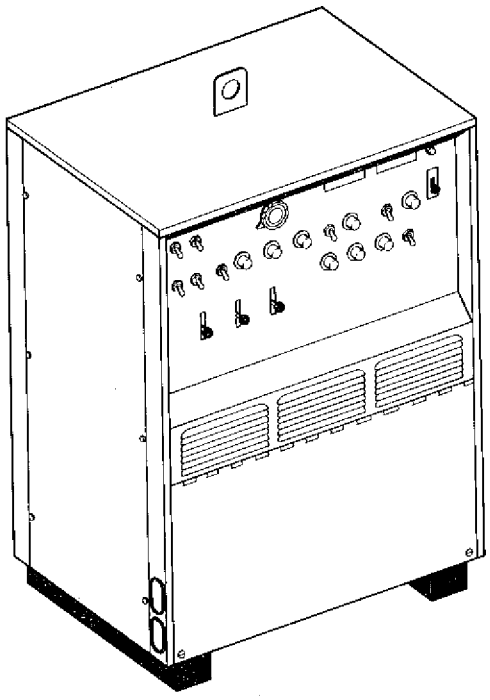
Sept. 1987 FORM: OM-350P

Effective With Serial No. JG064819

IMPORTANT: Read and understand the entire contents of this manual, with special emphasis on the safety material throughout the manual, before installing, operating, or maintaining this equipment. This unit and these instructions are for use only by persons trained and experienced in the safe operation of welding equipment. Do not allow untrained persons to install, operate, or maintain this unit. Contact your distributor if you do not fully understand these instructions.

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



OWNER'S MANUAL

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

NWSA CODE NO. 4579
PRINTED IN U.S.A.

LIMITED WARRANTY

EFFECTIVE: OCTOBER 1, 1986

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

LIMITED WARRANTY - Subject to the terms and conditions hereof, Miller Electric Mfg. Co., Appleton, Wisconsin warrants to its Distributor/Dealer that all new and unused Equipment furnished by Miller is free from defect in workmanship and material as of the time and place of delivery by Miller. No warranty is made by Miller with respect to engines, trade accessories or other items manufactured by others. Such engines, trade accessories and other items are sold subject to the warranties of their respective manufacturers, if any . All engines are warranted by their manufacturer for one year from date of original purchase, except Tecumseh engines which have a two year warranty.

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

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, robots, and components . 1 year
2. Load banks ..... 1 year
3. Original main power rectifiers ..... 3 years (labor - 1 year only)
4. All welding guns, feeder/guns and plasma torches ... 90 days
5. All other Millermatic Feeders ..... 1 year
6. Replacement or repair parts, exclusive of labor .. 60 days
7. Batteries ..... 6 months

provided that Miller is notified in writing within thirty (30) days of the date of such failure.

As a matter of general policy only, Miller may honor claims submitted by the original user within the foregoing periods.

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. MILLER's option of repair or replacement will be F.O.B., Factory, at Appleton, Wisconsin, or F.O.B., at a MILLER authorized service facility, therefore, no compensation for transportation costs of any kind will be allowed. Upon receipt of notice of apparent defect or failure, Miller shall instruct the claimant on the warranty claim procedures to be followed.

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

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

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 6 - MAINTENANCE

SECTION 7 - TROUBLESHOOTING

SECTION 8 - CERTIFICATION FOR HIGH FREQUENCY ARC WELDING EQUIPMENT

■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

Different arc welding processes, electrode alloys, and fluxes can produce different fumes, gases, and radiation levels. In addition to the information in this manual, be sure to consult flux and electrode manufacturers for specific technical data and precautionary measures concerning their material.

A. Burn Prevention

Wear protective clothing - gauntlet gloves designed for use in welding, 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

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 7 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, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, listed 11 in Standards index.

1. Pressure Regulators

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

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

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

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

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

2. Cylinders

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

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

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

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

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

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

Locate or secure cylinders so they cannot be knocked over.

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

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

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

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

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

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

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

3. Hose

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

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

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

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

Coil excess hose to prevent kinks and tangles.

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

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

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

4. Proper Connections

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

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

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

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

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

5. Pressurizing Steps:

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

Stand to side of regulator while opening cylinder valve.

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

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

Check for leaks on first pressurization and regularly there-after. 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.

*Trademark of Proctor & Gamble.

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 arc welding equipment is grounded according to the National Electrical Code, and the work is grounded according to ANSI Z49.1 "Safety In Welding And Cutting," a voltage may exist between the electrode and any conducting object. Examples of conducting objects include, but are not limited to, buildings, electrical tools, work benches, welding power source cases, workpieces, etc. **Never touch the electrode and any metal object unless the welding power source is off.**

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 requirements 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.

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

   a. Equipment with output on/off control (contactor)

      Welding power sources for use with the gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and similar processes normally are equipped with devices that permit on-off control of the welding power output. When so equipped the electrode wire becomes electrically HOT when the power source switch is ON and the welding gun switch is closed. Never touch the electrode wire or any conducting object in contact with the electrode circuit unless the welding power source is off.

   b. Equipment without output on/off control (no contactor)

      Welding power sources used with shielded metal arc welding (SMAW) and similar processes may not be equipped with welding power output on-off control devices. With such equipment the electrode is electrically HOT when the power switch is turned ON. Never touch the electrode unless the welding power source is off.

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.

F. Protection For Wearers Of Electronic Life Support Devices (Pacemakers)

Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (pacemaker) should consult with their doctor before going near arc welding, gouging, or spot welding operations.

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, 550 Le Jeune Rd, P.O. Box 351040, Miami, FL 33135.

2. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

3. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the U.S. Government Printing Office, Washington, D.C. 20402.

4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES obtainable from the American Welding Society, 550 Le Jeune Rd. P.O. Box 351040, Miami FL 33135.

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

9. NFPA Standard 70-1978, NATIONAL ELECTRICAL CODE obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

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

12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.

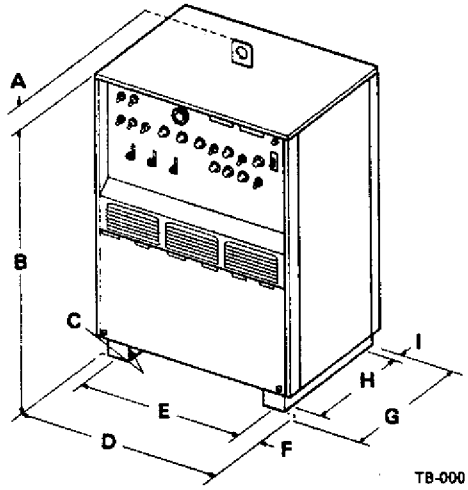
14. American Welding Society Standard AWSF4.1 "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", obtainable from the American Welding Society, 550 Le Jeune Rd. P.O. Box 351040, Miami, FL 33135.

15. ANSI Standard Z88.2 "Practice for Respiratory Protection" obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Model	Rated Welding Current Amperes	Welding Current Ranges Amperes	Max. Open-Circuit Voltage	Amperes Input At Rated Load Output** 60 Hz. Single-Phase 200V	230V	460V	575V	kva	kw	Weight Net	Ship
300 Without PFC*	300 @ 32 Volts 60% Duty Cycle	Low 5-75 2-37† High 15-375	80	138	120	60	48	27.6	12.8	720 lbs. (327 kg.)	735 lbs. (333 kg.)
300 With PFC*				110	96	48	38.5	22			
500 Without PFC*	500 @ 40 Volts 60% Duty Cycle	25-625	80	235	204	102	81.5	47	26	887 lbs. (402 kg.)	902 lbs. (409 kg.)
500 With PFC*				206	180	90	72	41.4			

*Power Factor Correction.
**Using ac current @ balance SMAW process.
†Optional low range.
Standard units are reconnectable for 200,230,460 volts. Other voltages are available.
NEMA RATING The above electrical specifications conform to Nema Rating EW1-1971 Class I (60) and comply with ANSI Standard C87.1-1971.

Figure 2 - 1. Specifications



	Inches	Millimeters
A	2-3/4	70
B	44-1/4	1124
C	9/16	14
D	31-1/4	794
E	25-1/2	648
F	2-13/16	71
G	22-3/4	578
H	19	483
I	1-7/8	48

Figure 2-2. Dimensional Drawing

2 - 1. GENERAL INFORMATION AND SAFETY

A. General

Information presented in this manual and on various labels, tags, and plates provided on this unit pertains to equipment design, installation, operation, maintenance and troubleshooting which should be read, understood and followed for the safe and effective use of this equipment.

B. Safety

The installation, operation, maintenance, and troubleshooting of arc welding equipment requires practices and procedures which ensure personal safety and the safety of others. Therefore, this equipment is to be installed, operated and maintained only by qualified persons in accordance with this manual and all applicable codes such as, but not limited to, those listed at the end of Section 1 - Safety Rules For Operation Of Arc Welding Power Source.

Safety instructions specifically pertaining to this unit appear throughout this manual highlighted by the signal words **WARNING** and **CAUTION** which identify different levels of hazard.

WARNING statements include installation, operating, and maintenance procedures or practices which if not carefully followed could result in serious personal injury or loss of life.

CAUTION statements include installation, operating and maintenance procedures or practices which if not carefully followed could result in minor personal injury or damage to this equipment.

A third signal word, **IMPORTANT**, highlights instructions which need special emphasis to obtain the most efficient operation 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 will be furnished by the manufacturer on request if occasion to file claim arises.

When requesting information concerning this equipment, it is essential that Model Description and Serial Number of the equipment be supplied.

2 - 3. DESCRIPTION - This unit is a single-phase welding power source that produces ac and dc weld output which can be used for Gas Tungsten-Arc or Shielded Metal-Arc Welding.

SECTION 3 - INSTALLATION

3 - 1. LOCATION

IMPORTANT: *Read entire Section 8 regarding high-frequency equipment location and installation requirements.*

CAUTION: IMPROPER LIFTING OF EQUIPMENT can result in personal injury and equipment damage.

- *Use equipment of adequate capacity to lift the unit.*
- *If using lift forks to handle this unit, be sure the lift forks are long enough to extend out of the opposite side of the base.*

Using lift forks too short will expose internal components to damage should the tips of the lift forks penetrate the bottom of the unit.

RESTRICTED AIR FLOW causes overheating and possible damage to internal parts.

- *Maintain at least 18 inches (457 mm) of unrestricted space on all sides of unit and keep underside free of obstructions.*
- *Do not place any filtering device over the intake air passages of this welding power source.*

Warranty is void if any type of filtering device is used.

This welding power source has a lifting device for moving the unit and holes in the base for mounting purposes. Figure 2-2 gives unit dimensions.

The location should allow room to remove cover and panels for maintenance and repair.

The service life and efficiency of this unit are reduced when the unit is subjected to high levels of dust, dirt, moisture, corrosive vapors, and extreme heat.

3 - 2. 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.

A. Welding Cables

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

1. Keep cables as short as possible and place cables close together. Excessive cable length adds resistance which may reduce output or cause overloading of the unit. Excessive cable length also increases high-frequency radiation (see Section 8).
2. Select adequate size welding cable for the anticipated maximum weld current. Use total length of welding cable in the circuit to determine cable size. For example: If the electrode holder cable is 75 feet (23 m) long and the work cable is 25 feet (8 m) long, select the size cable recommended in Table 3-1 for 100 ft (31 m). The maximum recommended cable length when using high frequency is 50 feet (15 m).
3. Do not use damaged or frayed cables.

Table 3-1. 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.

4. Install electrode holder to cable following manufacturer's instructions. An insulated electrode holder must be used to ensure operator safety.
5. Install lugs corresponding in size and capacity to the weld cables to remaining end of electrode holder cable and to both ends of work cable.
6. Install work clamp to cable.

B. Installation

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut unit down and be sure it cannot be accidentally energized before making weld output connections.*

1. Locate weld output terminals on the lower front panel.

2. Connect electrode and work cables to the ELECTRODE and WORK weld output terminals. Ensure that connections are clean and tight.

3 - 3. REMOTE CURRENT CONTROL CONNECTION (Figure 4-1) - The CURRENT control receptacle provides a connection point between an optional remote control and the welding power source current control circuitry.

To connect the remote control, insert plug into the receptacle and rotate collar clockwise.

3 - 4. REMOTE CONTACTOR CONTROL SWITCH ASSEMBLY - 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 3-1 for location of pins.

