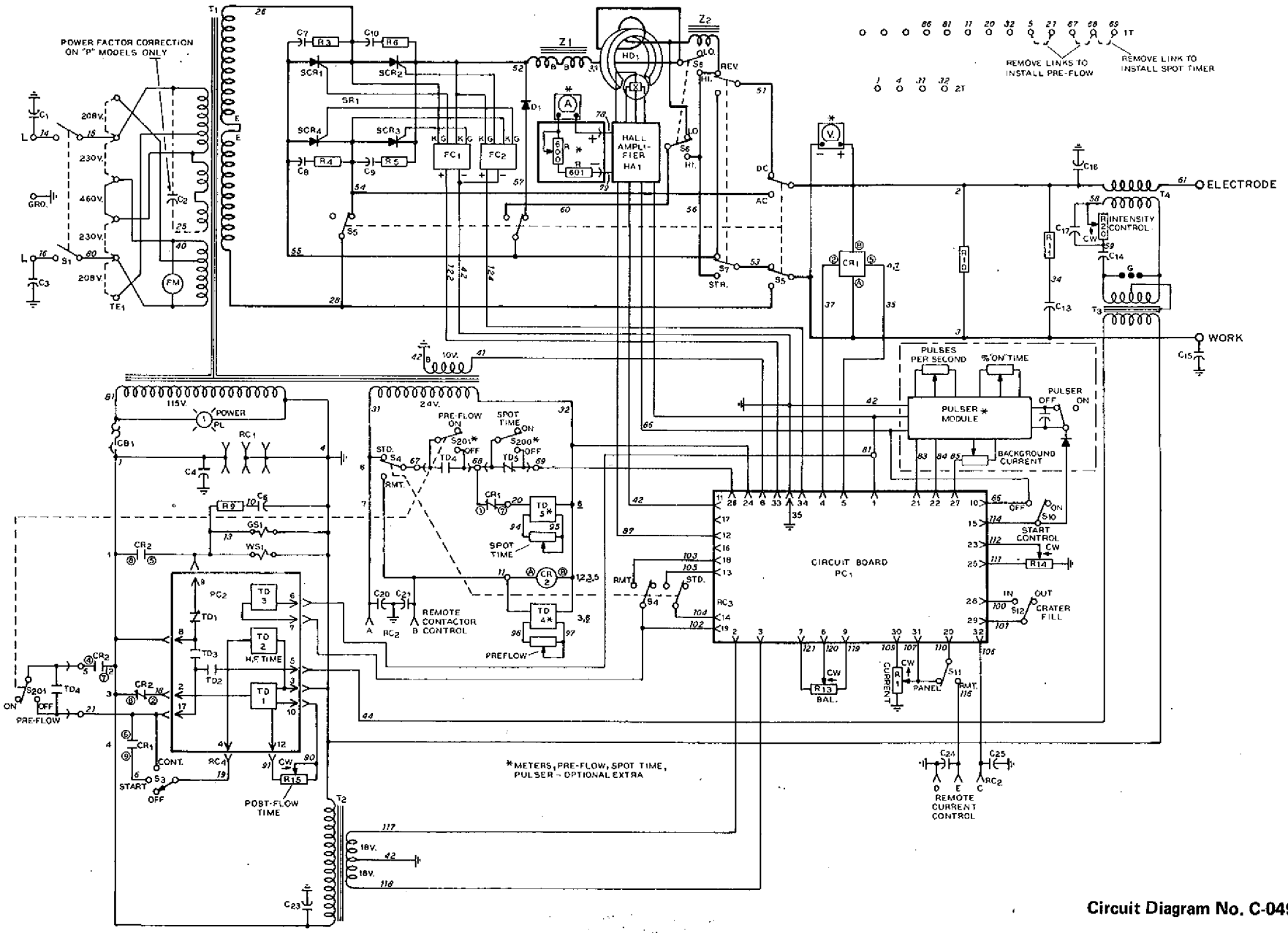
Hazardous voltages are present on the internal circuitry of the welding power source as long as power is connected to the unit. Disconnect power before attempting any inspection or work on the inside of the unit. Troubleshooting of internal circuitry should be performed by qualified personnel only.

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 weld output connections.	Refer to Sections 3-2 and 3-3 for proper electrical input and weld output 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 weld output connections.	Refer to Sections 3-2 and 3-3 for proper electrical input and weld output 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.
	Fan blade obstructions.	Check for and remove fan blade obstructions.



Circuit Diagram No. C-049 600

Figure 7-1. Circuit Diagram For 300 Ampere Models

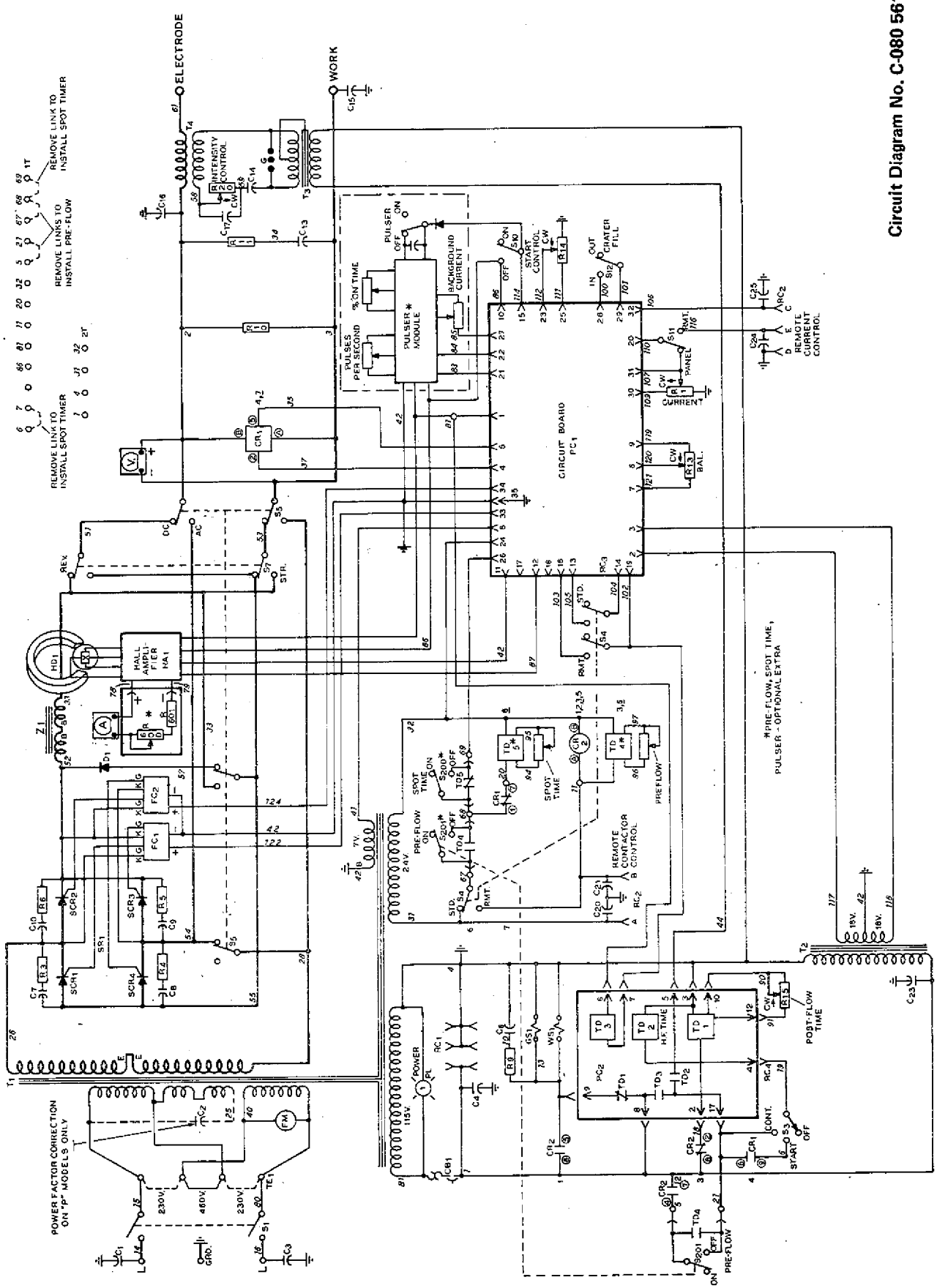
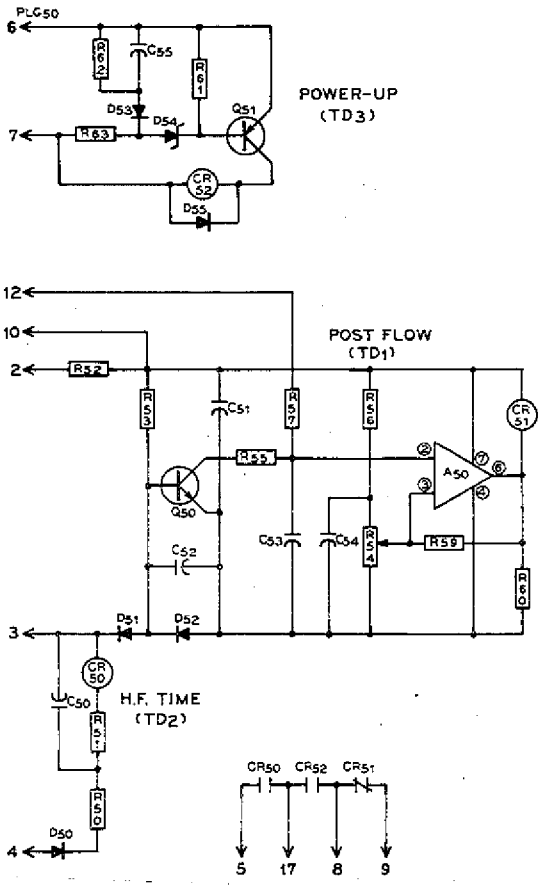


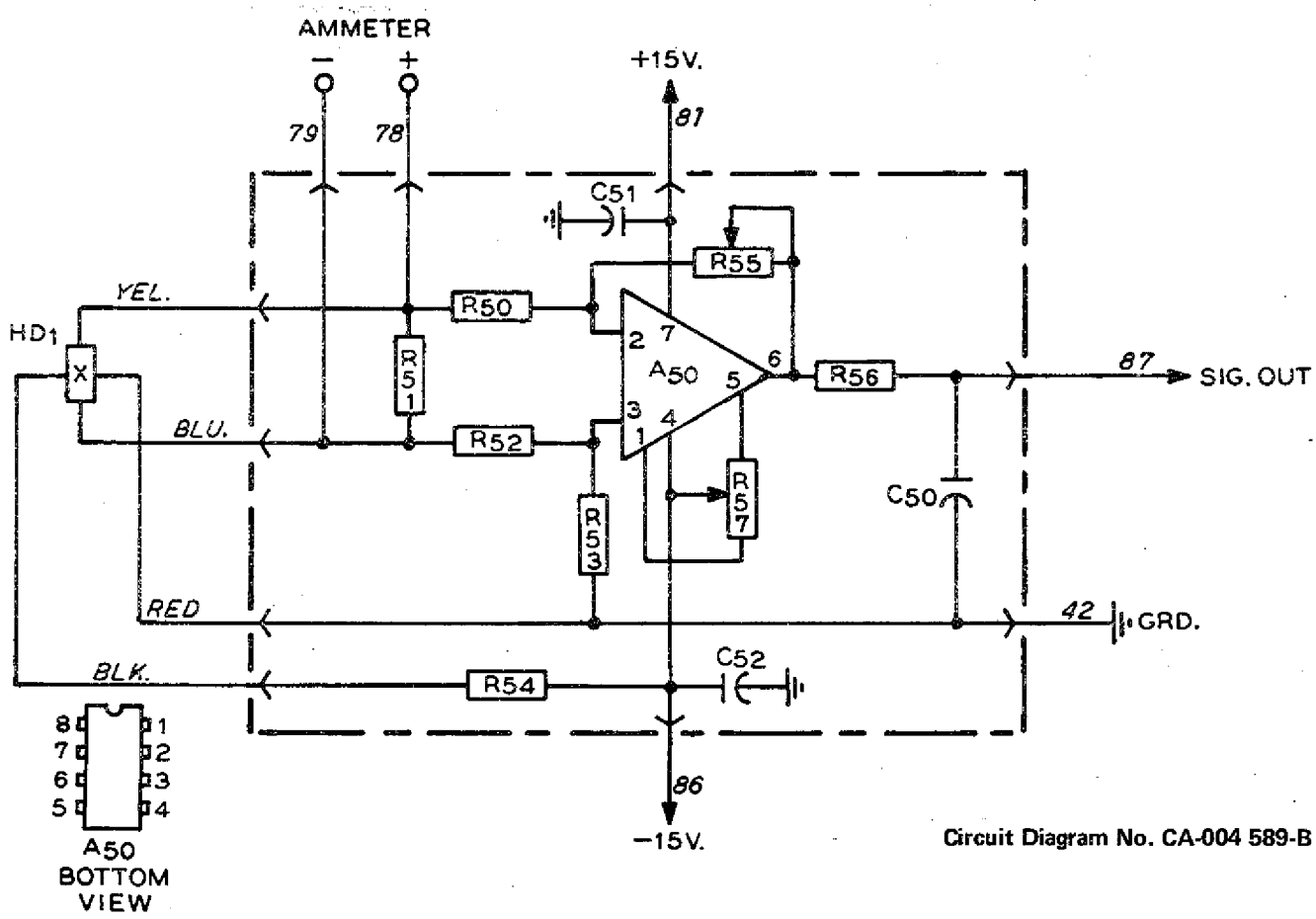
Figure 7-2. Circuit Diagram For 500 Ampere Models