IMPORTANT: *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).*

3 - 5. REMOTE CONTACTOR CONTROL CONNECTION (Figure 4-1) - The CONTACTOR control receptacle provides a connection point between an optional remote control and the welding power source contactor control circuitry.

To connect the remote control, insert plug into the receptacle and rotate collar clockwise.

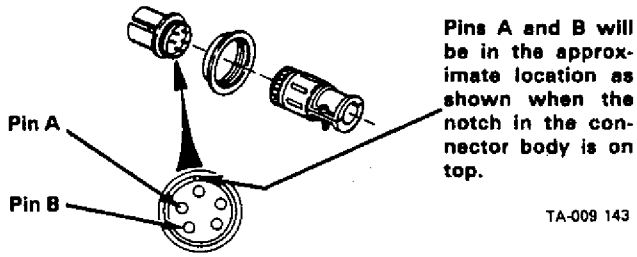


Figure 3-1. Contactor Control Switch Connections

3 - 6. WATER CONNECTIONS (Figure 4-1)

CAUTION: OVERHEATING Gas Tungsten-Arc Welding torch can damage torch.

- *If using a water cooled torch and recirculating coolant system make connections from the coolant system to the torch hoses. Do not use water connections on the welding power source.*

The WATER IN and WATER OUT fittings have 5/8-18, left hand threads. Attach the hose from the water supply to the WATER IN fitting. Attach the water hose from the torch to the WATER OUT fitting. Connect and route a hose from the torch output hose to a proper drain.

3 - 7. SHIELDING GAS CONNECTIONS (Figure 4-1) - The GAS IN and GAS OUT fittings have 5/8-18 right hand threads. Attach the hose from the shielding gas supply to the GAS IN fitting. Attach the shielding gas hose from the torch to the GAS OUT fitting.

3 - 8. ELECTRICAL INPUT CONNECTIONS

IMPORTANT: *Read and comply with entire Section 8 regarding high-frequency equipment location and installation requirements before making electrical input connections.*

A. Electrical Input Requirements

This welding power source is designed to be operated from single-phase, 60 Hertz, ac input power which has a voltage rating that corresponds with one of the electrical input voltages shown on the 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. Matching The Welding Power Source To The Available Input Voltage

This unit is equipped with input voltage jumper links on the primary terminal board which allow operation from different line voltages. This unit is shipped with the jumper links positioned for the highest voltage stated on the nameplate. If the unit is to be operated from a lower input voltage, open the side panel and reposition the jumper links to correspond to the available line voltage (see input voltage label inside right side panel).

CAUTION: INCORRECT INPUT VOLTAGE JUMPER LINK PLACEMENT can damage unit.

- *Position jumper links as shown on the input voltage label located inside right side panel.*

IMPORTANT: *Store unused jumper links across linked terminals.*

C. Input Conductor Connections

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *It is recommended that a fusible 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 internally inspect or service the unit.

- *Employ "lockout/tagging procedures" on input line before making input connections to the welding power source.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

- *Connect input conductors to the welding power source before connecting to three-phase input power.*

Table 3-2 provides guildelines for selecting the proper size input conductors and line fuses. The input conductors should be covered with an insulating material that complies with national, state, and local electrical codes.

Table 3-2. Input Conductor And Fuse Size

Model	PFC**	Input Conductor Size - AWG*				Fuse Size In Amperes			
		200V	230V	460V	575V	200V	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.

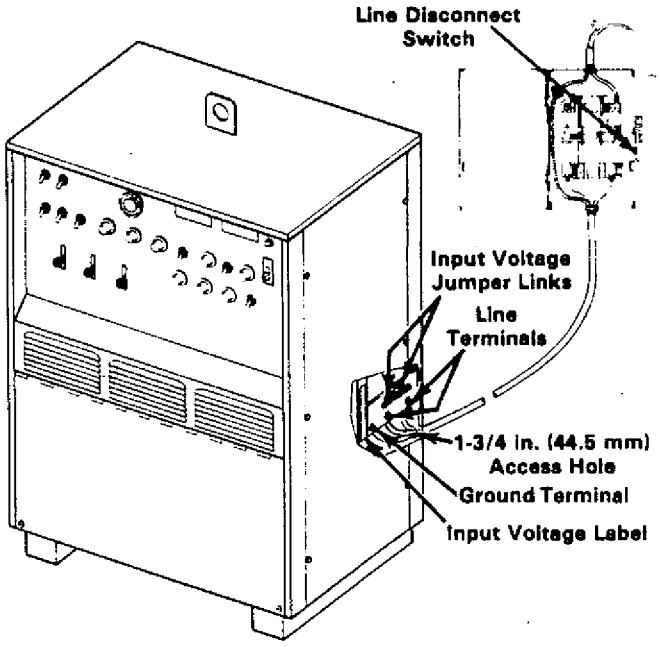


Figure 3-2. Input Conductor Connections

Install terminal lugs of adequate amperage capacity (see Table 3-2) to the input and ground conductors. Open the side panel and insert the conductors through the access hole in the rear panel (see Figure 3-2). This hole will accept standard conduit fittings.

WARNING: ELECTRIC SHOCK can kill.

- *Do not connect an input conductor to the ground terminal in the unit.*
- *Do not connect the ground conductor to an input line terminal.*

Incorrect input connections can result in an electrically energized welding power source chassis. The ground terminal is connected to the welding power source chassis and is for grounding purposes only.

Connect the input conductors to the line terminals on the primary terminal board and connect the ground conductor to the ground terminal. (Refer to the input voltage label for identification of these terminals.) Close and replace side panel.

Connect the remaining end of the ground conductor to a proper ground. Use a grounding method that is acceptable to the local electrical inspection authority.

SECTION 4 - OPERATOR CONTROLS

4 - 1. POWER SWITCH (Figure 4-1) - Placing the POWER switch in the ON position energizes the welding power source, making the unit operational. Placing the POWER switch in the OFF position shuts the unit down.

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

A. Range Switch (300 Ampere Models Only)

CAUTION: ARCING can damage switch contacts.

- *Do not change the position of the Range Selector switch while welding or under load.*

Arcing causes the contacts to become pitted and eventually inoperative.

The RANGE Selector switch allows the operator to select a coarse amperage range for ac or dc outputs. The amperage ranges are displayed on the nameplate. If the desired amperage is in the overlapping area of the two ranges, use the lower range for better fine amperage control.

B. Current Control

The CURRENT CONTROL provides the means of selecting the amperage desired within the range being used.

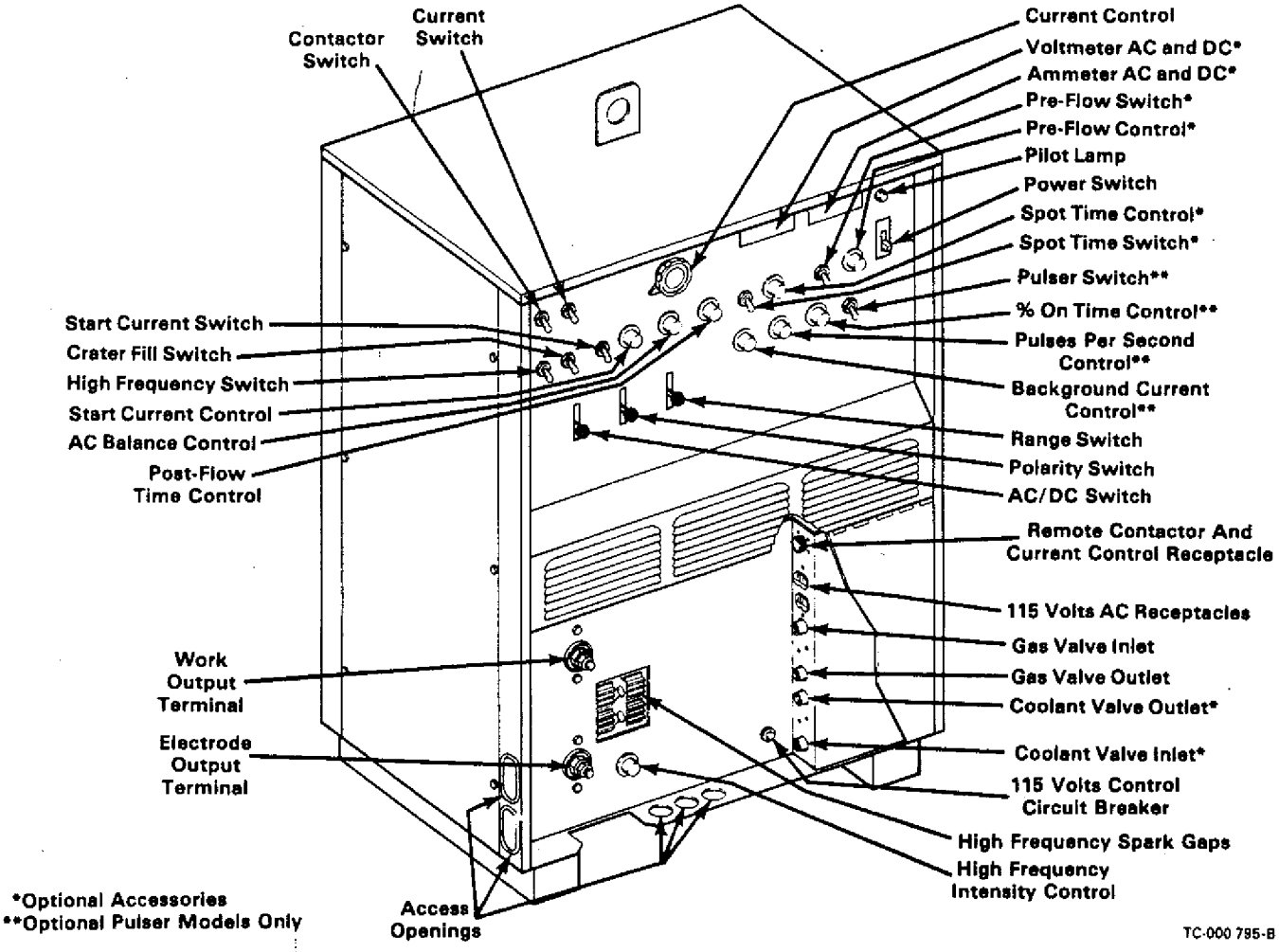


Figure 4-1. Front Panel View (300 Ampere Model Illustrated)

The scales surrounding the CURRENT CONTROL are calibrated as high or low amperage, depending on the position of the RANGE switch. Ensure that the scale being read corresponds to the position of the RANGE switch. The CURRENT CONTROL of the 500 ampere model will adjust the output within a range of 25 to 625 amperes. The scale surrounding the 500 ampere model is an actual current value.

C. Current Switch

If a remote current control is to be used, make connections from the remote current control to the CONTACTOR AND CURRENT CONTROL receptacle as instructed in Section 3-4.

When remote control of the current is to be used, place the CURRENT switch in the REMOTE position. If a Remote Current Control is not to be used, place the CURRENT switch in the PANEL position. When in the PANEL position, only the CURRENT CONTROL on the front panel will control the amperage.

D. Polarity Switch

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

E. AC/DC Switch

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

CAUTION: ARCING can damage switch contacts.

- *Do not change switch position while welding or under load.*

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 in increments from 1 to 10 but is not meant to be an amperage or voltage reading. Read the meters whenever it is necessary to know the amperage and voltage output.

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

WARNING: ELECTRIC SHOCK can kill.

- *Keep electrode holder and work clamp electrically isolated when not welding.*
- *Do not touch electrode holder and work clamp at the same time.*

If the CONTACTOR switch is in the STANDARD position, open-circuit voltage is present at the weld output terminals when the POWER switch is ON. Open-circuit voltage is present until the POWER switch is placed in the OFF position.

If a Remote Contactor Control is used, place the CONTACTOR switch in the REMOTE position.

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

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

WARNING: USING HIGH FREQUENCY WITH THE SHIELDED METAL-ARC WELDING PROCESS can result in serious personal injury.

- *Place the HIGH FREQUENCY switch in the OFF position before using Shielded Metal-Arc Welding process.*

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 operator.

The HIGH FREQUENCY switch allows the operator to choose whether high frequency will be used or not and for how long.

A. START

High frequency is present from the time the contactor is closed until an arc is established. Once an arc is established, high frequency is no longer present. High frequency is present any time the arc is broken to aid in restarting the arc.

B. OFF

High frequency is not present. The HIGH FREQUENCY switch must be in the OFF position while doing Shielded Metal-Arc Welding.

C. CONTINUOUS

High frequency is present whenever the contactor is closed.