Circuit Diagram No. C-080 561-A



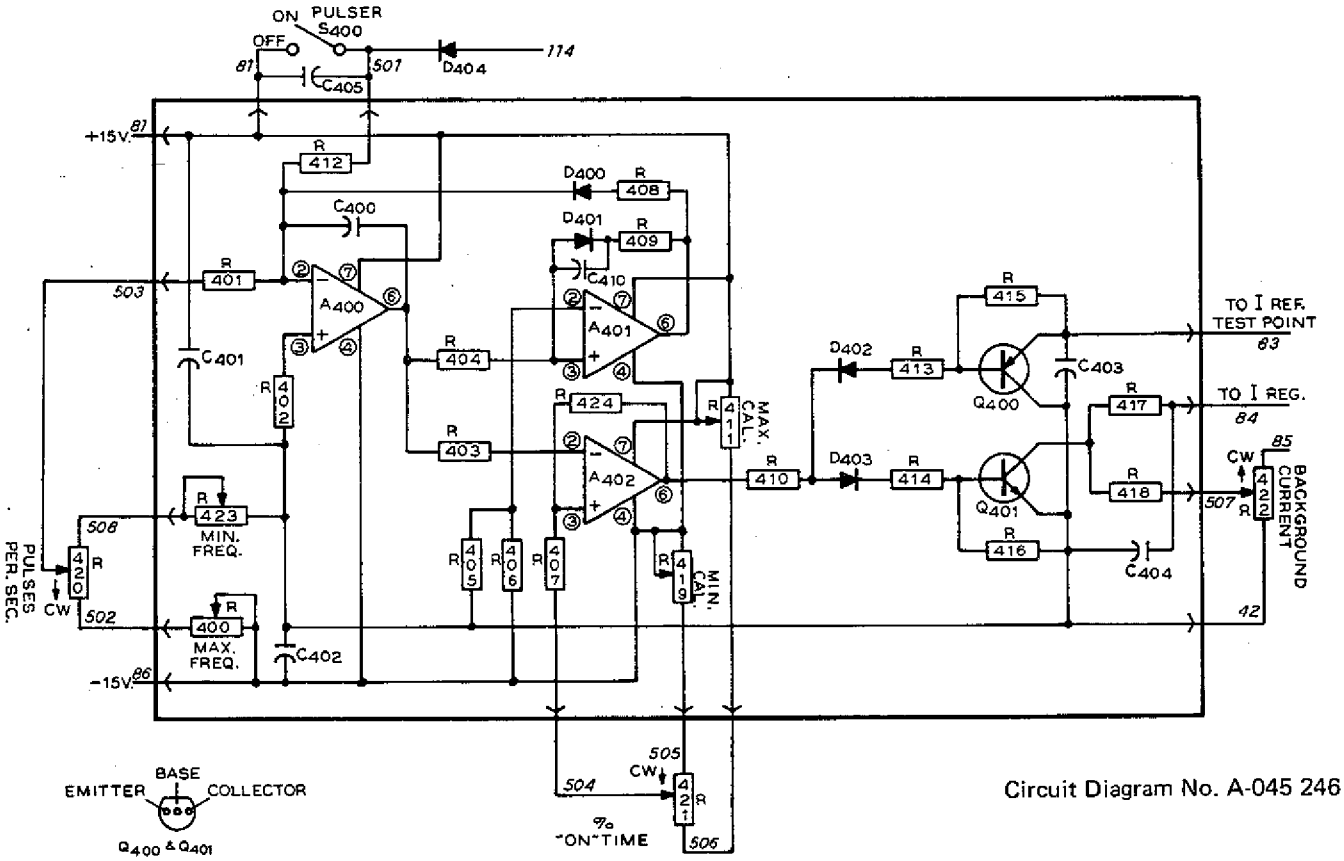
Circuit Diagram No. A-052 835

Figure 7-3. Circuit Diagram For Post-Flow And High Frequency Timer



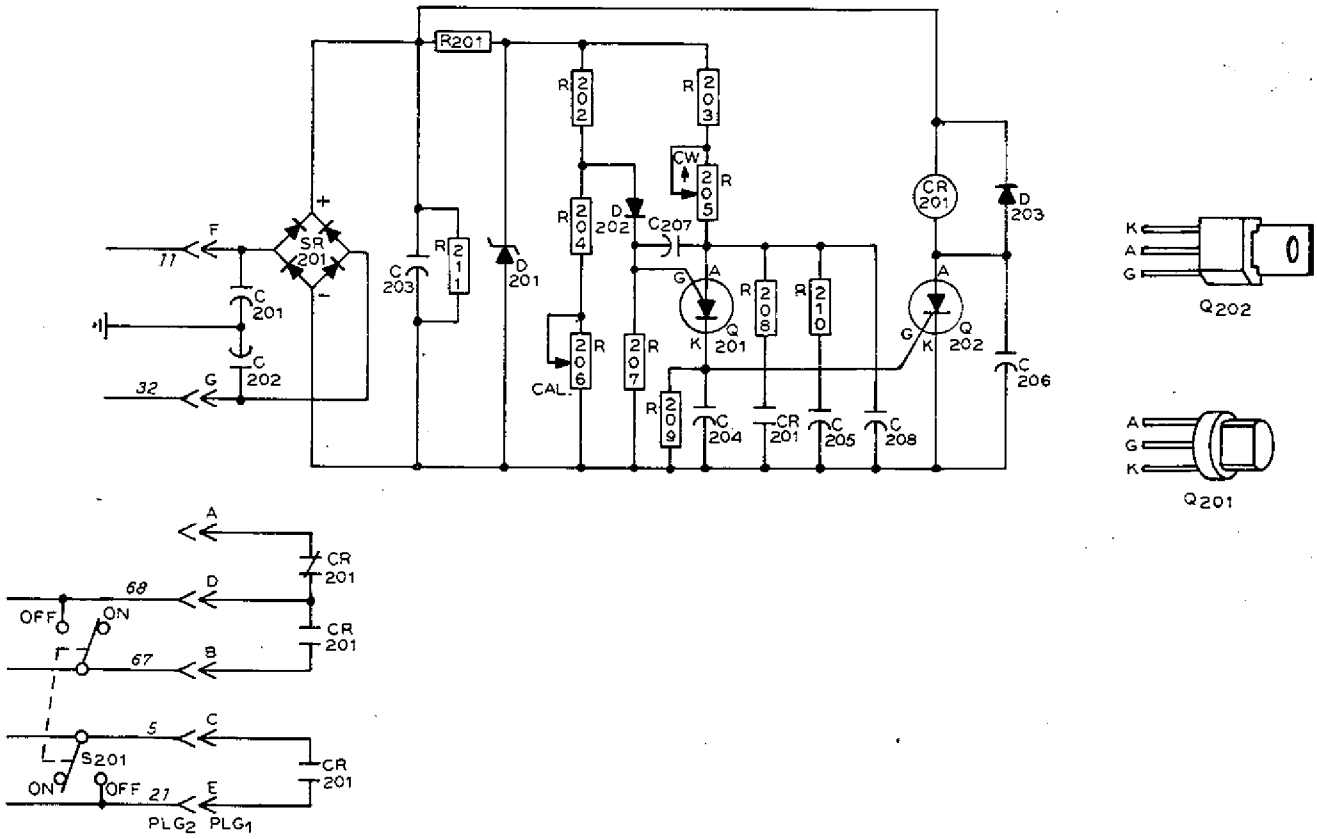
Circuit Diagram No. CA-004 589-B

Figure 7-4. Circuit Diagram For Hall Amplifier



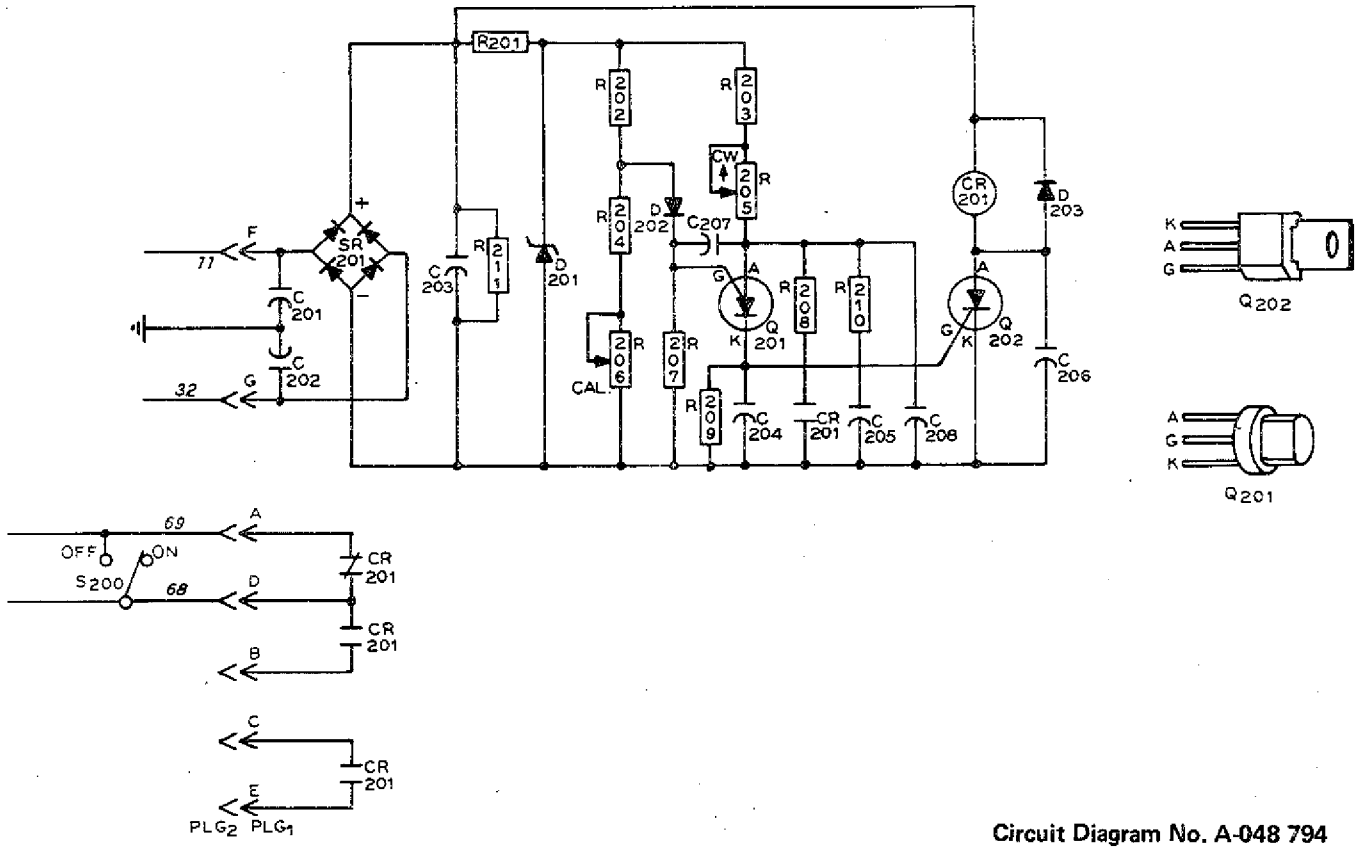
Circuit Diagram No. A-045 246

Figure 7-5. Circuit Diagram For Pulser



Circuit Diagram No. A-048 789

Figure 7-6. Circuit Diagram For Pre-Flow Timer



Circuit Diagram No. A-048 794

Figure 7-7. Circuit Diagram For Spot Timer

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.

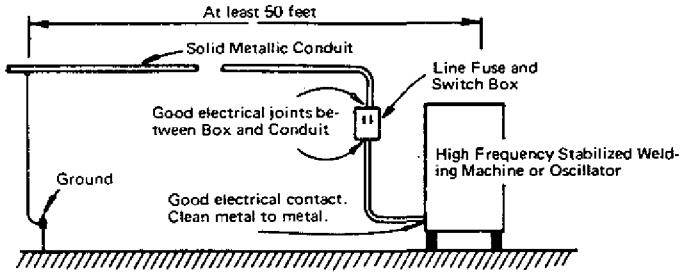


Figure 8-1. Power Service Installation H.F. Stabilized Arc Welding Machine

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.

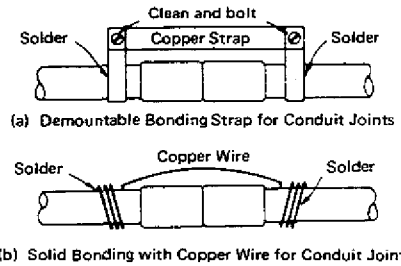


Figure 8-2. Two Recommended Methods For Electrical Bonding Across Poor Conductivity Conduit Joints

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).

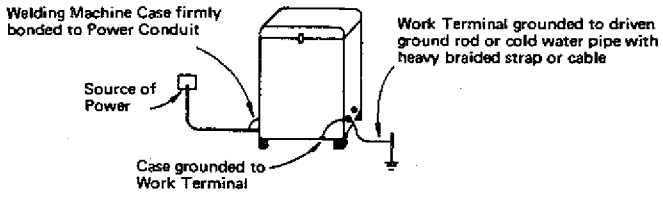


Figure 8-3. Ground Connections At Welding Machine

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).

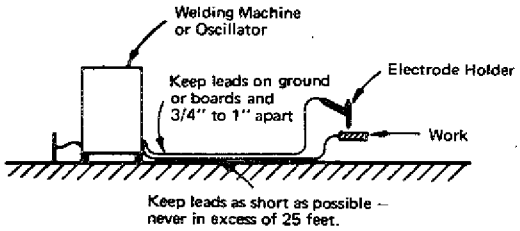


Figure 8-4. General Rules For Welding Leads

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.

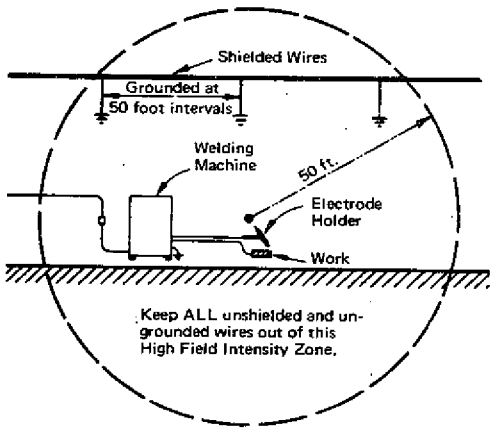


Figure 8-5. General Requirements to Minimize Reradiation Pick-Up In the Vicinity of the Weld Zone

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

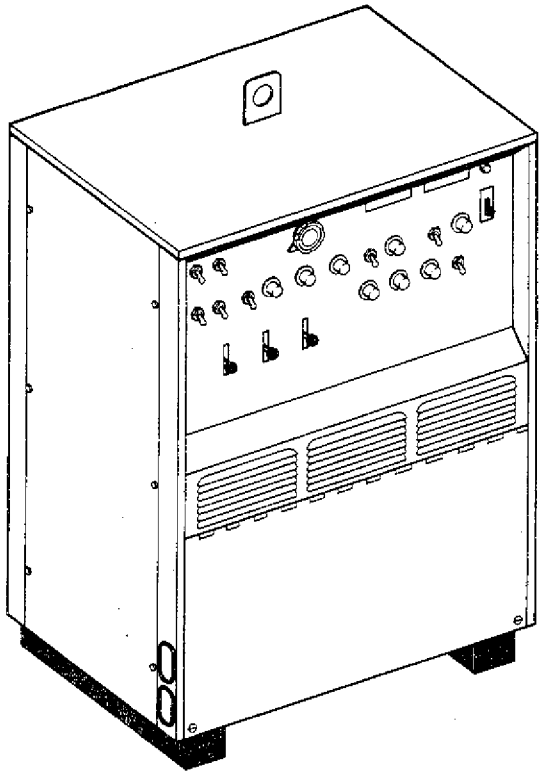
The following questions may be used by the installer as a check to see if all installation requirements have been met:

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.

April 1980 FORM: OM-350F

Effective With Serial No. JA378493



PARTS LIST

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure A			**Main Assembly**		
1		039 244	COVER, top.	1	1
1		052 302	COVER, top - w/programmer	1	1
2		039 248	PANEL, side	2	2
3	C15	009 063	CAPACITOR ASSEMBLY	1	1
4	C16	009 062	CAPACITOR ASSEMBLY	1	1
5		026 627	GASKET, lifting eye - cover	1	1
6	HA1, HD1	004 590	SENSOR, current	1	
6	HA1, HD1	059 641	SENSOR, current		1
7		Figure B	PANEL, rear - with components (See Page 2)	1	1
8	TE1	007 928	TERMINAL ASSEMBLY, primary (See Fig. C Page 2)	1	
8	TE1	059 241	TERMINAL ASSEMBLY, primary (See Fig. C Page 2)		1
9	C1,3	031 636	CAPACITOR, ceramic 0.001 uf 2000 volts dc	2	2
10		006 901	REACTOR & TRANSFORMER, power - main (See Fig. D Page 3)	1	
10		059 510	REACTOR & TRANSFORMER, power - main (See Fig. D Page 3)		1
11		+025 142	BRACKET, mounting - capacitor	2	4
12	C4	007 967	CAPACITOR, metalized paper 2 uf 115 volts	1	1
13	C2	+059 417	CAPACITOR, paper oil 30 uf 460 volts	2	4
14		003 034	BASE	1	1
15	Z2	000 051	REACTOR, square wave - low range	1	
16		Figure F & G	PANEL, front - with components (See Pages 5-8)	1	1
17		004 603	HIGH FREQUENCY PANEL (See Fig. E Page 4)	1	1

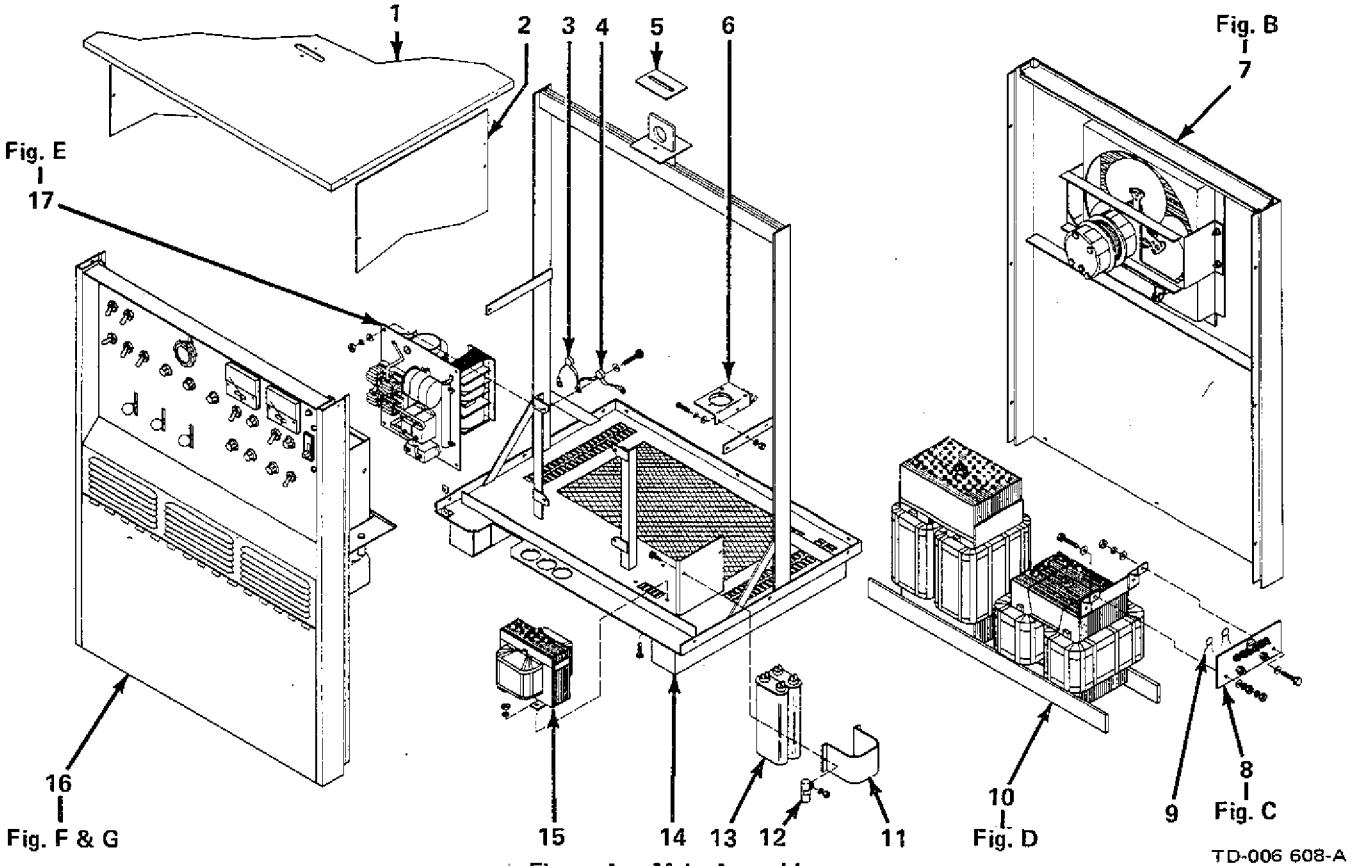
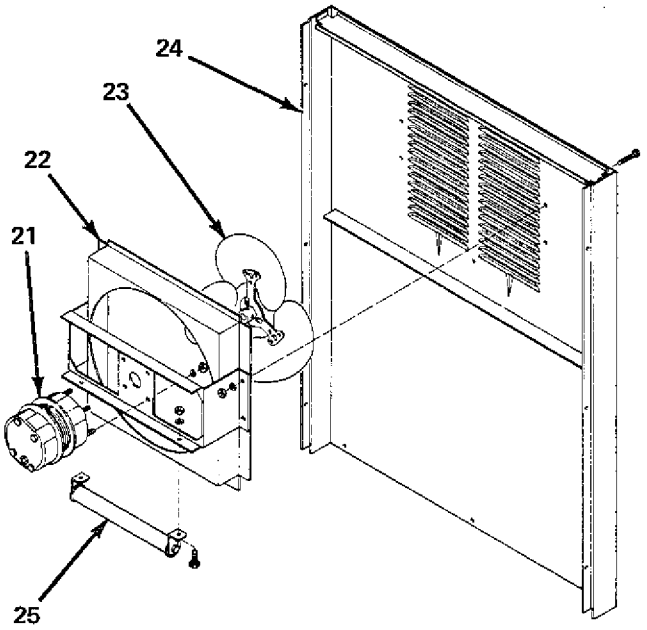


Figure A — Main Assembly

+Optional Equipment.