4 - 6. POST FLOW TIMER (Figure 4-1)

IMPORTANT: *The POST-FLOW TIME control and gas and water valves will not work unless the CONTACTOR switch is in the REMOTE position and a remote control is connected to the CONTACTOR control receptacle.*

The POST FLOW TIME allows the operator to choose the length of time water and shielding gas will flow after the arc is extinguished. The scale surrounding the control is calibrated in seconds. Rotating the control clockwise increases post flow time.

The post flow timer begins to time out when the arc is extinguished and the contactor opens. When the post flow is finished, the water and shielding gas valves close thereby shutting off water and shielding gas flow to the torch.

4 - 7. CRATER FILL SWITCH (Figure 4-1) - The crater-fill circuitry provides a gradual taper of the weld current from the setting of the CURRENT CONTROL to a lower level of weld current. This gradual taper in the weld current provides better weld-puddle solidification at the end of the weld when using the Gas Tungsten-Arc Welding process.

Place the CRATER FILL switch in the IN position to activate the crater-fill circuitry. Place the CRATER FILL switch in the OUT position to disable the crater-fill circuitry.

IMPORTANT: *When using the crater-fill mode, ensure that the POST-FLOW TIME control is adjusted to 8 to 10 seconds. 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 taper. The CRATER-FILL switch should be placed in the OUT position when employing the Shielded Metal-Arc Welding process.*

4 - 8. AC BALANCE CONTROL (Figures 4-1 & 4-2) - The AC BALANCE control alters the 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 wave shape provides penetration and cleaning action. The AC BALANCE control should be in the BALANCED position when employing the dc Gas Tungsten-Arc Welding process.

The scale surrounding the AC BALANCE control is calibrated in increments from 1 to 10. The scale is not an amperage or voltage reading. Read the amperage and voltage meters whenever it is necessary to know the amperage and voltage output.

IMPORTANT: *For the AC BALANCE control to work properly, the electrode and work cables must be connected to the proper terminals on the welding power source (electrode cable to the ELECTRODE terminal and work cable to the WORK terminal).*

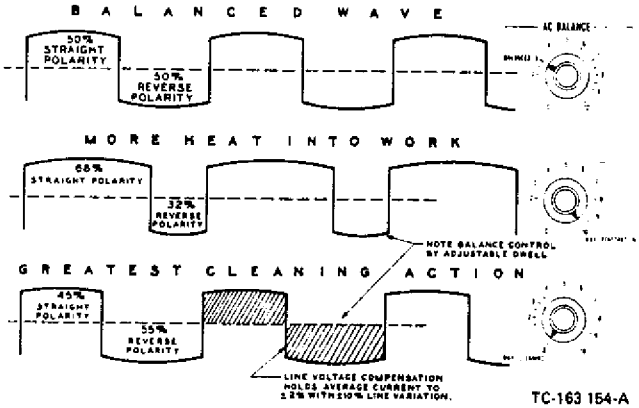


Figure 4-2. Square Wave Function Of The AC Balance Control

4 - 9. PILOT LAMP - The PILOT LAMP will illuminate when the welding power source is energized.

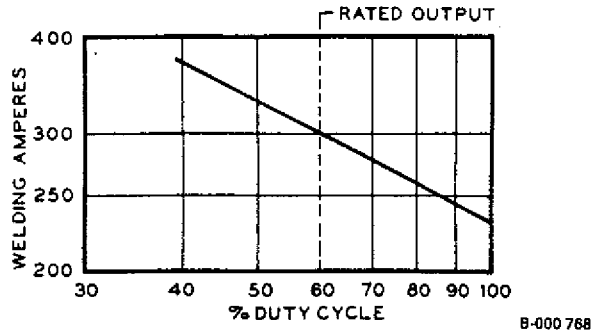
4-10. HIGH-FREQUENCY INTENSITY CONTROL (Figure 4-1) - The HIGH-FREQUENCY INTENSITY control governs the strength of the high frequency. Rotating the control in a clockwise direction increases the intensity of the high frequency.

IMPORTANT: *As the high-frequency intensity is increased, the possibility of interfering with local electronic apparatus, especially communication equipment, also increases. Set the HIGH-FREQUENCY INTENSITY control as low as practical to avoid such interference.*

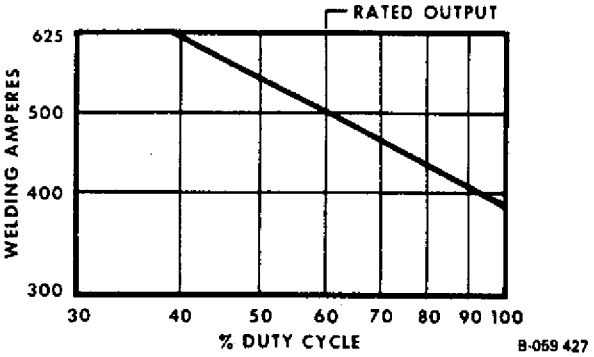
4-11. DUTY CYCLE (Figure 4-3) - The duty cycle of a welding power source is the percentage of a ten minute period that a welding power source can safely be operated at a given output. This welding power source is rated at 60 percent duty cycle. This means that the welding power source can be safely operated at rated load for six minutes out of every ten. If the welding amperes are increased beyond rated output, the duty cycle will decrease. Figure 4-3 enables the operator to determine the safe output of the welding power source at various duty cycles.

CAUTION: EXCEEDING DUTY CYCLE RATINGS will damage the welding power source.

- *Do not exceed duty cycles indicated on duty cycle chart.*



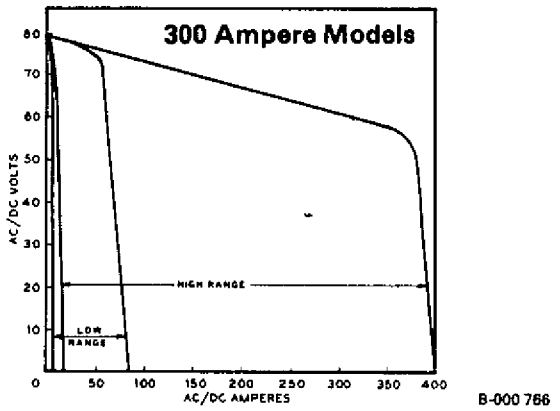
300 Ampere Models



500 Ampere Models

Figure 4-3. Duty Cycle Charts

4-12. VOLT-AMPERE CURVES (Figure 4-4) - The volt-ampere curves show the voltage and amperage output capabilities of the welding power source at min. and max. of each coarse range. Voltages and amperage adjustment within each range is provided by the CURRENT CONTROL.



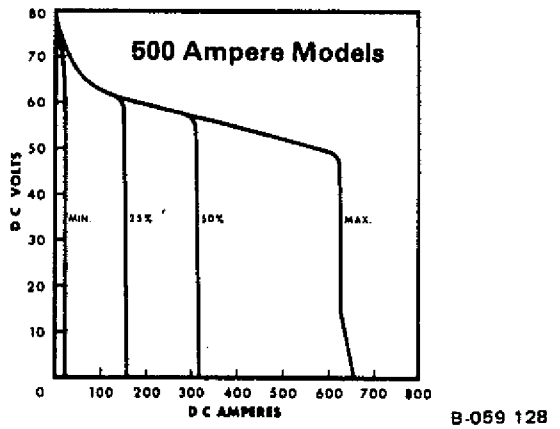


Figure 4-4. Volt-Ampere Curves

With the use of the volt-ampere curves it is possible to determine the load voltage at any particular weld current.

4-13. METERS (Optional) - This welding power source can be equipped with meters. The meters are for monitoring the welding operation and serve as indication of the welding process. These meters are internally connected to the welding power source output terminals. The voltmeter will indicate the voltage at the weld output terminals, not the actual voltage at the welding arc (due to cable resistance). The ammeter will indicate the current output of the welding power source.

4-14. 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.

The BACKGROUND CURRENT control, PULSES PER SECOND control, % ON TIME control, and the PULSER switch operate independently 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.

4-15. % 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.

4-16. 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.

4-17. 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 read as an amperage or voltage value. Read the meters whenever it is necessary to know the amperage and voltage output.

4-18. 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 than 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.

IMPORTANT: *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 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.*

4-19. 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

WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury; IMPROPER AIR FLOW AND EXPOSURE TO ENVIRONMENT can damage internal parts.

- *Keep all covers and panels in place while operating.*

Warranty is void if the welding power source is operated with any portion of the outer enclosure removed.

ARC RAYS, SPARKS, AND HOT SURFACES can burn eyes and skin; NOISE can damage hearing.

- *Wear correct eye, ear, and body protection.*

FUMES AND GASES can seriously harm your health.

- *Use enough ventilation to keep fumes and gases from the breathing zone.*

See Section 1 - Safety Rules For Operation Of Arc Welding Power Source for basic welding safety information.

5 - 1. GAS TUNGSTEN-ARC WELDING

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

2. Place the CONTACTOR switch in the REMOTE position.

3. If a Remote Current Control is not to be used, place the CURRENT switch in the PANEL position. If a Remote Current Control is to be used, place the CURRENT switch in the REMOTE position.

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

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

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

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

   a. BALANCED for dc welding.

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

8. Rotate the POST-FLOW TIME control to the desired coolant-gas post-flow time. If the welding power source is equipped with a PRE-FLOW TIME control (optional) set the PRE-FLOW TIME controls as instructed in Section 4-18. 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 4-19 and Section 5-4.

15. Place the POWER switch in the ON position.

16. Begin welding.

5 - 2. SHIELDED METAL-ARC WELDING

WARNING: USING HIGH FREQUENCY WITH THE SHIELDED METAL-ARC WELDING PROCESS can result in serious personal injury.

- *Place the HIGH FREQUENCY switch in the OFF position before using Shielded Metal-Arc Welding process.*

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 operator.

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.

14. Begin 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.

19. Begin 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.

16. Begin welding.

5 - 5. SHUTTING DOWN

1. Stop 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.

WARNING: HIGH CONCENTRATION OF SHIELDING GASES can harm health or kill.

- *Shut off gas supply when not in use.*

SECTION 6 - MAINTENANCE

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Disconnect input power and employ "lockout/tagging procedures" before internally inspecting or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

IMPORTANT: *Periodically inspect the labels on the unit for legibility. All precautionary labels must be maintained in a clearly readable state and replaced when necessary. See Parts List for part number of precautionary labels.*

6 - 1. FAN MOTOR - This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor is manufactured with lifetime sealed bearings and requires no maintenance.

6 - 2. INTERNAL CLEANING - Occasional blowing out or vacuuming of the dust and dirt from around the internal components is recommended. This should be done periodically depending on the location of the unit and the amount of dust and dirt in the atmosphere. The welding power source outer enclosure should be removed and a clean, dry airstream or vacuum suction should be used for this cleaning operation.

6 - 3. SPARK GAPS (Figures 4-1 and 6-1) - It is necessary to readjust the spark gaps every three to four months or when intermittent operation occurs. Normal spark gap setting is 0.008 in. (0.208 mm).

High-frequency output varies with the spark gap setting. When a great amount of high frequency is necessary, the spark gaps can be adjusted to 0.010 in. to 0.013 in. (0.254 to 0.330 mm). This, however, increases high-frequency radiation which increases interference with communications equipment. It is suggested that a minimum spark gap setting of 0.004 to 0.008 in. (0.102 to 0.203 mm) be used.

IMPORTANT: *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.*

To adjust the spark gaps, proceed as follows:

1. Loosen screws A on both sides.

2. Place feeler gauge of proper thickness between points C.

3. Apply slight pressure against points B so feeler gauge is held firmly in gap.

4. Tighten screws A.

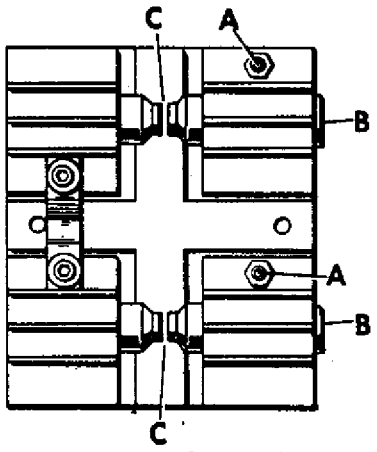


Figure 6-1. Spark Gap Adjustment

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 provids 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.

6 - 6. WELD CABLES - Periodically inspect cables for breaks in insulation and ensure that all connections are clean and tight. Repair or replace cables as necessary. Clean and tighten connections periodically.