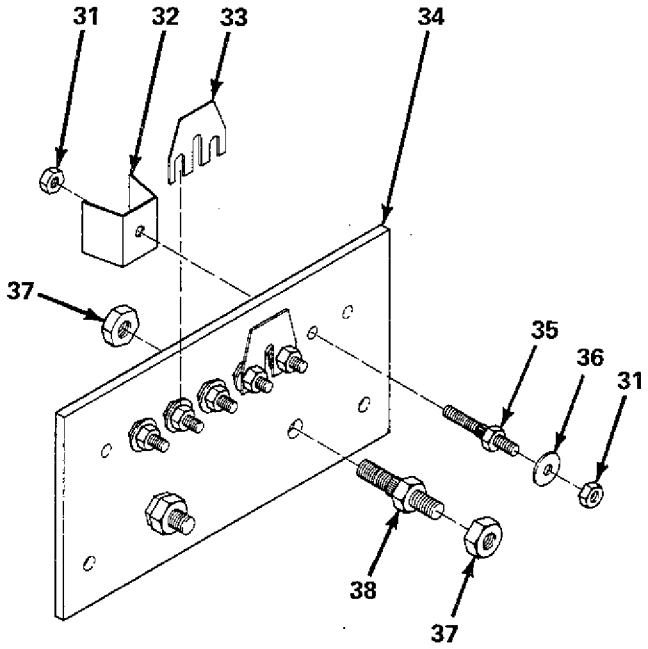
BE SURE TO PROVIDE MODEL AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
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	
21	FM	032 605	MOTOR, capacitor - permanent SP 1/4 hp		1
22		016 258	CHAMBER, plenum 14 inch	1	
22		020 729	CHAMBER, plenum 18 inch		1
23		032 604	BLADE, fan 60 Hz. 14 inch 3 wing 19 deg.	1	
23		032 606	BLADE, fan 60 Hz. 18 inch 3 wing 22 deg.		1
24		039 247	PANEL, rear	1	
24		059 068	PANEL, rear		1
25	R10	030 060	RESISTOR, WW adj 375 watt 20 ohm	1	1



TC-006 610

Figure B — Panel, Rear - With Components



TB-006 887

Figure C — Terminal Board Assembly, Primary

Item No.	Factory Part No.	Description	Quantity Model 300 Amp 007 928	Quantity Model 500 Amp 059 241
Figure C		**Terminal Assembly, Primary (See Fig. A Page 1 Item 8)**		
31	601 835	NUT, brass - hex 10-32	12	
31	601 838	NUT, brass - hex 3/8-16		24
32	026 754	INSULATION, primary - stud barrier	6	
33	038 618	LINK, jumper - terminal primary board	2	
33	038 898	LINK, terminal - connecting		2
34	034 588	TERMINAL BOARD, primary	1	
34	059 050	TERMINAL BOARD, primary		1
35	038 887	STUD, brass No. 10-32 x 1-3/8 w/hex collar	6	
35	038 804	STUD, brass 3/8-16 x 2-1/2		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 MODEL AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp 006 901	Quantity Model 500 Amp 059 510
Figure D			**Reactor & Transformer, Power - Main (See Fig. A Page 1 Item 10)**		
51	Z1	**039 313	REACTOR, square wave (consisting of)	1	
51	Z1	**059 113	REACTOR, square wave (consisting of)		1
52		**000 192	. COIL, reactor - square wave RH	1	
52		**059 101	. 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	
56		059 112	. STRIP, phenolic 3/8 x 6 x 9-1/8		2
57		**003 031	. COIL, reactor - square wave LH	1	
57		**059 102	. COIL, reactor - square wave LH		1
		059 111	. STRIP, fiber 1/16 x 6 x 9-1/8		1
58	T1	**006 857	TRANSFORMER, power - main (consisting of)	1	
58	T1	**059 108	TRANSFORMER, power - main (consisting of)		1
59		**006 910	. TRANSFORMER SUBASSEMBLY, power - main (consisting of)	1	
59		**059 107	. TRANSFORMER SUBASSEMBLY, power - main (consisting of)		1
60		006 967	. . STRIP, glastic 1/16 x 3-5/8 x 7-1/4	2	
60		059 106	. . STRIP, glastic 1/16 x 3-3/4 x 7		2
61		010 340	. . WEDGE, hardwood 1/2 x 1 x 5-1/2	4	
61		059 105	. . WEDGE, hardwood 1/2 x 1 x 10		4
62		**006 859	. COIL, primary/secondary RH	1	
62		**059 086	. COIL, primary/secondary RH		1
63		**006 858	. COIL, primary/secondary LH	1	
63		**059 087	. 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	

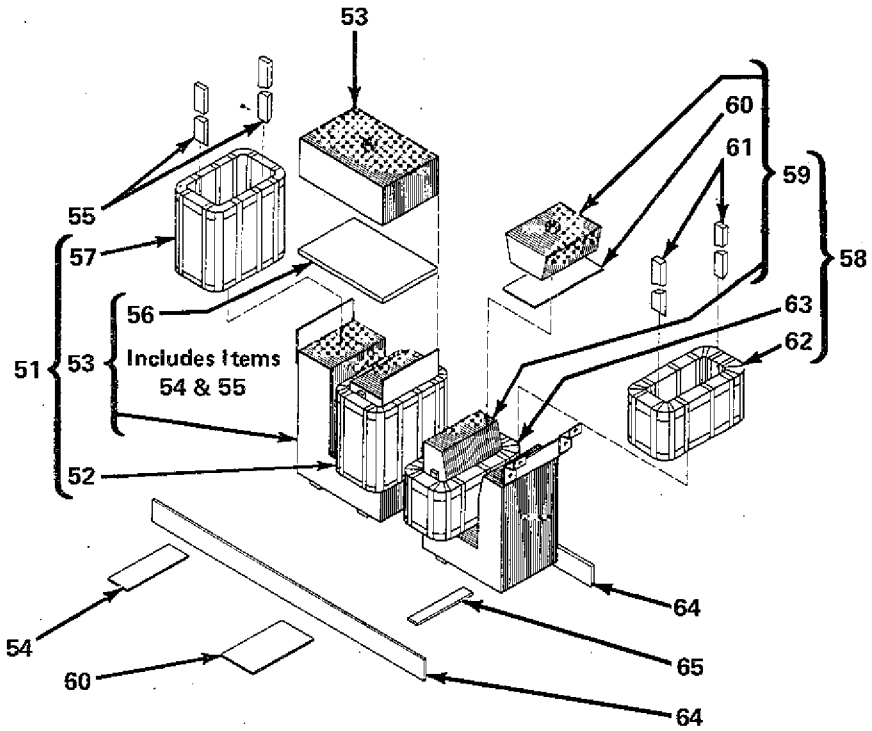


Figure D — Reactor & Transformer, Power - Main

+Not available as an assembly in 500 ampere models.
**Replace at Factory or Factory Authorized Service Station.
BE SURE TO PROVIDE 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 17)**	
81		010 885	STRIP, conductor	2
82		603 737	SCREW, machine - brass round hd 3/8-16 x 1-3/4	2
83		016 601	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		081 291	CAPACITOR, HF (consisting of)	1
99	C13	059 887	. CAPACITOR, metal film 10 uf 220 volts	1
100		007 532	. CLAMP, capacitor 1 inch dia	2
101		081 282	. STRIP, mounting - capacitor	1
102		010 883	STRIP, conductor	1
103		020 623	SPARK GAP ASSEMBLY (consisting of)	1
104		010 888	. CONNECTOR, holder - spark gap	1
105		020 622	. HOLDER, points	4
106	G	*020 603	. POINT, spark gap	4
107		020 621	. BASE, spark gap	1

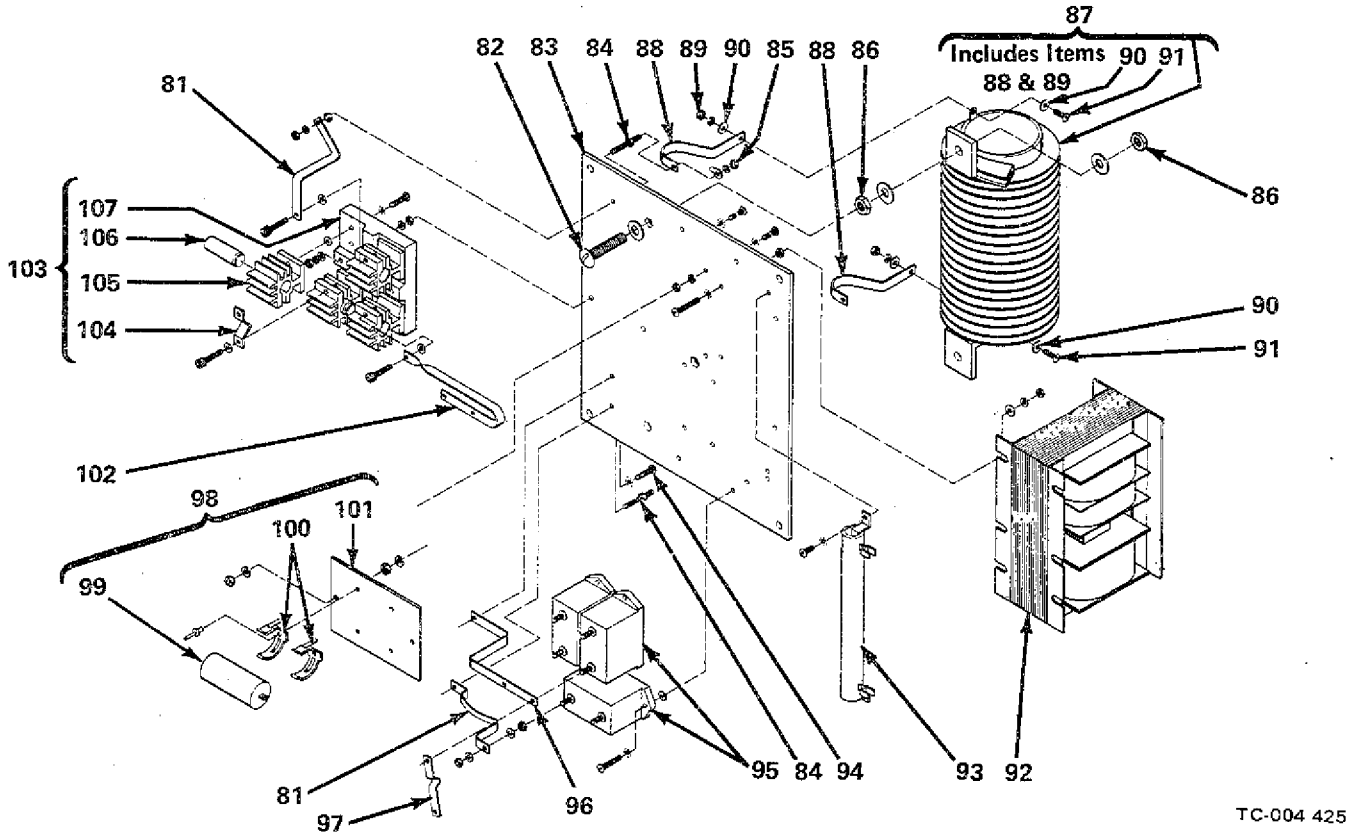


Figure E — High Frequency Panel

*Recommended Spare Parts.