SECTION 7 - TROUBLESHOOTING

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut unit down and disconnect from line power employing "lockout/tagging procedures" before internally inspecing or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

MOVING PARTS can cause serious injury.

- *Keep clear of moving parts.*

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

Troubleshooting of internal parts to be performed only by qualified persons.

7 - 1. GENERAL - It is assumed that the unit was properly installed according to Section 3 of this manual, the operator is familiar with the function of controls, the welding power source was working properly, and that the trouble is not related to the welding process.

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

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 3-8 for proper input connections.
	Input voltage jumper links not in proper configuration.	Refer to Section 3-8B 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 3-8 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 S4 in the STANDARD position. If remote contactor control is desired, retain 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 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 3-8 for proper electrical input and weld output connections.
	Input voltage jumper links not in proper configuration.	Refer to Section 3-8B 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 S11 in the PANEL position. If remote current control is desired, retain S11 in the REMOTE position, and make remote current control connections as instructed in Section 3-3.
Insufficiency or absence 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.	Fan Motor (FM).	Check and replace FM.
	Fan motor (FM) leads open or shorted.	Check for and correct open or shorted FM leads.
	Fan blade obstructions.	Check for and remove fan blade obstructions.

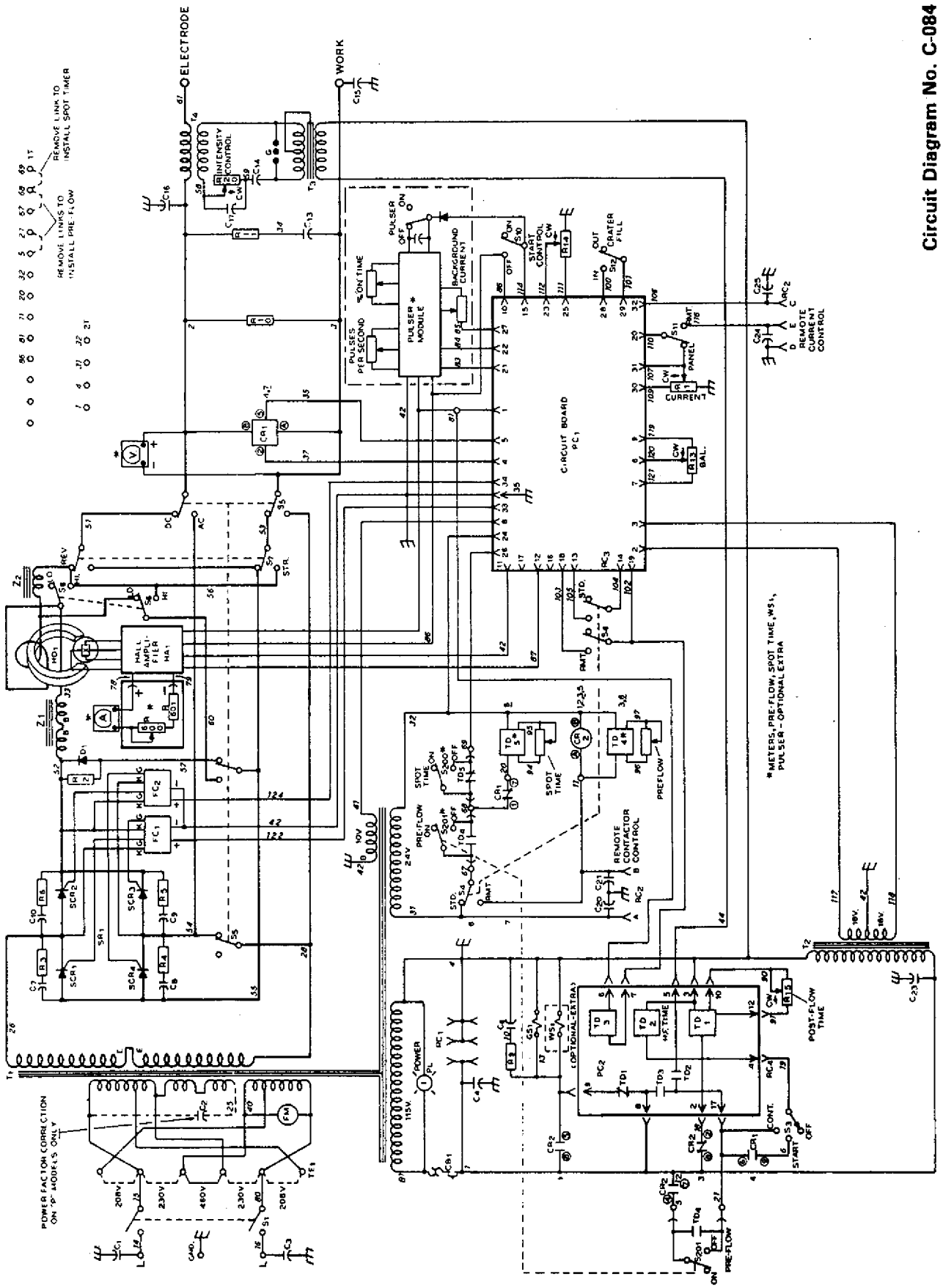


Figure 7 - 1. Circuit Diagram For 300 Ampere Models

Circuit Diagram No. C-084 602-A

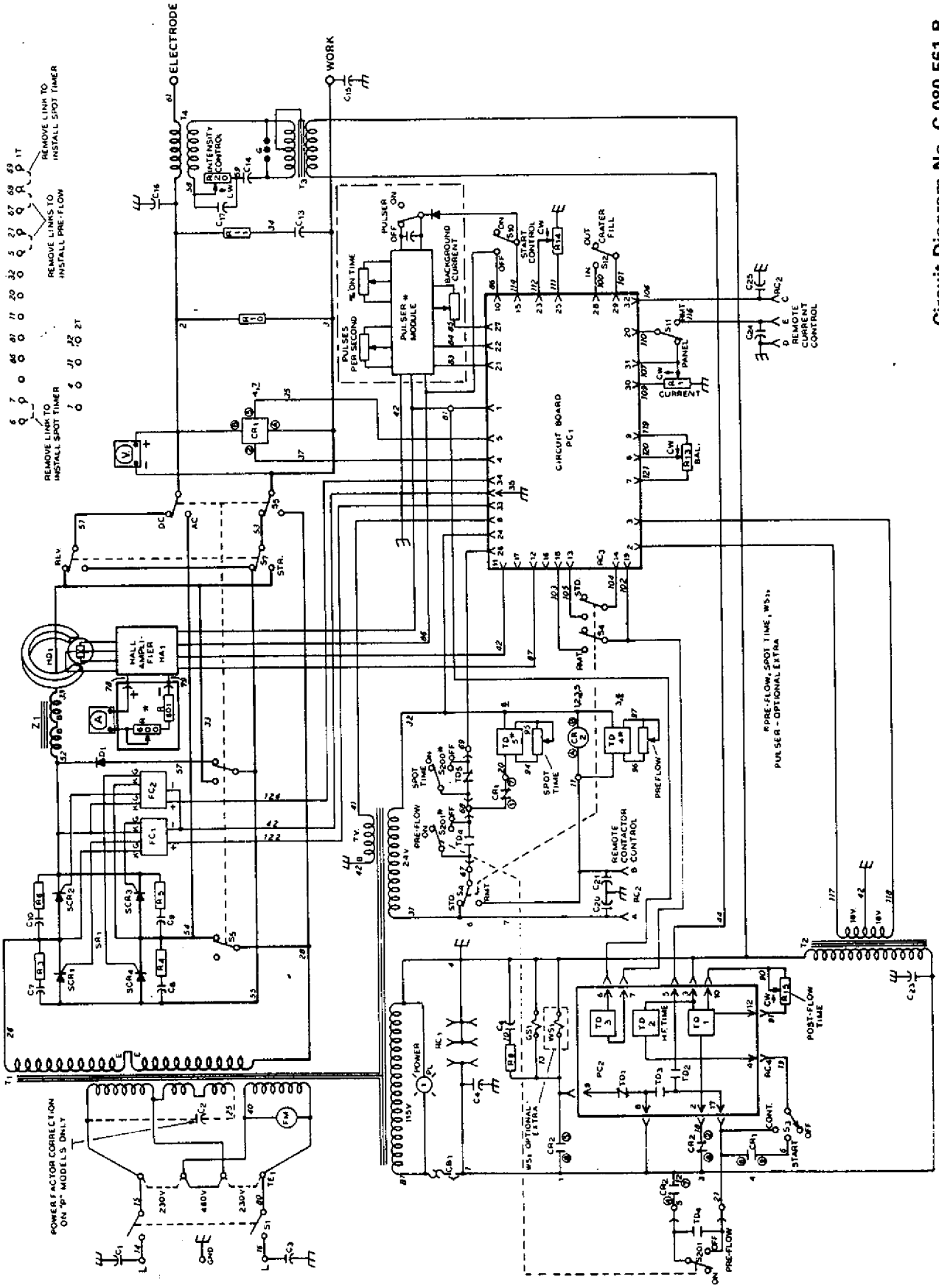
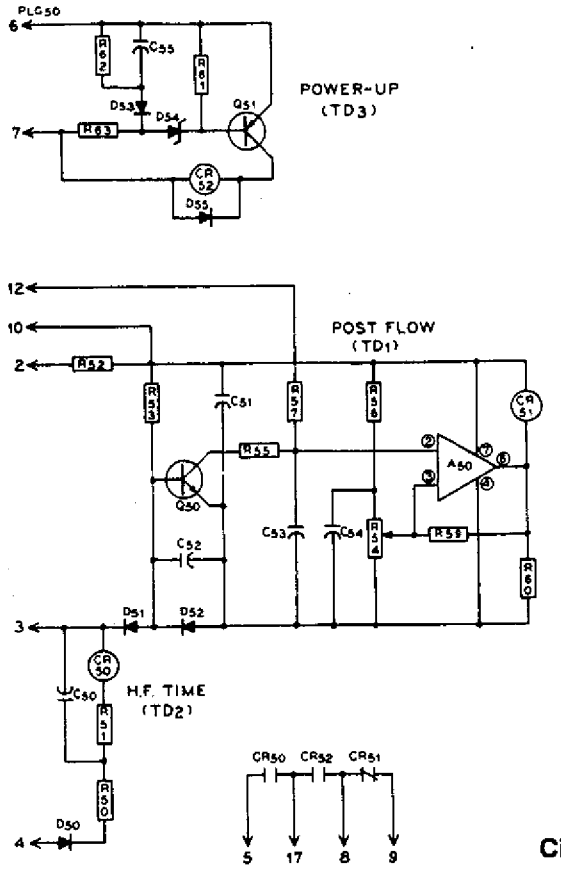