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

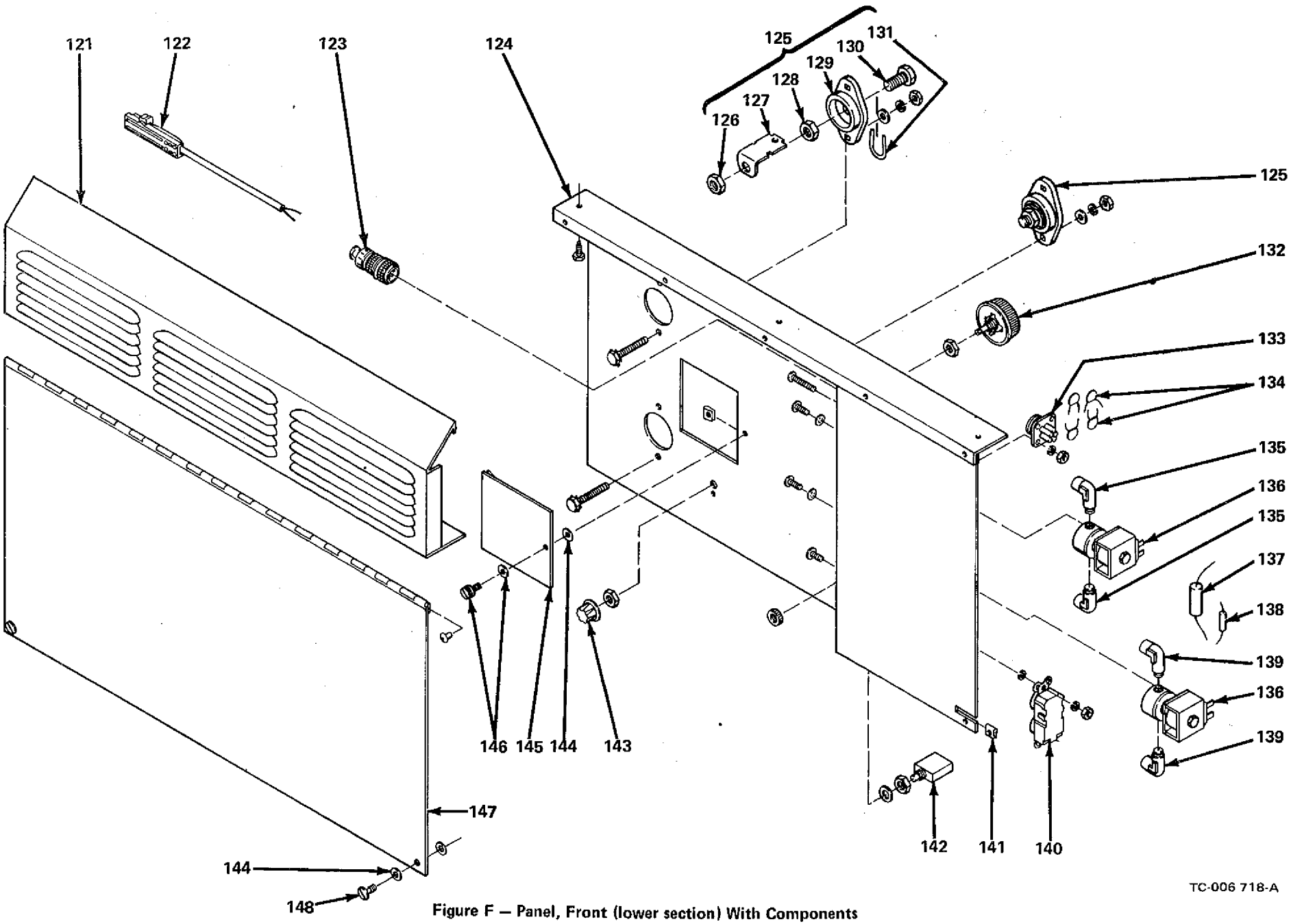


Figure F — Panel, Front (lower section) With Components

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure F			**Panel, Front - (Lower Section) With Components (See Fig. A Page 1 Item 16)**		
121		003 045	PANEL, front - louvered	1	1
122		009 835	SWITCH, w/leads	1	1
123		039 273	PLUG, 5 pin MS3106A-16S-8P	1	1
124		+052 938	PANEL, front	1	
124		+059 519	PANEL, front		1
125		039 047	TERMINAL, power output - red (consisting of)	2	2
126		601 879	. NUT, steel - hex full 1/2-13	1	1
127		039 044	. BUS BAR	1	1
128		601 880	. NUT, steel - hex jam 1/2-13	1	1
129		039 049	. TERMINAL BOARD, red	1	1
130		601 976	. SCREW, cap - steel hex hd 1/2-13 x 1-1/2	1	1
131		053 032	. CLIP, spring - bus bar	1	1
132	R20	*605 828	RHEOSTAT, WW 50 watt 1.5 ohm	1	1
133	RC2	035 523	RECEPTACLE, 5 socket MS-3102A-16S-8S	1	1
134	C20,21,24,25	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	4	4
135		010 296	FITTING, hose - brass elbow male 1/4 NPT x 5/8-18 RH	2	2
136	GS1,WS1	003 538	VALVE, 115 volts ac 2 way 1/4 IPS port 1/8 orifice (consisting of)	2	2
		003 539	. COIL, valve 115 volts ac	1	1
137	C6	028 294	CAPACITOR, mylar 1 uf 200 volts dc	1	1
138	R9	030 761	RESISTOR, carbon 1 watt 10 ohm	1	1
139		010 295	FITTING, hose - brass elbow male 1/4 NPT x 5/8-18 LH	2	2
140	RC1	604 176	RECEPTACLE, straight - duplex grounded 2P3W	1	1
141		605 670	NUT, speed 12-24	3	3
142	CB1	011 972	CIRCUIT BREAKER, 10 amp 250 volts	1	1
142	CB1	053 283	CIRCUIT BREAKER, manual reset 1P 15 amp 250 volts (used only if using 2 kva)	1	1
143		019 666	KNOB, line indicator	1	1
144		010 855	RETAINER, screw No. 2	3	3
145		052 467	DOOR, access - HF	1	1
146		602 358	FASTENER, screw - knurled hd No. 2	1	1
147		003 043	DOOR, access - front	1	1
148		078 034	FASTENER, screw - slotted hd 0.736 lg	2	2

*Recommended Spare Parts.
+This item and item 172 on page 8 are available only as a welded assembly.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBERS WHEN ORDERING REPLACEMENT PARTS.

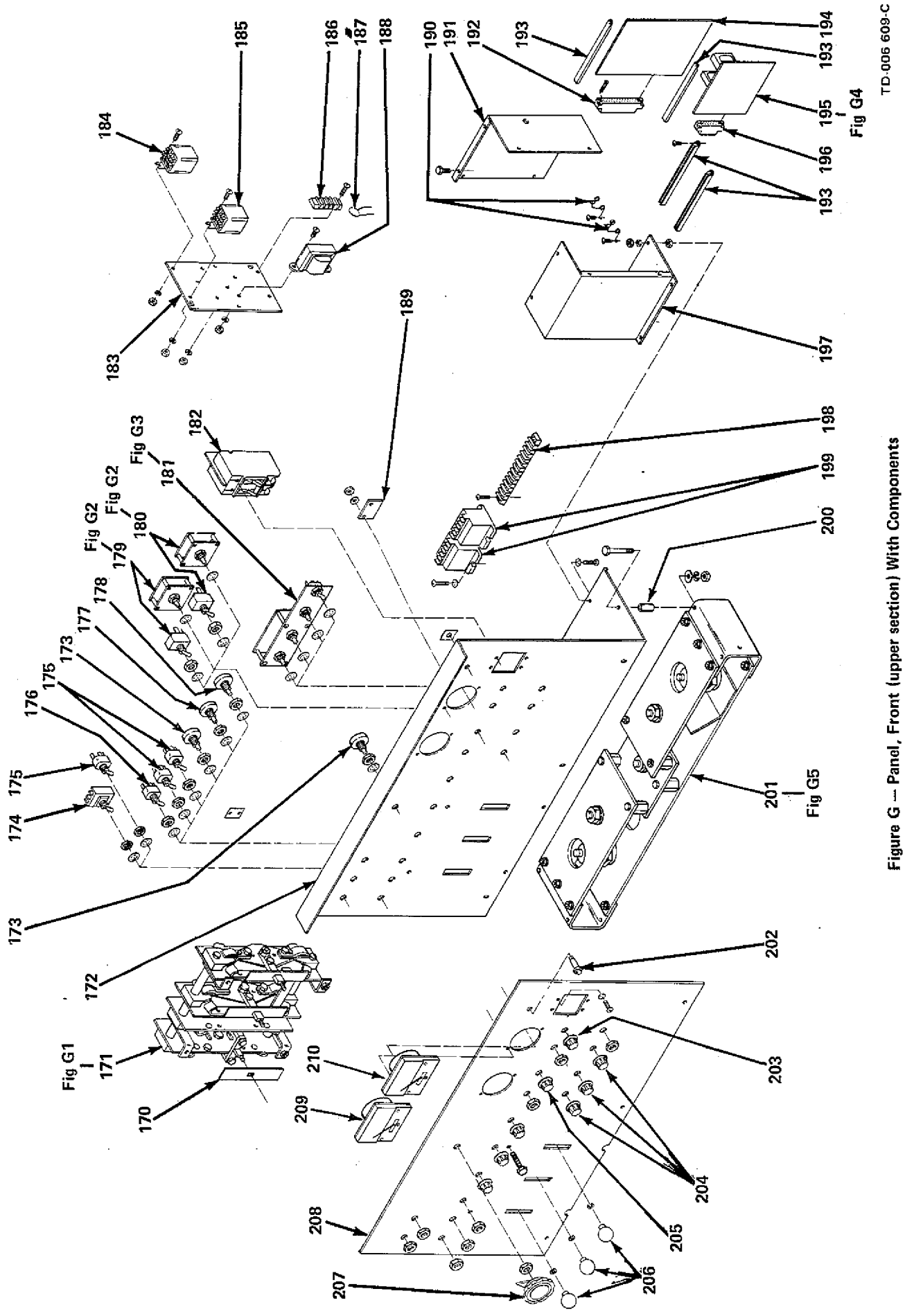


Figure G — Panel, Front (upper section) With Components

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G			**Panel, Front (Upper Section) With Components (See Fig. A Page 1 Item 16)**		
170		003 053	GUARD, slot - switch selector	3	2
171	S5-7	004 266	SWITCH, range/polarity/selector (See Fig. G1 Page 10)	1	
171	S5-7	059 081	SWITCH, polarity/selector (See Fig. G1 Page 10)		1
172			PANEL, front (See item 124 on page 6)		
173	R1,14	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	2	2
174	S4	011 622	SWITCH, toggle 3PDT 15 amp 125 volts	1	1
175	S10-12	011 609	SWITCH, toggle SPDT 10 amp 125 volts	3	3
176	S3	011 610	SWITCH, toggle SPDT 10 amp 125 volts	1	1
177	R13	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1	1
178	R15	028 769	POTENTIOMETER, carbon 1 turn 2 watt 750K ohm	1	1
179		†Figure G2	SPOT TIMER (See Page 15)	1	1
180		†Figure G2	PRE-FLOW TIMER (See Page 15)	1	1
181		Figure G3	PULSER CONTROL (See Page 16)	1	1
182	S1	006 966	CIRCUIT BREAKER, non auto 2P 100 amp 600 volts ac	1	
182	S1	059 518	CIRCUIT BREAKER, 2P 225 amp 600 volts		1
		027 350	TUBING, steel 1/2 OD x 12 ga wall x 9/16		4
183		059 152	PANEL, mounting - components	1	1
184	CR2	000 174	RELAY, enclosed 24 volts ac 3PDT	1	1
185	CR1	052 251	RELAY, current 47-44 volts dropout 110 volts ac/dc	1	1
186	2T	038 081	BLOCK, terminal 20 amp 4 pole	1	1
187	C23	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1	1
188	T2	035 759	TRANSFORMER, control - miniature 115/36	1	1
189		+080 309	CIRCUIT CARD ASSEMBLY, meter - calibration (consisting of)	1	1
	R601	030 937	. RESISTOR, carbon 0.5 watt 10 ohm	1	1
	R600	032 261	. POTENTIOMETER, cermet trimmer 15 turn 0.75 watt 200 ohm	1	1
190		039 349	SPRING, retainer - circuit card	2	2
191		000 020	PANEL, enclosure - circuit card assembly	1	1
192	RC3	039 358	CONNECTOR, edge 35 socket	1	1
193		035 506	GUIDE, circuit card 9 inch	4	4
194	PC1	+048 024	CIRCUIT CARD ASSEMBLY, control - main	1	1
195	PC2	052 790	CIRCUIT CARD ASSEMBLY, post - flow & HF timer (See Fig. G4 Page 17)	1	1
196	RC4	039 347	CONNECTOR, edge PC card 17 socket	1	1
197		000 022	ENCLOSURE, circuit card assembly	1	1
198	1T	038 833	BLOCK, terminal 20 amp 13 pole	1	1
		601 219	LINK, jumper - terminal block 20 amp	As Required	
199	FC1,2	000 105	PULSE MODULE	2	2
200		007 097	TUBING, steel 1/2 OD x 0.060 wall	2	2
201	SR1	000 176	RECTIFIER, SCR main (See Fig. G5 Page 18)	1	
201	SR1	059 072	RECTIFIER, SCR main (See Fig. G5 Page 18)		1
202	PL1	027 645	LIGHT, indicator 115 volts ac red lens	1	1
203		†019 666	KNOB, line indicator (included with item 180)	1	1
204		019 666	KNOB, line - indicator	6	4
205		†019 666	KNOB, line - indicator (included with item 179)	1	1
206		019 603	KNOB, ball	3	2
207		019 627	KNOB, pointer	1	1
208			NAMEPLATE (order by model and serial number)	1	1
209	V	†080 311	METER, volts ac/dc 0-100 scale	1	1
210	A	†080 310	METER, amp ac/dc 0-400 scale	1	
210	A	†059 494	METER, amp ac/dc 0-750 scale		1

†Optional Equipment.