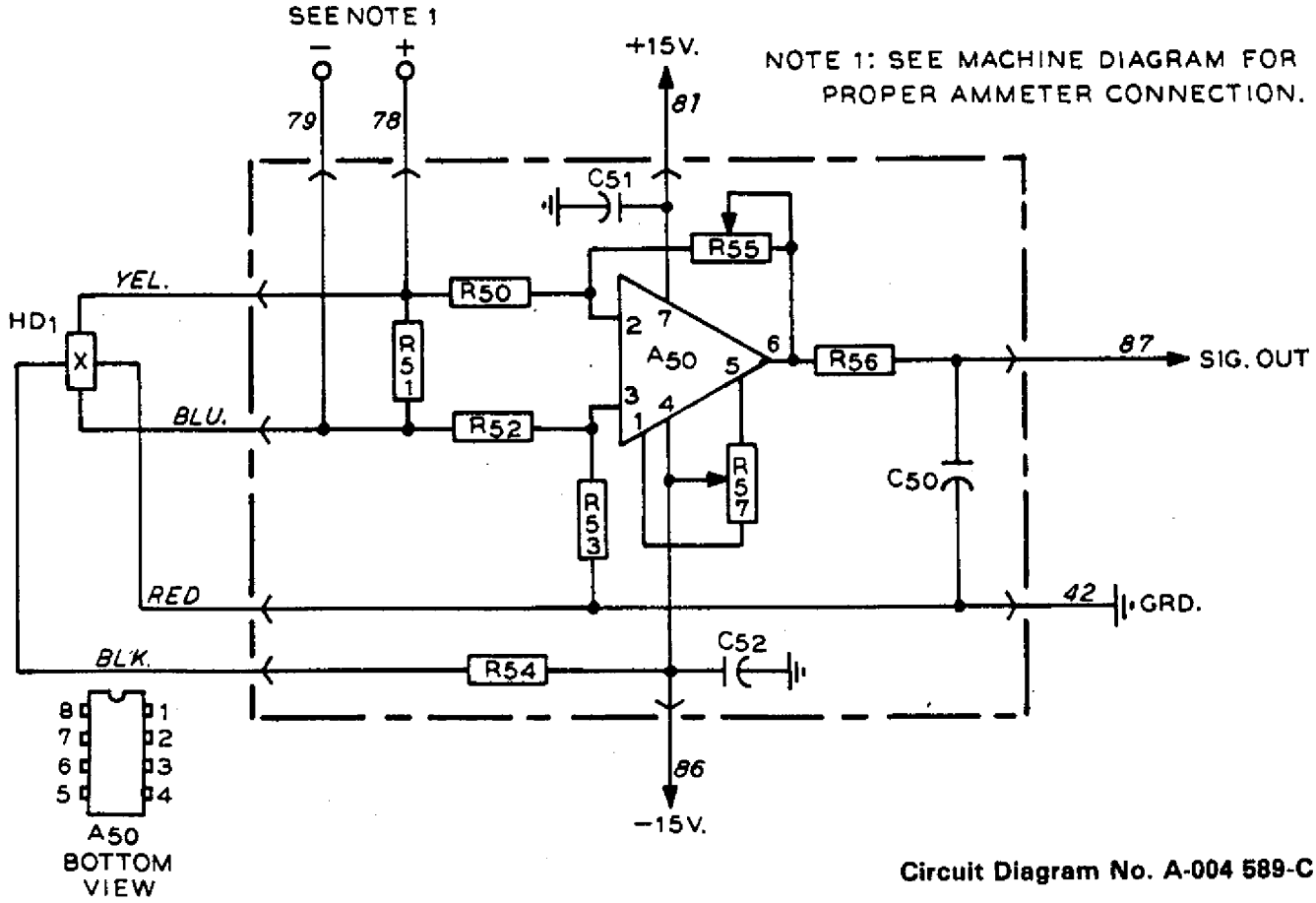
Figure 7 - 2. Circuit Diagram For 500 Ampere Models

Circuit Diagram No. C-080 561-B



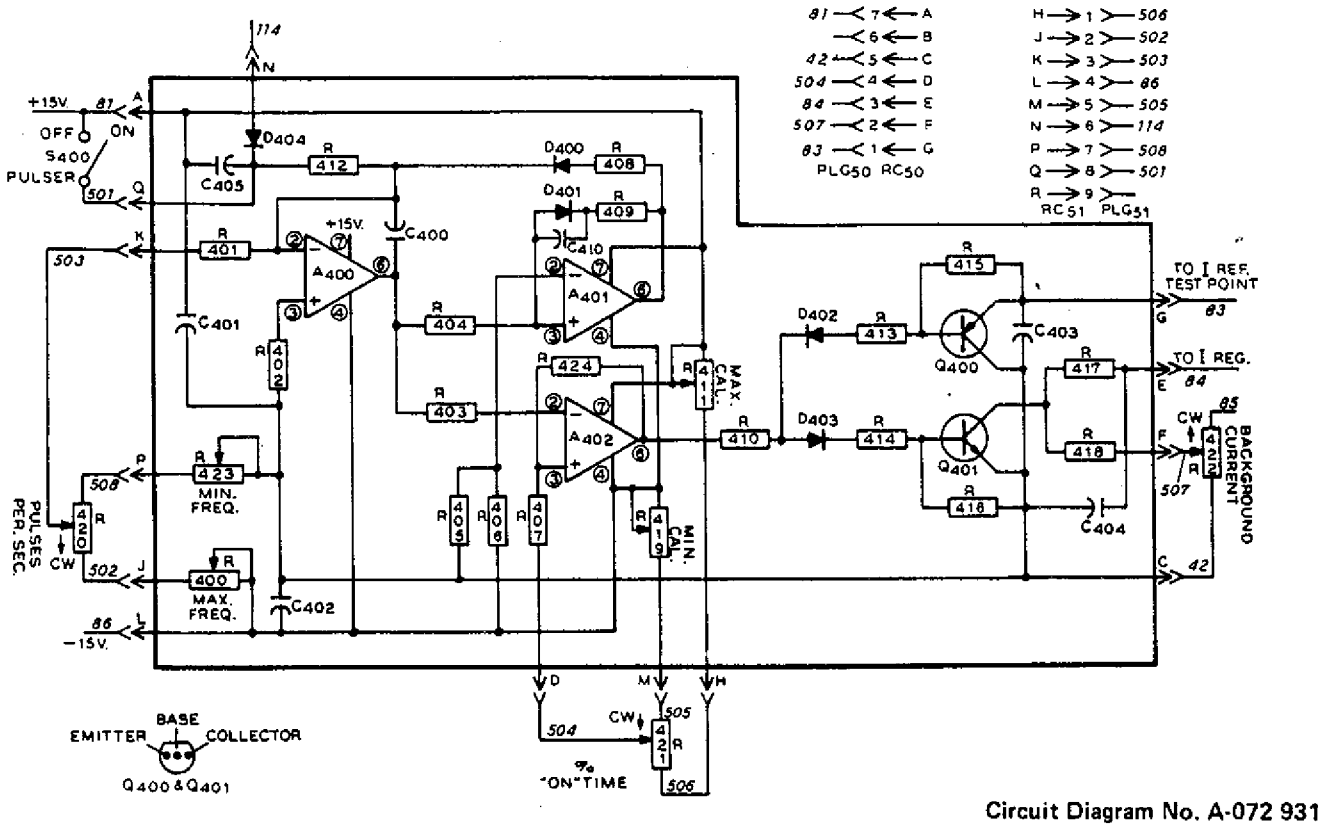
Circuit Diagram No. A-052 835-A

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



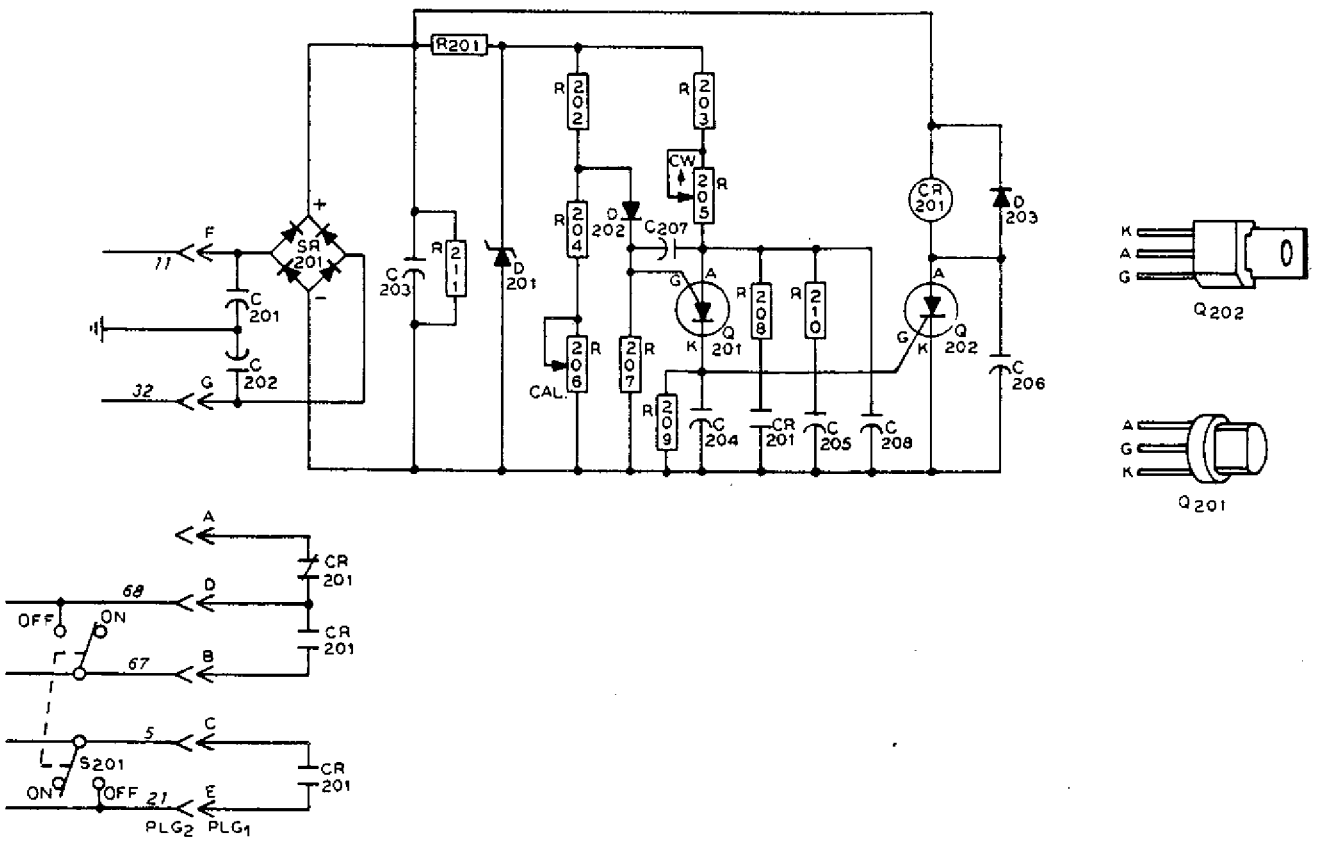
Circuit Diagram No. A-004 589-C

Figure 7-4. Circuit Diagram For Hall Amplifier



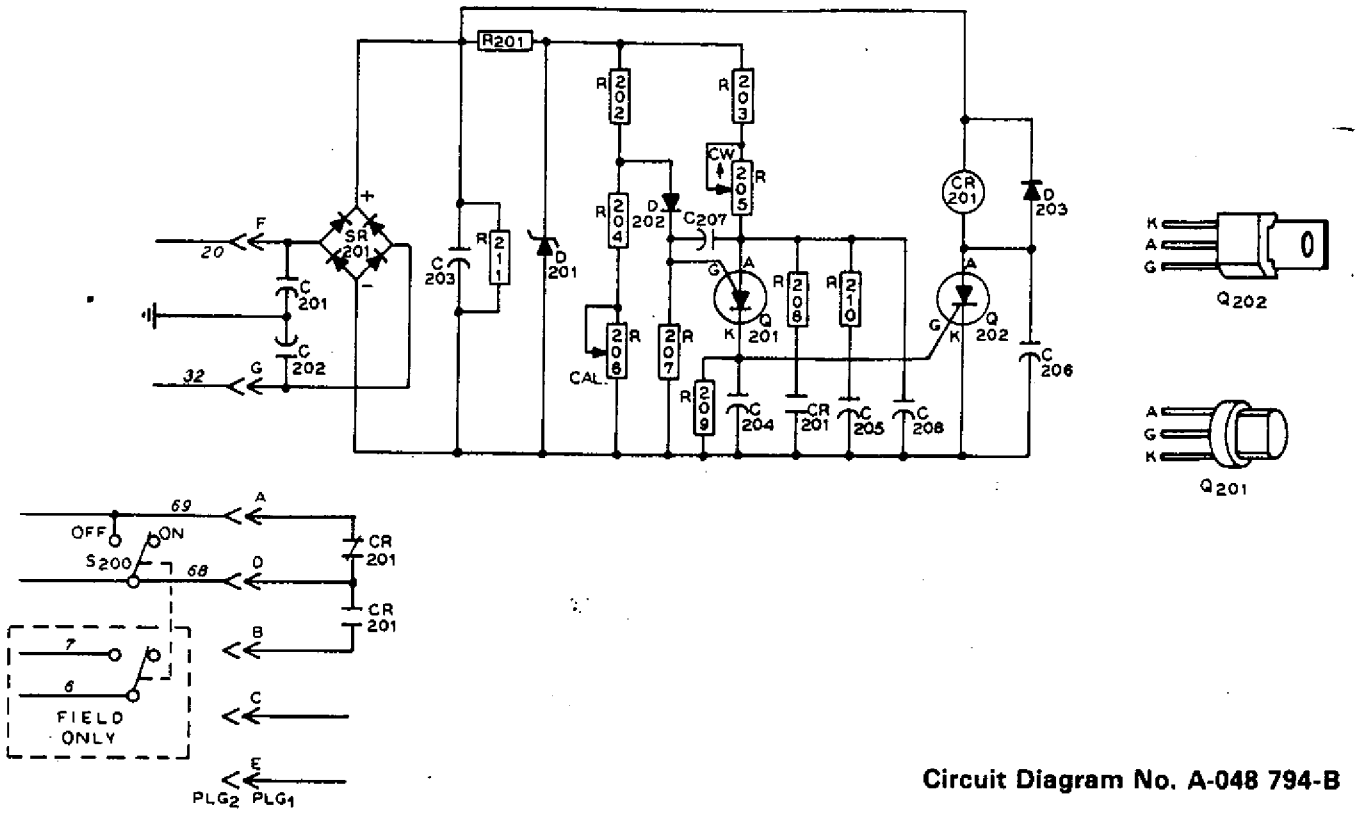
Circuit Diagram No. A-072 931

Figure 7 - 5. Circuit Diagram For Pulser



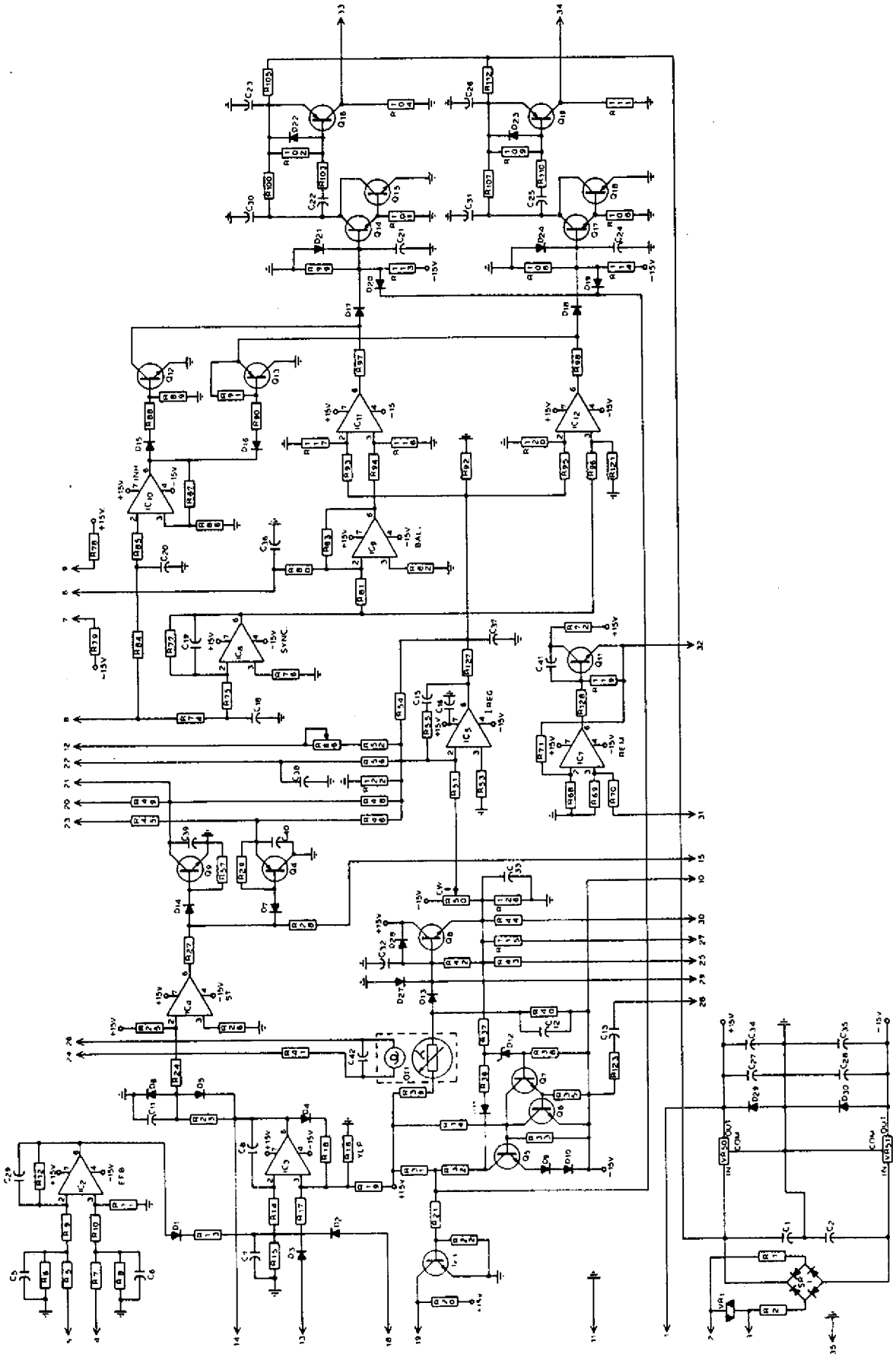
Circuit Diagram No. A-048 789

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



Circuit Diagram No. A-048 794-B

Figure 7 - 7. Circuit Diagram For Spot Timer



Circuit Diagram No. C-070 731

Figure 7-8. Circuit Diagram For Circuit Board PC1

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.

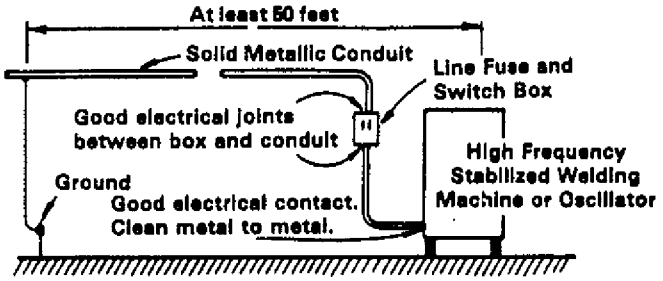


Figure 8-1. Power Service Installation H.F. Stabilized Arc Welding Machine

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 noted in the following paragraph.

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

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

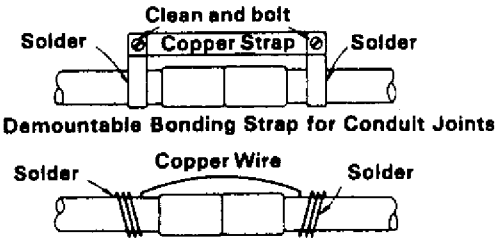


Figure 8-2. Two Recommended Methods For Electrical Bonding Across Poor Conductivity Conduit Joints

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).

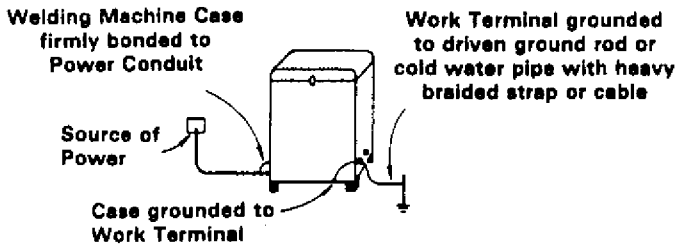


Figure 8-3. Ground Connections At Welding Machine

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).

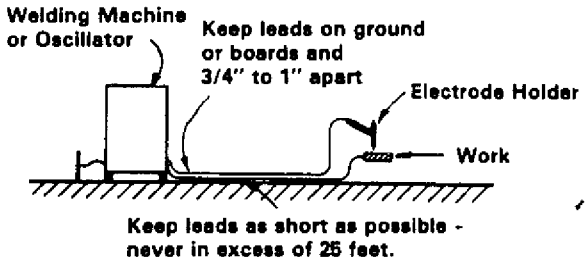


Figure 8-4. General Rules For Welding Leads

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, producd 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.

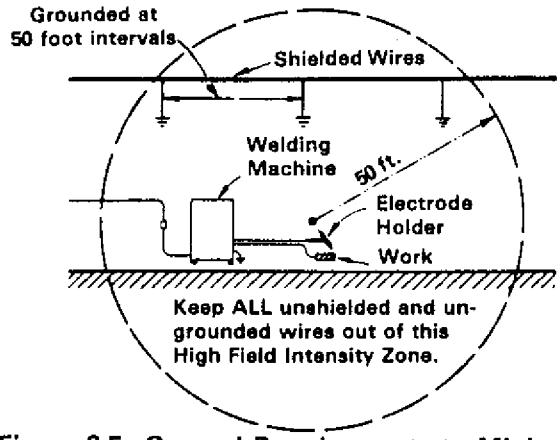


Figure 8-5. General Requirements to Minimize Reradiation Pick-Up In the Vicinity of the Weld Zone

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 bcome necessary to improve the ground conductivity by treating soil around the ground rod with a salt solution.

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

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

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

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

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

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

8-10. CHECK LIST - The following questions may be used by the installer as a check to see if all installation requirements have been met:

1. Has the equipment been located so that ground leads can be kept short?
2. Are the power leads, serving the unit, in conduit?
3. Is there good electrical contact between power conduit and case?
4. Do the conduit couplings make good electrical contact? (If in doubt, use bonding).
5. Is there good electrical contact between conduit and switch on service boxes?
6. If rigid metallic conduit is not used, is the shielding used of equivalent shielding efficiency? (Copper sleeving, lead covered cable, etc., is satisfactory. Spirally wound flexible metallic conduit is not suitable).
7. Is the conduit system grounded at a point at least 50 feet from the equipment?
8. Is the conduit run complete (without any gap) in the H.F.I. zone?
9. Is the equipment case connected to the work terminal of the secondary?

10. Is the wire used for this connection of sufficient size?

11. Is the work terminal connected to a good electrical ground?

12. Is the cable or copperbraid used for this connection equal to or greater in current carrying capacity than the welding lead?

13. Is this cable as short as possible?

14. Are the spark-gaps set at .008" or less?

15. Are all service and access doors closed and bolted?

16. Are the welding leads less than 25 feet long?

17. Are they as short as possible?

18. Are the welding leads on the floor or placed on a suitable board?

19. Are the welding leads approximately 3/4" to 1" apart?

20. Have you visualized the H.F.I. zone, a sphere with a 50 foot radius centered on the weld zone?

21. Have the unshielded power and light wires originally in this H.F.I. zone been placed in grounded shields or been relocated outside the zone?

22. Have all large metallic objects and any long guy or supporting wires in the H.F.I. zone been grounded?

23. Have you checked so that no external power or telephone lines off the premises are within the zone?

24. Are the grounds driven ground rods?

25. Is a cold water pipe used as ground?

26. If so, does it enter the ground 10 feet or less from the connection?

27. Are the connections to the ground clean and tight?

28. If operated within a metal building, is the building properly grounded?

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

Sept. 1987 FORM: OM-350P

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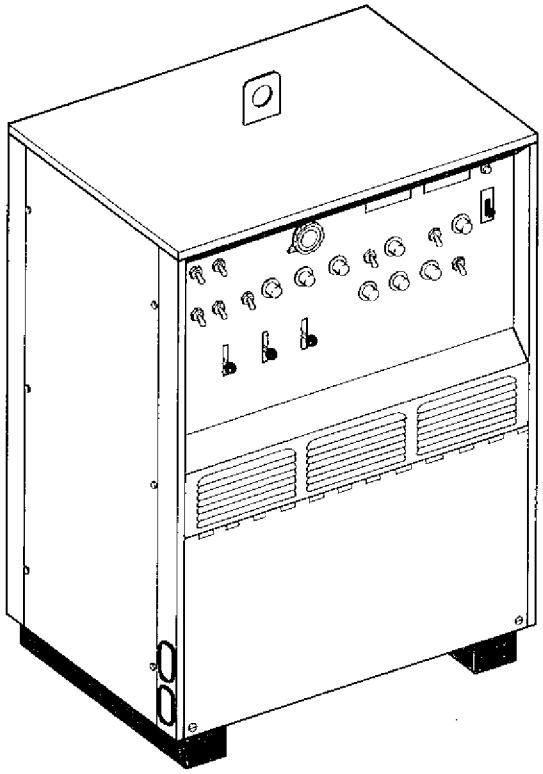