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

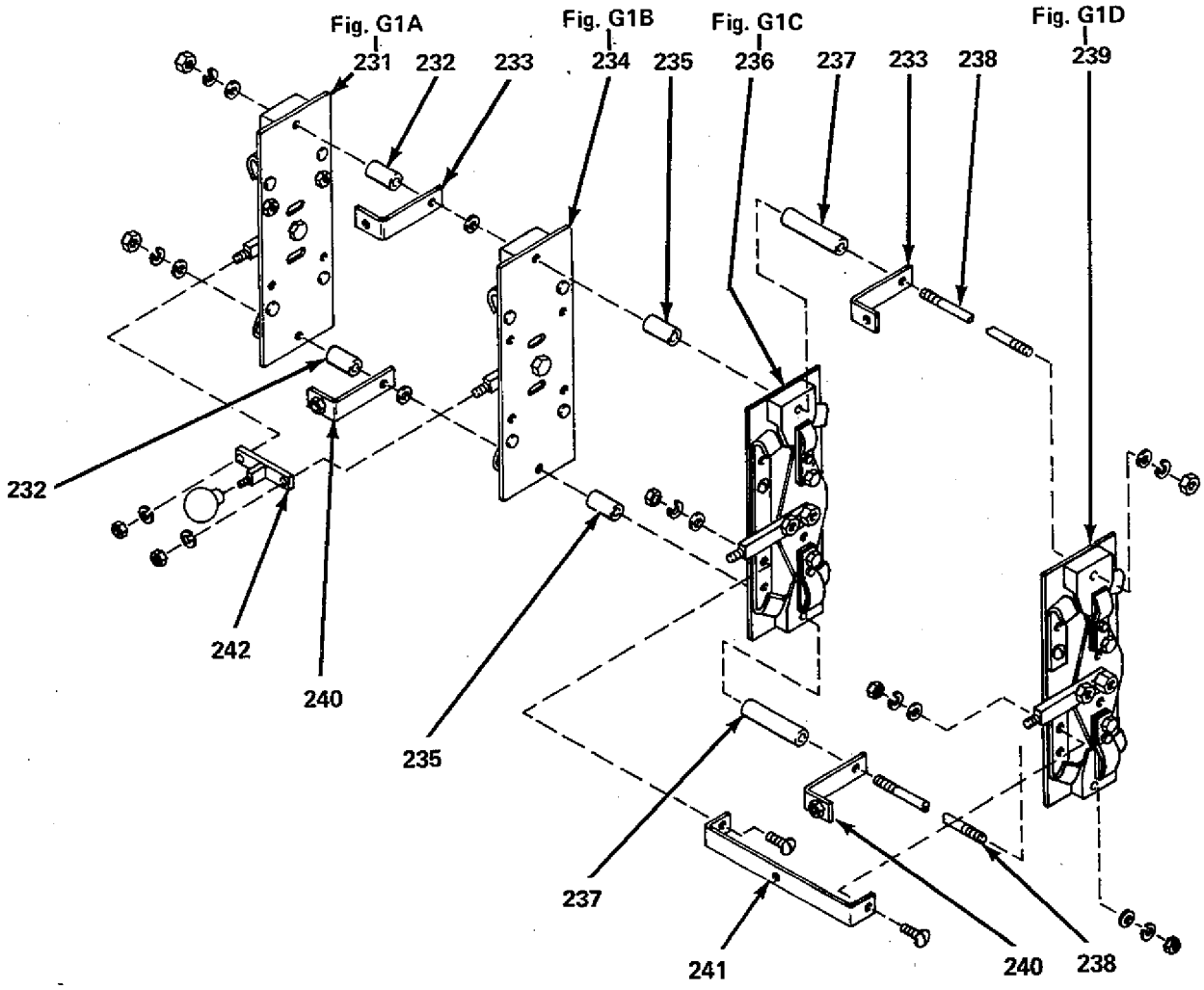


Figure G1 — Switch, Range/Polarity/Selector

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
				004 266	059 081
Figure G1			**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 11)	1	
231	S5	059 083	CONTACT BOARD ASSEMBLY, switch - selector ac/dc (See Fig. G1A Page 11)		1
232		003 231	TUBING, steel 5/8 OD x 12 ga wall x 1-1/8	2	
232		003 230	TUBING, steel 5/8 OD x 12 ga wall x 2-5/8		2
233		104 935	BRACKET, mounting - switch	2	2
234	S5	000 879	CONTACT BOARD ASSEMBLY, switch - selector ac/dc (See Fig. G1B Page 12)	1	
234	S5	059 084	CONTACT BOARD ASSEMBLY, switch - selector ac/dc (See Fig. G1B Page 12)		1
235		009 229	TUBING, steel 5/8 OD x 12 ga wall x 15/16	2	
235		010 086	SPACER, polarity - switch		2
236	S6	000 878	CONTACT BOARD ASSEMBLY, switch - polarity (See Fig. G1C Page 13)	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	
238		028 389	STUD, steel 1/4-20 x 10		2
239	S7	004 265	CONTACT BOARD ASSEMBLY, switch - range (See Fig. G1D Page 14)	1	
239	S7	059 082	CONTACT BOARD ASSEMBLY, switch - polarity (See Fig. G1D Page 14)		1
240		004 696	BRACKET, mounting - switch	2	2
241		004 267	LINK, jumper - switch ac/dc	1	
241		080 346	LINK, jumper - switch		1
242		039 260	HANDLE, switch	1	
242		080 348	HANDLE, switch		1
		025 181	TUBING, steel 5/8 OD x 12 ga wall x 1/2		6
		010 530	TUBING, steel 5/8 OD x 5/32 wall x 1/4		2

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

Item No.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1A		**Contact Board Assembly, Switch - Selector AC/DC (See Fig. G1 Page 10 Item 231)**	000 880	059 083
251	604 318	NUT, steel - self - locking hex 1/4-20	1	1
252	039 257	HANDLE, switch	1	1
253	024 694	BEARING, polarity	1	2
254	011 948	GUIDE, contact - movable switch	2	4
255	011 950	CONTACT, switch	1	4
256	103 634	MOUNTING BOARD, components - polarity switch	1	1
257	011 951	CONTACT, switch	1	4
258	103 633	BUS BAR, shorting - switch polarity	1	
259	038 769	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1	2
260	103 632	. PLATE, toggle switch	1	1
261	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2	2
262	011 075	.. SPRING, pressure - contact switch	1	1
263	011 953	.. CONTACT, switch	2	2
264	011 074	.. SPRING, pressure - contact switch	1	1

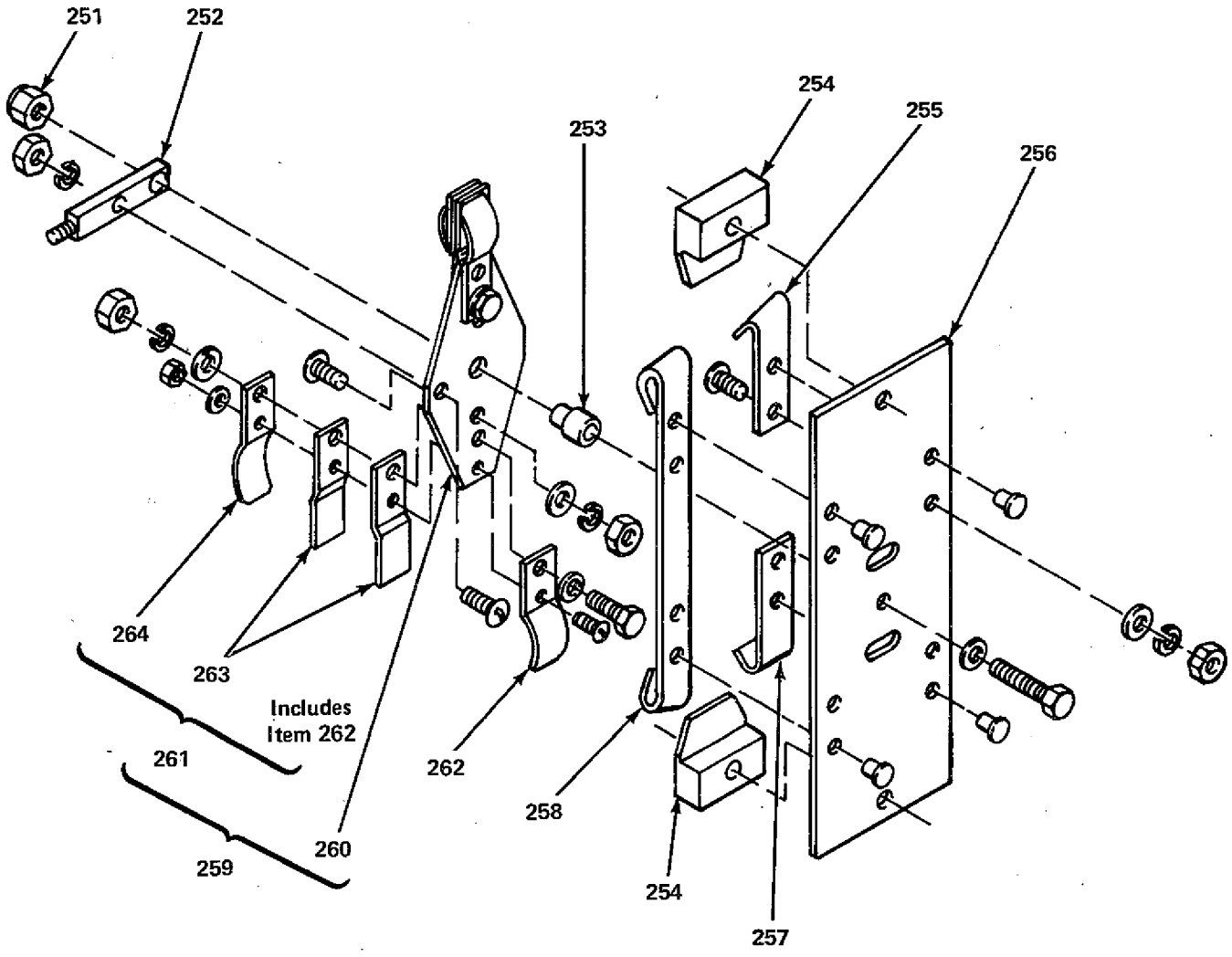


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Figure G1A — Contact Board Assembly, Selector AC/DC

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

Item No.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1B		**Contact Board Assembly, Switch - Selector AC/DC (See Fig. G1 Page 10 Item 234)**	000 879	059 084
271	038 679	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1	2
272	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2	2
273	011 074	.. SPRING, pressure - contact switch	1	1
274	011 953	.. CONTACT, switch	2	2
275	011 075	.. SPRING, pressure - contact switch	1	1
276	103 632	. PLATE, toggle switch	1	1
277	011 948	GUIDE, contact - movable switch	2	4
278	011 951	CONTACT, switch	2	2
279	011 950	CONTACT, switch	2	2
280	103 634	MOUNTING BOARD, component - polarity switch	1	1
281	024 694	BEARING, polarity	1	1
282	039 257	HANDLE, switch	1	1
283	604 318	NUT, steel - self - locking hex 1/4-20	1	1
	020 484	TUBING, steel 5/8 OD x 12 ga wall x 1/4		1
	103 633	BUS BAR, shorting - switch		2

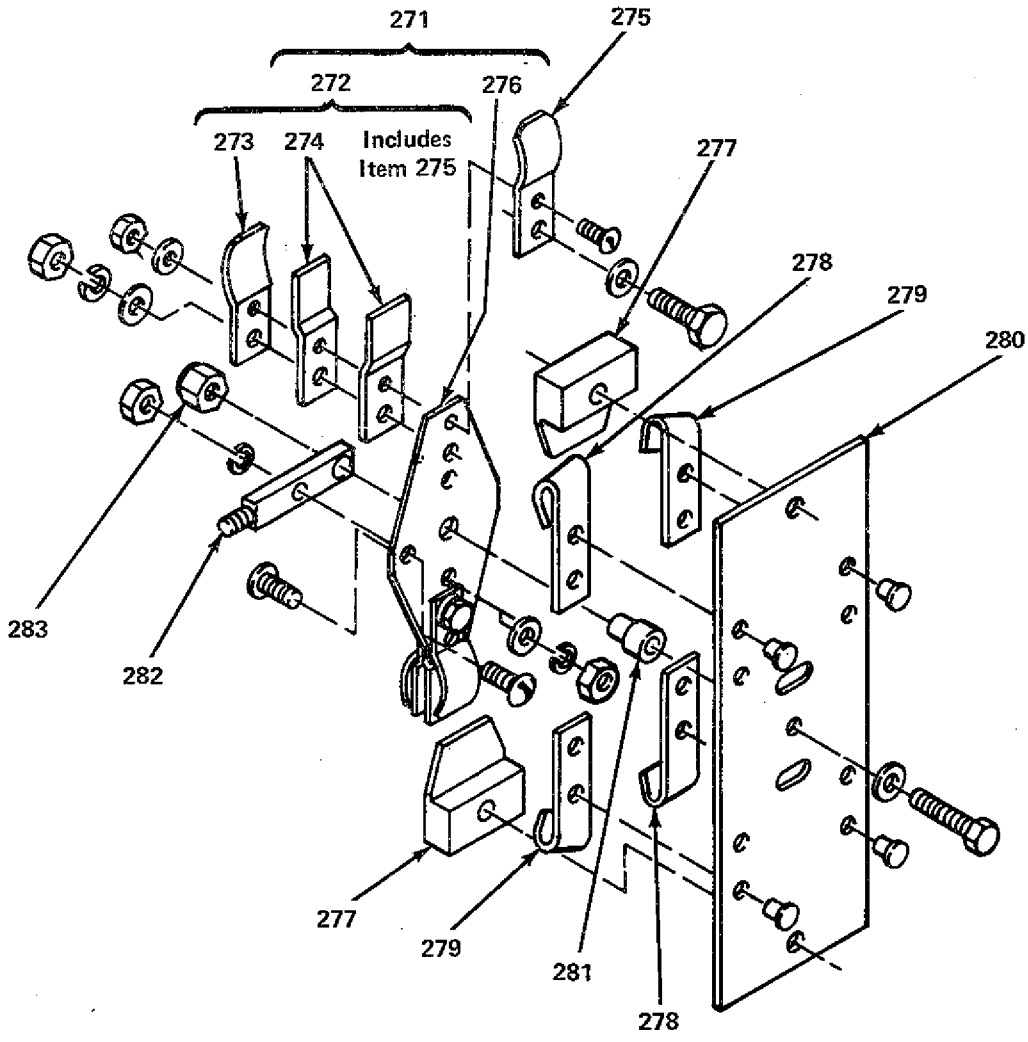

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Figure G1B — Contact Board Assembly, Selector AC/DC