PARTS LIST

Item No.	Dia. Mkgs.	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 (consisting of)	1	1
		031 670	. CAPACITOR, ceramic 0.05 uf 500 volts dc	2	2
4	C16	009 062	CAPACITOR (consisting of)	1	1
		031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	2	2
5		026 627	GASKET, lifting eye	1	1
6	HA1,HD1	004 590	SENSOR, current	1	
6	HA1,HD1	059 641	SENSOR, current		1
7		Figure B	PANEL, rear-w/components (Pg 2)	1	1
8	TE1	034 587	TERMINAL ASSEMBLY, primary (Fig C Pg 2)	1	
8	TE1	059 241	TERMINAL ASSEMBLY, primary (Fig C Pg 2)		1
9	C1,3	112 557	CAPACITOR, ceramic 0.001 uf 3000 volts dc	2	2
10		Figure D	REACTOR & TRANSFORMER, power-main (Pg 3)	1	1
11		+025 141	BRACKET, mtg-capacitor	1	2
12	C4	113 501	CAPACITOR, ceramic 0.01 uf 500 volts	1	1
13	C2	+114 610	CAPACITOR, poly film 30 uf 480 volts ac	2	4
14		003 034	BASE	1	1
15	Z2	000 051	REACTOR, square wave-low range	1	
16		Fig F & G	PANEL, front-w/components (Pg 6, 8)	1	1
17		108 323	HF PANEL, (Fig E Pg 4)	1	1

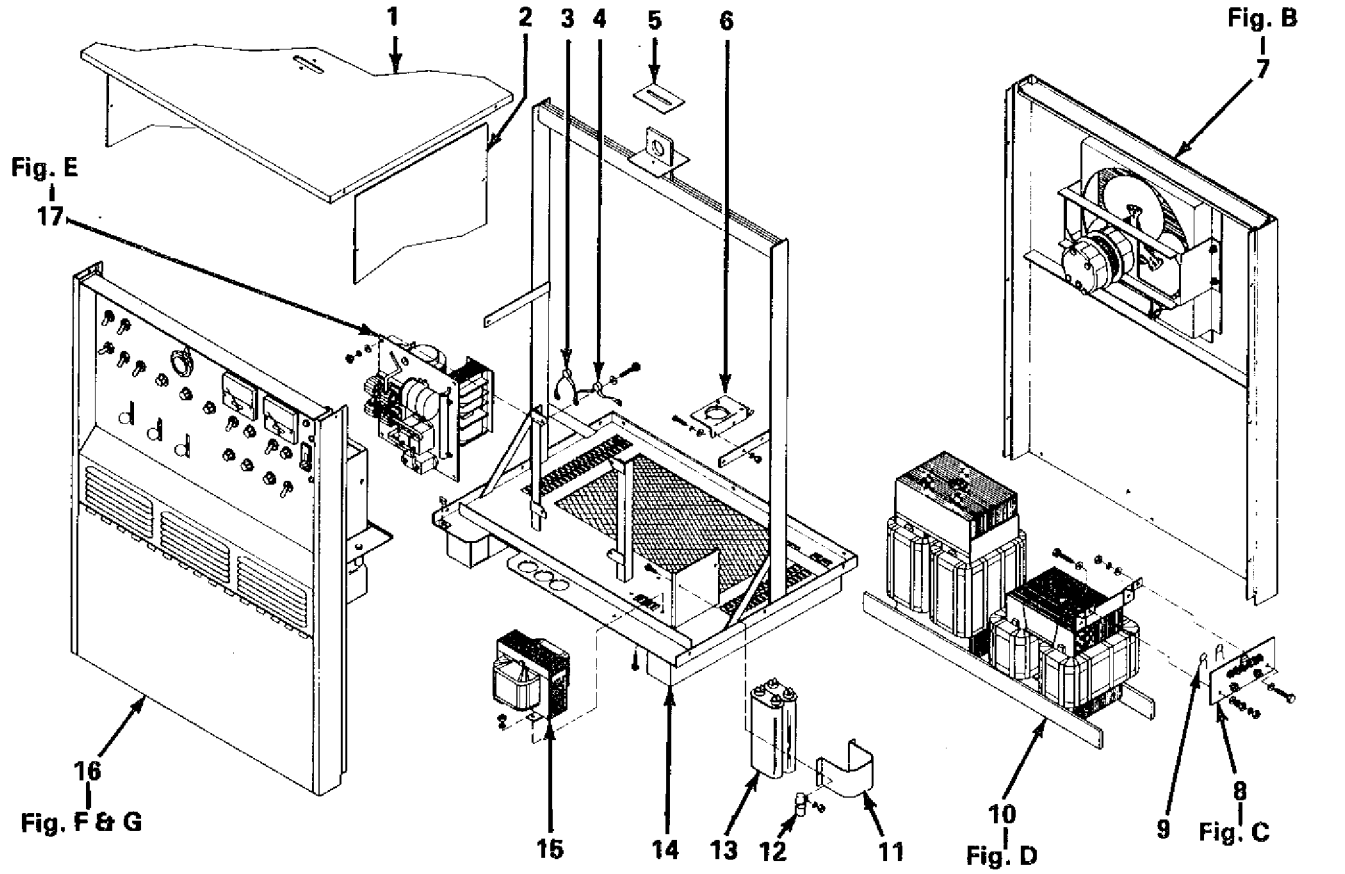

Figure A - Main Assembly

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+Optional Equipment.

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure B			**Panel, Rear-W/Components (Fig A Pg 1 Item 7)**		
1	FM	079 801	MOTOR, fan 1/12 hp 230 volts 1550 rpm	1	
1	FM	032 605	MOTOR, SP 1/4 hp		1
2		016 258	CHAMBER, plenum 14 inch	1	
2		020 729	CHAMBER, plenum 18 inch		1
3		032 604	BLADE, fan 60 Hz 14 inch 3 wing 19 deg	1	
3		032 606	BLADE, fan 60 Hz 18 inch 3 wing 22 deg		1
4		039 247	PANEL, rear	1	
4		059 068	PANEL, rear		1
5	R10	097 459	RESISTOR, WW fixed 375 watt 20 ohm	1	1

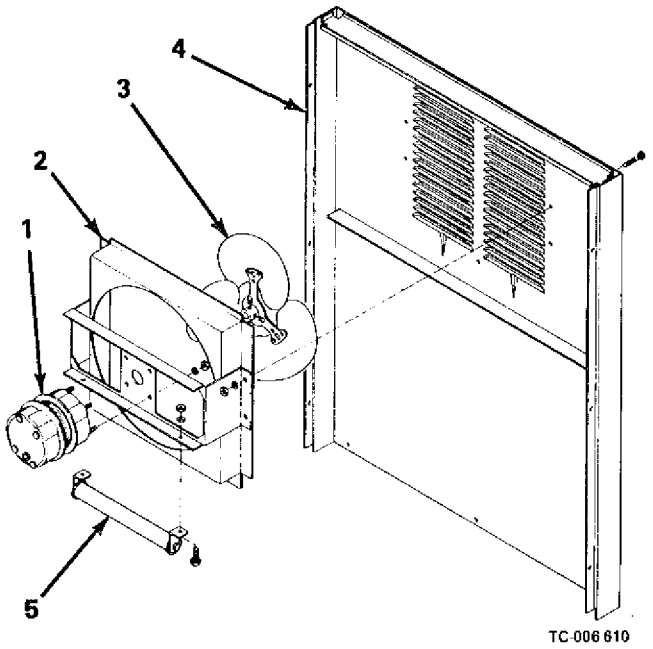

Figure B - Panel, Rear-W/Components

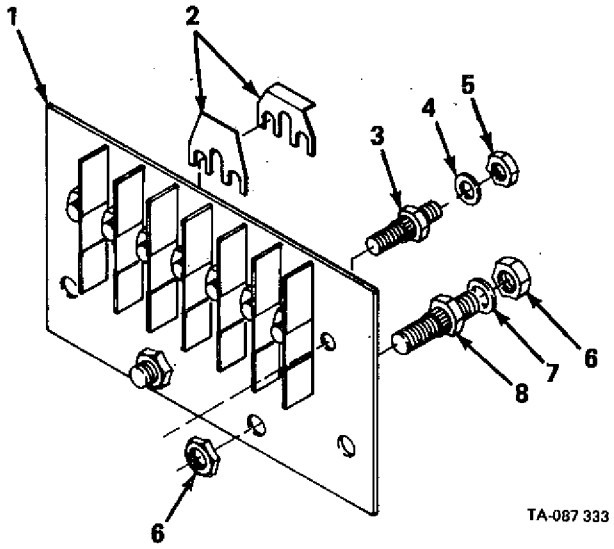

Figure C - Terminal Assembly, Primary

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp (034 587)	Quantity Model 500 Amp (059 241)
Figure C			**Terminal Assembly, Primary (Fig A Pg 1 Item 8)**		
1		083 426	TERMINAL BOARD, primary	1	
1		059 050	TERMINAL BOARD, primary		1
2		038 618	LINK, jumper-terminal	2	
2		038 898	LINK, terminal-connecting		2
3		038 887	STUD, brass No. 10-32 x 1/8 w/hex collar	6	
3		038 804	STUD, brass 3/8-16 x 2-1/2		6
4		010 913	WASHER, flat-brass 3/16 ID x 1/2 OD	6	
5		601 835	NUT, brass-hex 10-32	12	
5		601 838	NUT, brass-hex 3/8-16		24
6		601 836	NUT, brass-hex jam 1/4-20	4	
7		010 915	WASHER, flat-brass 1/4 ID x 5/8 OD	4	
8		038 888	STUD, brass 1/4-20 x 1-1/2 w/hex collar	2	

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

Replace Coils at Factory or Factory Authorized Service Station

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure D			**Reactor & Transformer, Power-Main (Fig A Pg 1 Item 10)**		
1	Z1	039 313	REACTOR, square wave (consisting of)	1	
1	Z1	059 113	REACTOR, square wave (consisting of)		1
2		000 192	. COIL, reactor-square wave RH	1	
2		059 101	. COIL, reactor-square wave RH		1
3		003 031	. COIL, reactor-square wave LH	1	
3		059 102	. COIL, reactor-square wave LH		1
4	T1	107 205	TRANSFORMER (200/230/460)(consisting of)	1	
4	T1	097 035	TRANSFORMER (230/460) (consisting of)		1
4	T1	097 037	TRANSFORMER (200/230/460 (consisting of)		1
4	T1	107 207	TRANSFORMER (230/460/575)(consisting of)	1	
4	T1	097 038	TRANSFORMER (230/460/575) (consisting of)		1
5		090 523	. COIL, pri/sec LH (200/230/460)	1	
6		090 524	. COIL, pri/sec RH (200/230/460)	1	
5		096 699	. COIL, pri/sec LH (230/460)		1
6		096 700	. COIL, pri/sec RH (230/460)		1
5		096 709	. COIL, pri/sec LH (200/230/460)		1
6		096 710	. COIL, pri/sec RH (200/230/460)		1
5		090 589	. COIL, pri/sec LH (230/460/575)	1	
6		090 590	. COIL, pri/sec RH (230/460/575)	1	
5		096 707	. COIL, pri/sec LH (230/460/575)		1
6		096 708	. COIL, pri/sec RH (230/460/575)		1
7		000 194	BAR, 3/8 x 2 x 29-3/4	2	
8		022 113	BAR, 1/4 x 1 x 5-7/8	2	

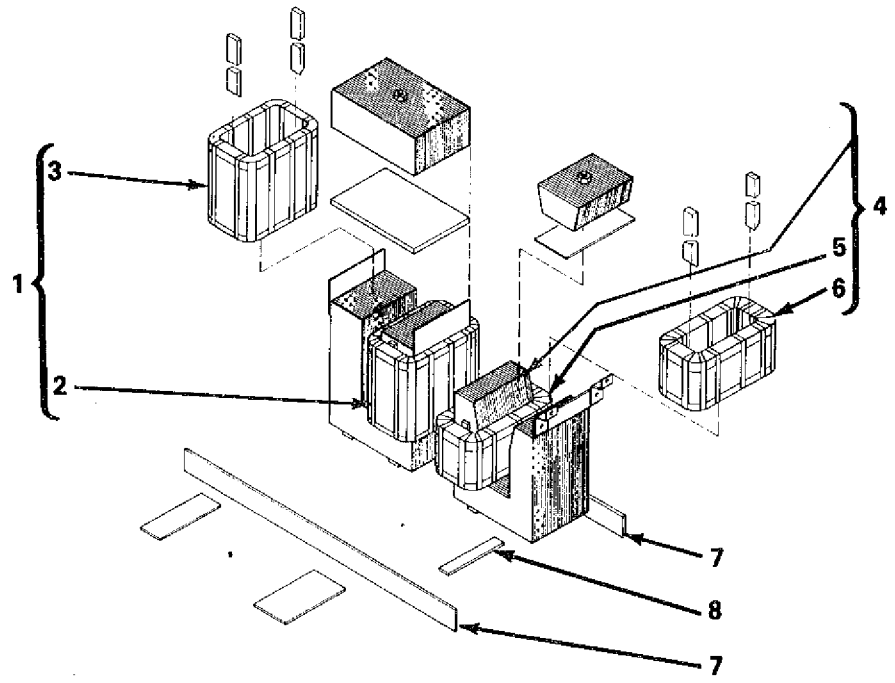

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Figure D - Reactor & Transformer, Power-Main