BE SURE TO PROVIDE 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 10 Item 236)**	300 Amp Models Only
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

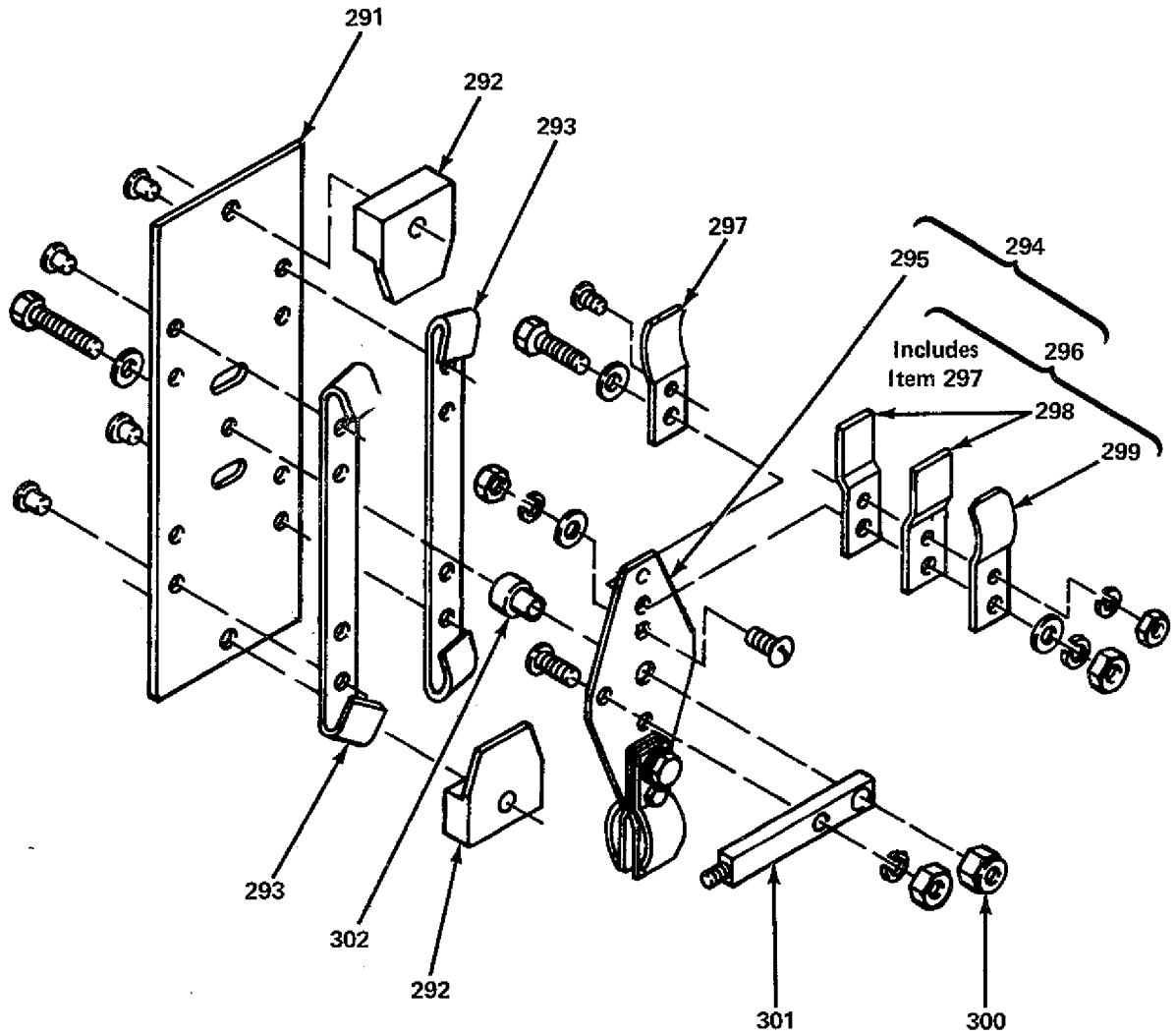

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Figure G1C — Contact Board Assembly, Switch - Polarity

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

Item No.	Factory Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
			004 265	059 082
Figure G1D		**Contact Board Assembly, Switch - Range (See Fig. G1 Page 10 Item 239)**		
311	103 634	MOUNTING BOARD, component - polarity switch	1	1
312	011 948	GUIDE, contact - movable switch	2	2
	021 193	GUIDE, contact		2
313	011 951	CONTACT, switch	2	
313	103 633	BUS BAR, shorting - switch		4
314	038 769	CONTACT BOARD ASSEMBLY, switch - polarity (consisting of)	1	2
315	103 632	. PLATE, toggle switch	1	1
316	011 645	. CONTACT ASSEMBLY, movable - switch (consisting of)	2	2
317	011 075	.. SPRING, pressure - contact switch	1	1
318	011 953	.. CONTACT, switch	2	2
319	011 074	.. SPRING, pressure - contact switch	1	1
320	604 318	NUT, steel - self - locking hex 1/4-20	1	1
321	010 805	HANDLE, switch - polarity	1	
321	039 257	HANDLE, switch		1
322	024 694	BEARING, polarity	1	2
323	011 950	CONTACT, switch	2	

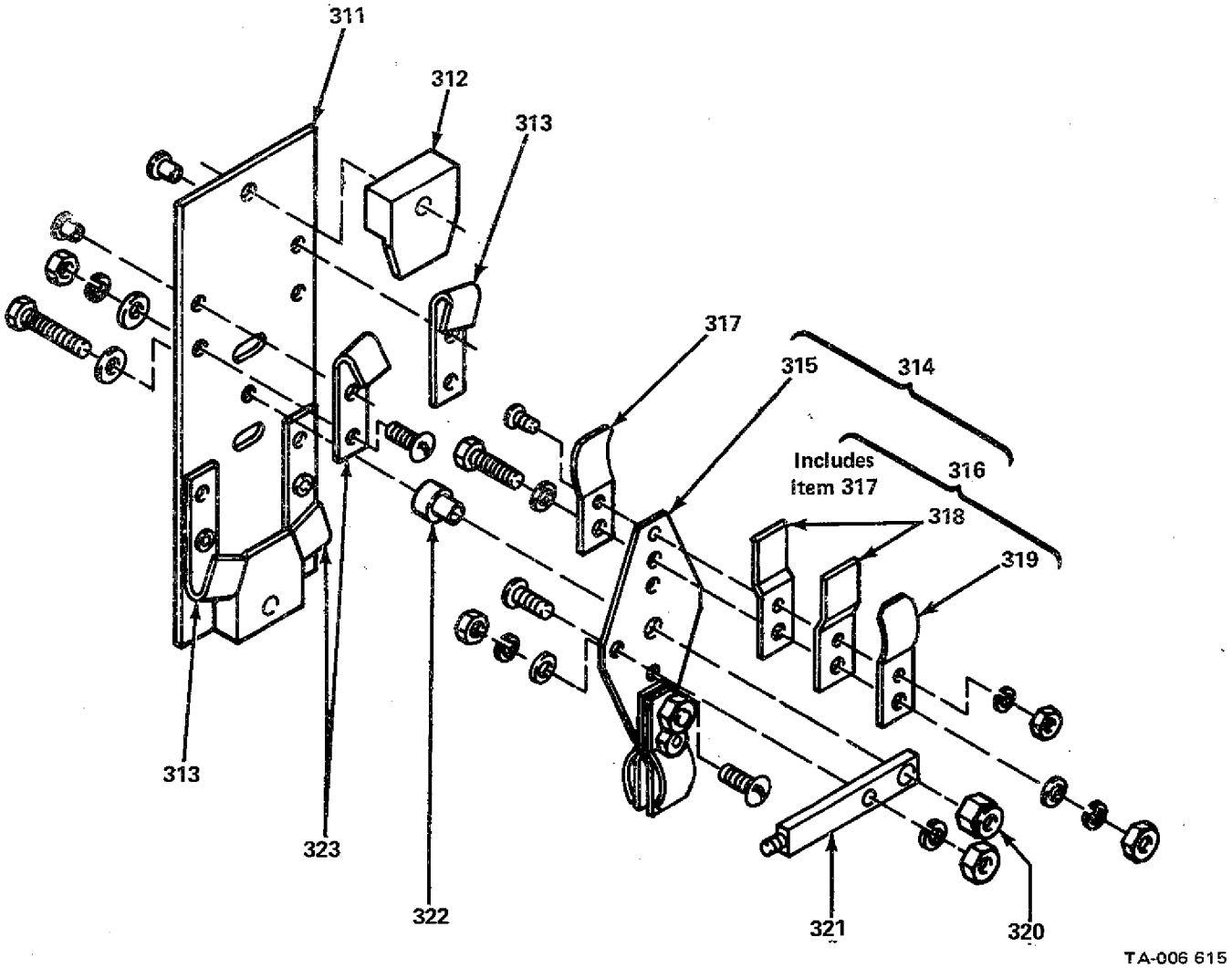

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Figure G1D — Contact Board Assembly, Switch - Range

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Spot Timer 041 170	Quantity Pre-flow Timer 041 172
Figure G2			**Spot Timer and Pre-flow Timer (See Fig. G Page 8 Items 179 & 180)**		
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	028 769	. POTENTIOMETER, carbon 1 turn 2 watt 750K 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	031 677	. CAPACITOR, tantalum 5 uf 35 volts dc	1	
	C205	031 651	. CAPACITOR, tantalum 68 uf 20 volts dc		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
	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
		048 104	HOUSING, terminal 7 position	1	1

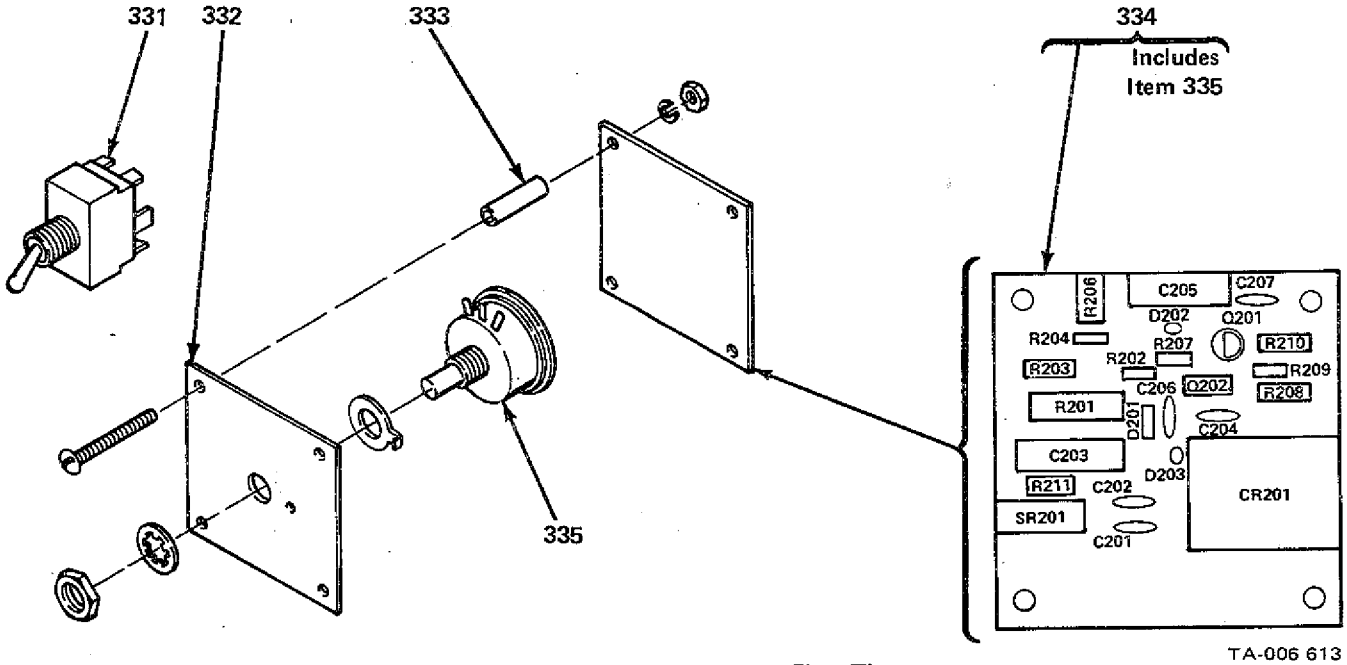

Figure G2 — Spot Timer and Pre-Flow Timer

BE SURE TO PROVIDE 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		045 240	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
	C410	052 141	. CAPACITOR, ceramic 33 pf 1000 volts	1
	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	000 886	. RESISTOR, carbon 0.25 watt 10 ohm	1
	R418	605 915	. RESISTOR, carbon 0.25 watt 2200 ohm	1
	R423	003 913	. POTENTIOMETER, cermet 15 turn 0.5 watt 500 ohm	1
346	R424	076 712	. RESISTOR, carbon 0.25 watt 220K ohm	1
347	R421	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
348	S400	011 609	SWITCH, toggle SPDT 10 amp 125 volts	1
349	C405	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1
	D404	026 202	DIODE, rectifier 1 amp 400 volts straight polarity	1

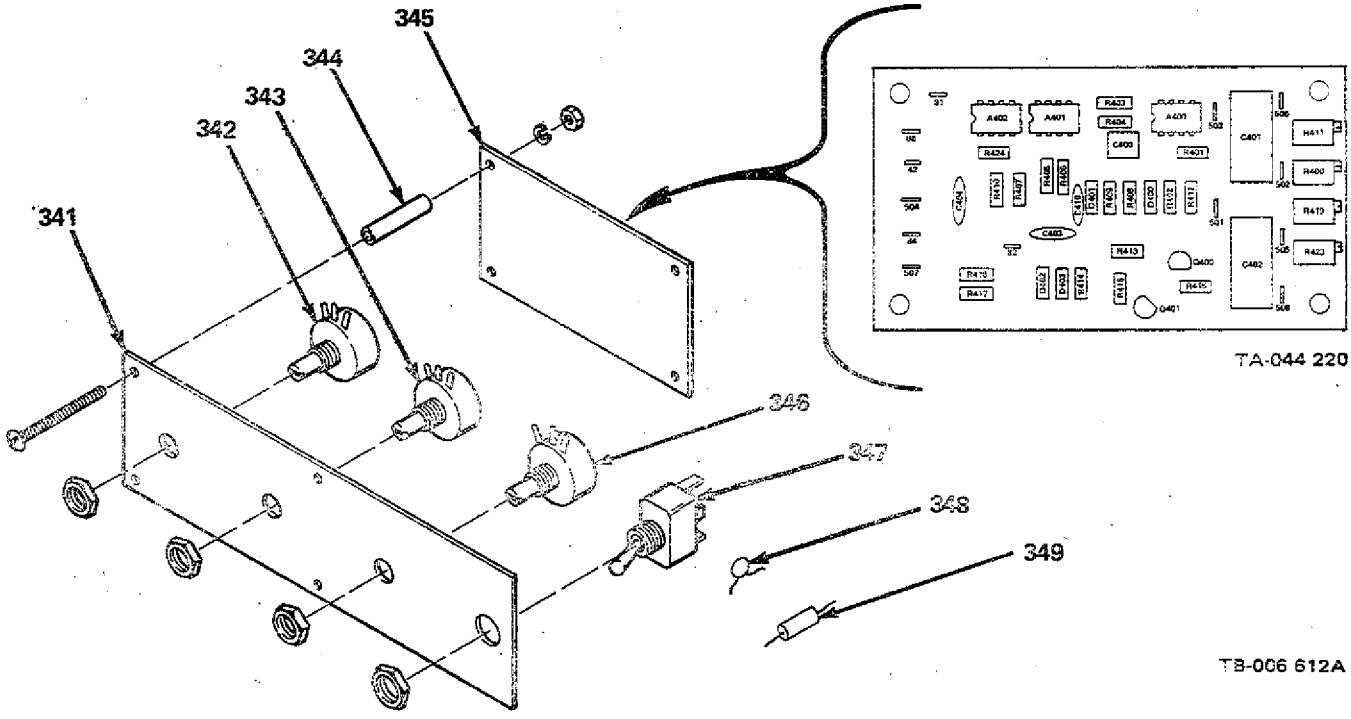

Figure G3 — Pulser Control

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

Dia. Mkgs.	Factory Part No.	Description	Quantity
Figure G4	**052 790**	**Circuit Card Assembly, Post - Flow & HF Timer (See Fig. G Page 8 Item 203)**	
A50	008 971	INTEGRATED CIRCUIT, operational amplifier	1
C50	031 610	CAPACITOR, electrolytic 40 uf 250 volts dc	1
C51,53	039 482	CAPACITOR, electrolytic 100 uf 35 volts dc	2
C52	031 677	CAPACITOR, tantalum 5.6 uf 35 volts dc	1
C54	039 481	CAPACITOR, electrolytic 3.3 uf 50 volts dc	1
C55	035 835	CAPACITOR, electrolytic 4.7 uf 35 volts	1
CR50,51	039 486	RELAY, enclosed 24 volts dc SPDT 25 amp	2
CR52	059 931	RELAY, enclosed 12 volts dc SPDT	1
D50-53, 55	026 202	DIODE, rectifier 1 amp 400 volts straight polarity	5
D54	037 203	DIODE, zener 6.8 volts 1 watt	1
Q50	000 088	TRANSISTOR, 800MA 40 volts NPN	1
Q51	037 201	TRANSISTOR, 200MA 40 volts PNP	1
R50	030 712	RESISTOR, carbon 1 watt 1000 ohm	1
R51	601 394	RESISTOR, carbon 2 watt 10K ohm	1
R52	074 121	RESISTOR, carbon 2 watt 3300 ohm	1
R53	039 335	RESISTOR, carbon film 0.25 watt 47K ohm	1
R54	000 342	POTENTIOMETER, cermet trimmer 1 turn 0.5 watt 5K ohm	1
R55	035 823	RESISTOR, carbon film 0.25 watt 100 ohm	1
R56	035 888	RESISTOR, carbon film 0.25 watt 2200 ohm	1
R57	039 108	RESISTOR, carbon film 0.25 watt 82K ohm	1
R59	035 896	RESISTOR, carbon film 0.25 watt 33K ohm	1
R60	030 997	RESISTOR, carbon 0.5 watt 2700 ohm	1
R61	035 827	RESISTOR, carbon film 0.25 watt 10K ohm	1
R62	035 884	RESISTOR, carbon film 0.25 watt 100K ohm	1
R63	035 886	RESISTOR, carbon film 0.25 watt 22K ohm	1
	039 348	CONNECTOR, edge PC card 17 pin 5 amp	1

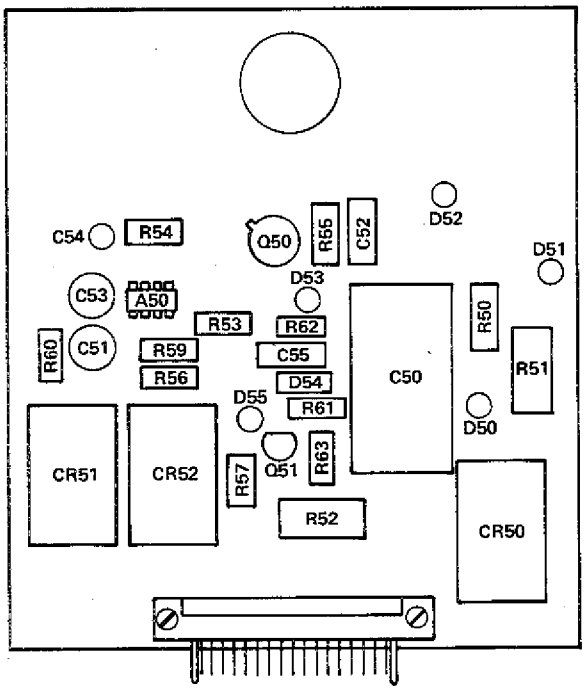

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Figure G4 — Circuit Card Assembly, Post-Flow & HF Timer

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

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model 300 Amp 000 176	Quantity Model 500 Amp 059 072
Figure G5			**Rectifier, SCR Main (See Fig. G Page 9 Item 209)**		
361		005 264	SUPPRESSOR, snubber (consisting of)	4	
361		059 079	SUPPRESSOR, snubber (consisting of)		4
362	R3-6	030 055	. RESISTOR, carbon 2 watt 10 ohm	1	1
363	C7-10	031 683	. CAPACITOR, paper oil 0.5 uf 200 volts dc	1	1
364		010 311	CLAMP, 3/4 dia. x 1/2 wide	4	
364		005 214	CLAMP, thyristor		4
365	SCR1-4	000 251	THYRISTOR, 250 amp 300 volts	4	
365	SCR1-4	059 512	THYRISTOR, SCR 850 amp 300 volts		4
366		025 248	INSULATOR, stand - off	6 -	
367	D1	037 957	DIODE, rectifier 275 amp 300 volts reverse polarity	1	
367	D1	023 178	DIODE, N matched reverse polarity		1

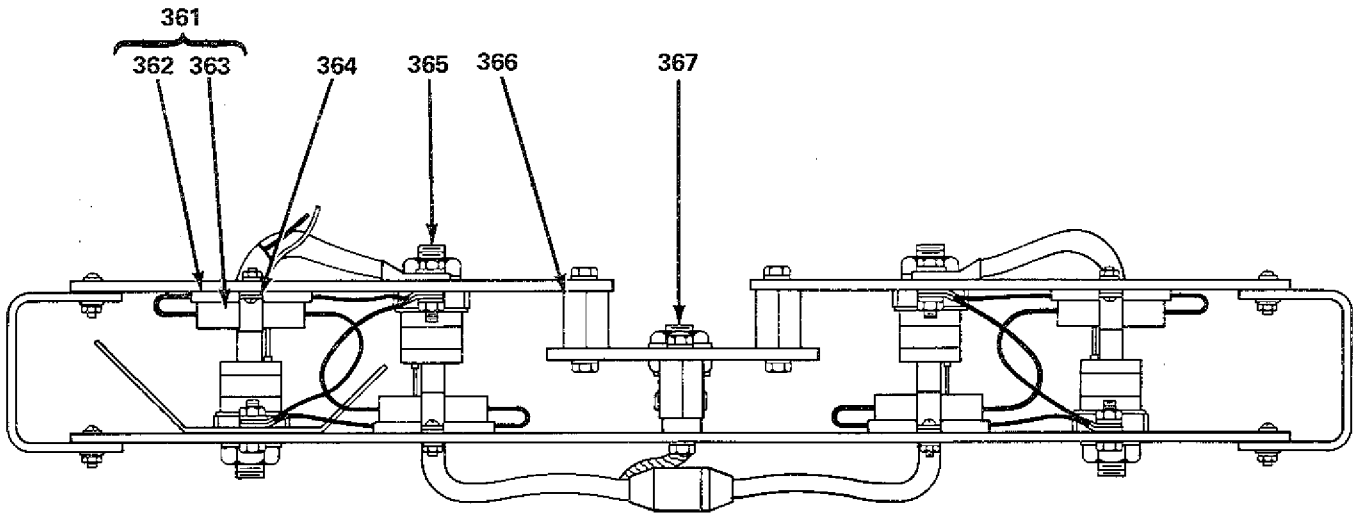

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Figure G5 — Rectifier, SCR Main

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