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure E		**108 323**	**HF Panel (Fig A Pg 1 Item 17)**	
1		010 885	STRIP, conductor	4
2		603 737	SCREW, brass-round hd 3/8-16 x 1-3/4	2
3		016 601	MOUNTING BOARD, component	1
4		038 887	STUD, brass 10-32 x 1-3/8 w/hex collar	2
5		601 835	NUT, brass-hex 10-32	6
6		601 838	NUT, brass-hex jam 3/8-16	4
7	T4	033 373	COIL, coupling-air (consisting of)	1
8		010 147	. STRIP, conductor	2
9		601 831	. NUT, brass-hex 8-32	2
10		010 913	. WASHER, flat-brass 3/16 ID x 1/2 OD	4
11		602 030	. SCREW, brass-round hd 8-32 x 3/8	2
12	T3	074 398	TRANSFORMER, HV 115 volts	1
13	R11	083 784	RESISTOR, WW fixed 100 watt 10 ohm	1
14		602 042	SCREW, brass-round hd 10-32 x 1	1
15	C14	096 761	CAPACITOR, mica 0.002 uf 10000 volts dc	2
16		111 181	LINK, connecting	1
17		088 487	CAPACITOR, HF (consisting of)	1
18	C13	059 887	. CAPACITOR, metal film 10 uf 220 volts	2
19		007 532	. CLAMP, capacitor 1 inch dia	4
20		081 282	. STRIP, mtg-capacitor	1
21		020 623	SPARK GAP ASSEMBLY (consisting of)	1
22		010 888	. CONNECTOR, holder-spark gap	1
23		020 622	. HOLDER, points	4
24	G	*020 603	. POINT, spark gap	4
25		020 621	. BASE, spark gap	1

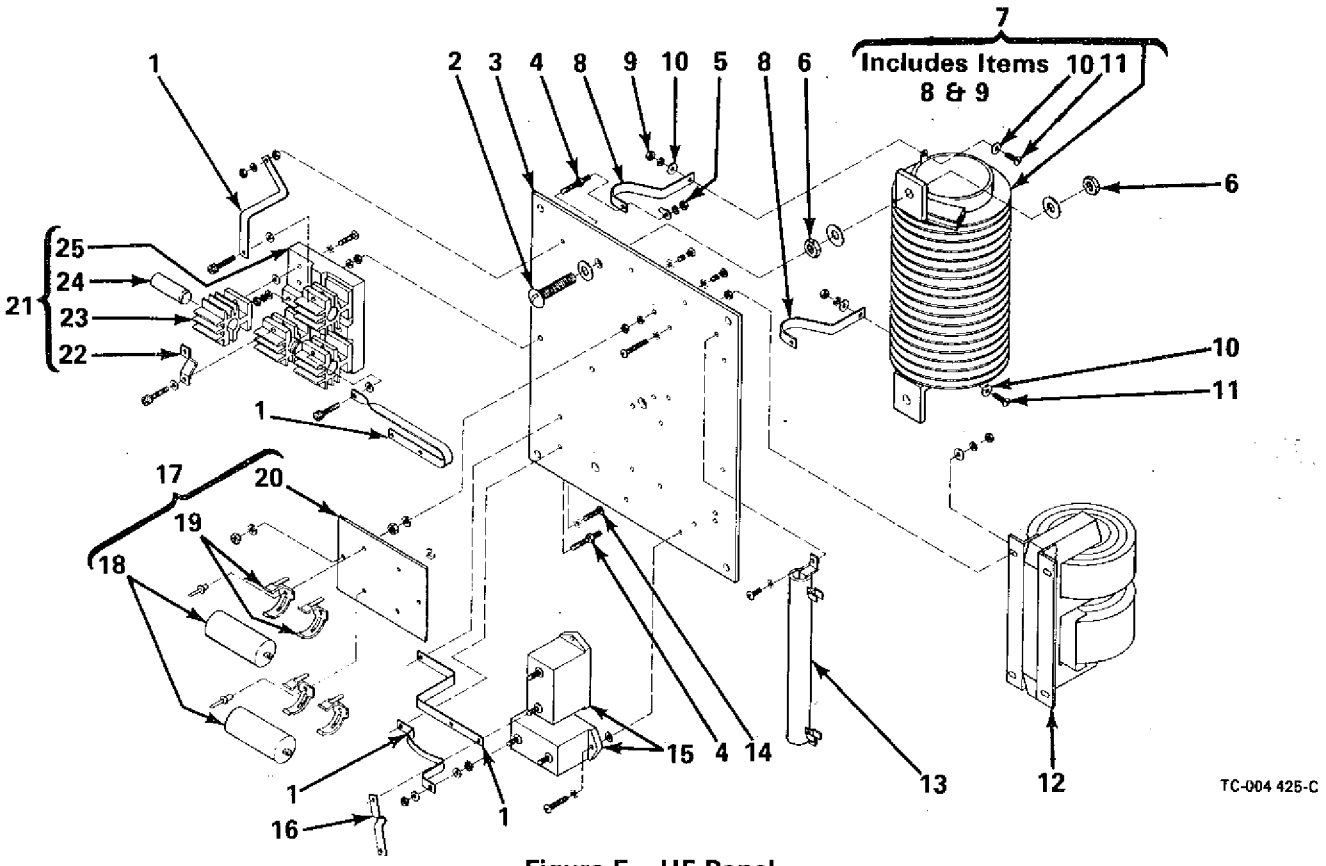

Figure E - HF Panel

*Recommended Spare Parts.

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

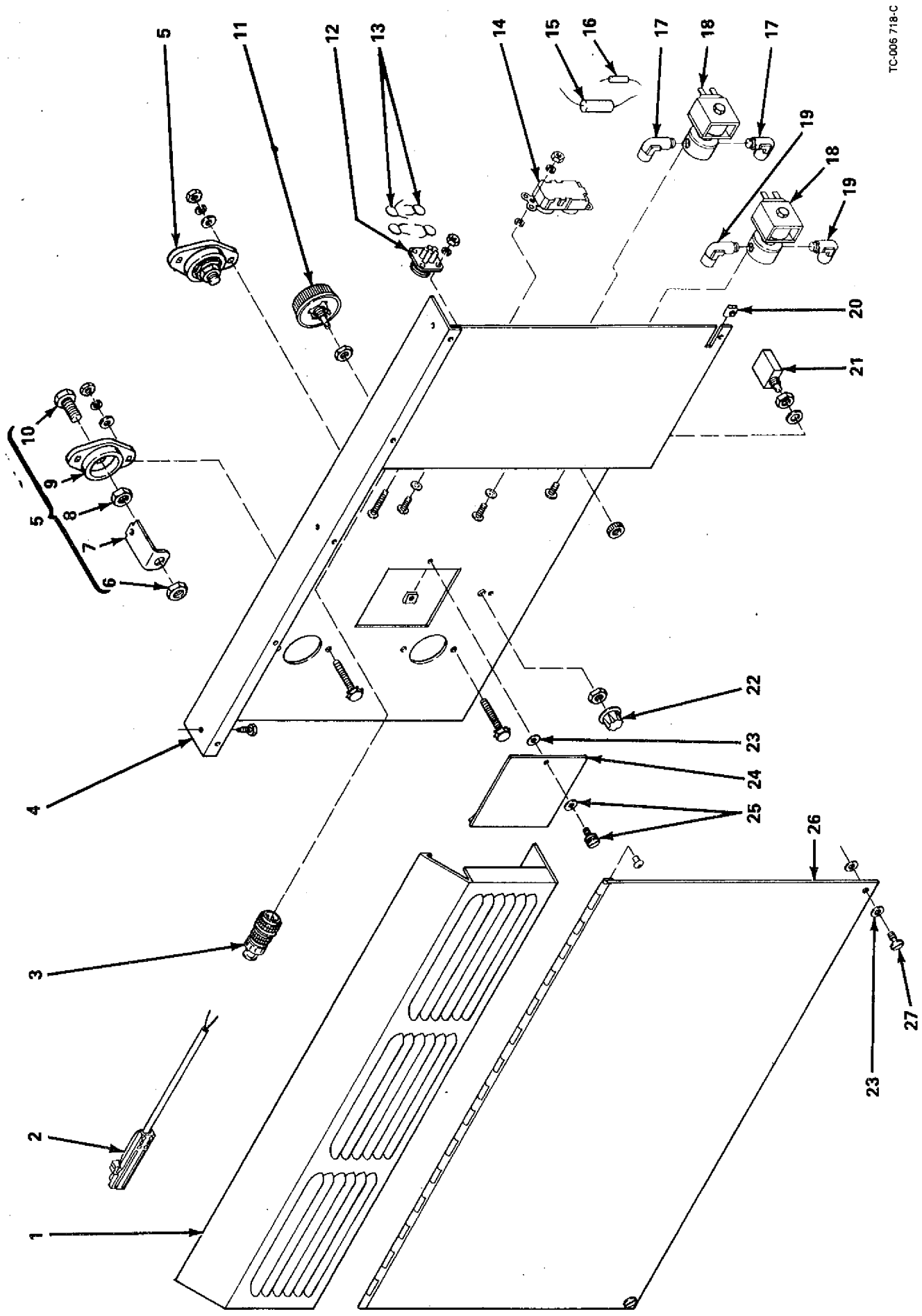

Figure F - Panel, Front-(Lower Section) W/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure F			**Panel, Front-(Lower Section) W/Components (Fig A Pg 1 Item 16)**		
1		003 045	PANEL, front-louvered	1	1
2		009 835	SWITCH, w/leads	1	1
3		039 273	PLUG, 5 pin MS3106A-16S-8P	1	1
		039 685	CLAMP, cable	1	1
4		+106 554	PANEL, front	1	
4		+106 552	PANEL, front		1
5		039 047	TERMINAL, power output (consisting of)	2	2
6		601 879	. NUT, hex-full 1/2-13	1	1
7		039 044	. BUS BAR	1	1
8		601 880	. NUT, hex-jam 1/2-13	1	1
9		039 049	. TERMINAL BOARD, red	1	1
10		601 976	. SCREW, cap-hex hd 1/2 x 1-1/2	1	1
11	R20	*605 828	RHEOSTAT, WW 50 watt 1.5 ohm	1	1
12	RC2	035 523	RECEPTACLE, 5 socket MS-3102A-16S-8S	1	1
		039 273	PLUG, Amphenol MS3106-16S-8P		
		039 685	CLAMP, Amphenol AN-3057-8		
13	C20,21,25	097 749	CAPACITOR, ceramic 0.05 uf 500 volts dc	3	3
	C24	097 750	CAPACITOR, ceramic 0.05 uf 500 volts	1	1
14	RC1	604 176	RECEPTACLE, duplex grd 2P3W 15A 125V	1	1
		073 690	CAP, P & S 5266DF		
15	C6	028 294	CAPACITOR, mylar 1 uf 200 volts dc	1	1
16	R9	030 761	RESISTOR, carbon 1 watt 10 ohm	1	1
17		010 296	FITTING, hose-brass elbow M 1/4 NPT x 5/8-18 RH	2	2
18	GS1,WS1	++003 538	VALVE, 115 volts ac 2 way 1/4 IPS port 1/8 orifice	2	2
19		++010 295	FITTING, hose-brass elbow M 1/4 NPT x 5/8-18 LH	2	2
20		605 670	NUT, speed 12-24	3	3
21	CB1	053 283	CIRCUIT BREAKER, manual reset 1P 15 amp 250 volts	1	1
22		097 922	KNOB, indicator	1	1
23		010 855	RETAINER, screw No. 2	3	3
24		052 467	DOOR, access-HF	1	1
25		602 358	FASTENER, screw-knurled hd No. 2	1	1
26		+003 043	DOOR, access-front	1	1
		047 497	LABEL, general precautionary	1	1
27		078 034	FASTENER, screw-slotted hd 0.736 lg	2	2
		070 371	BLANK, snap-in 1-3/32/1-1/8 mtg hole	1	1

*Recommended Spare Parts.
+When ordering a component originally displaying a precautionary label, the label should also be ordered.
++WS1 and fittings are now optional parts.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

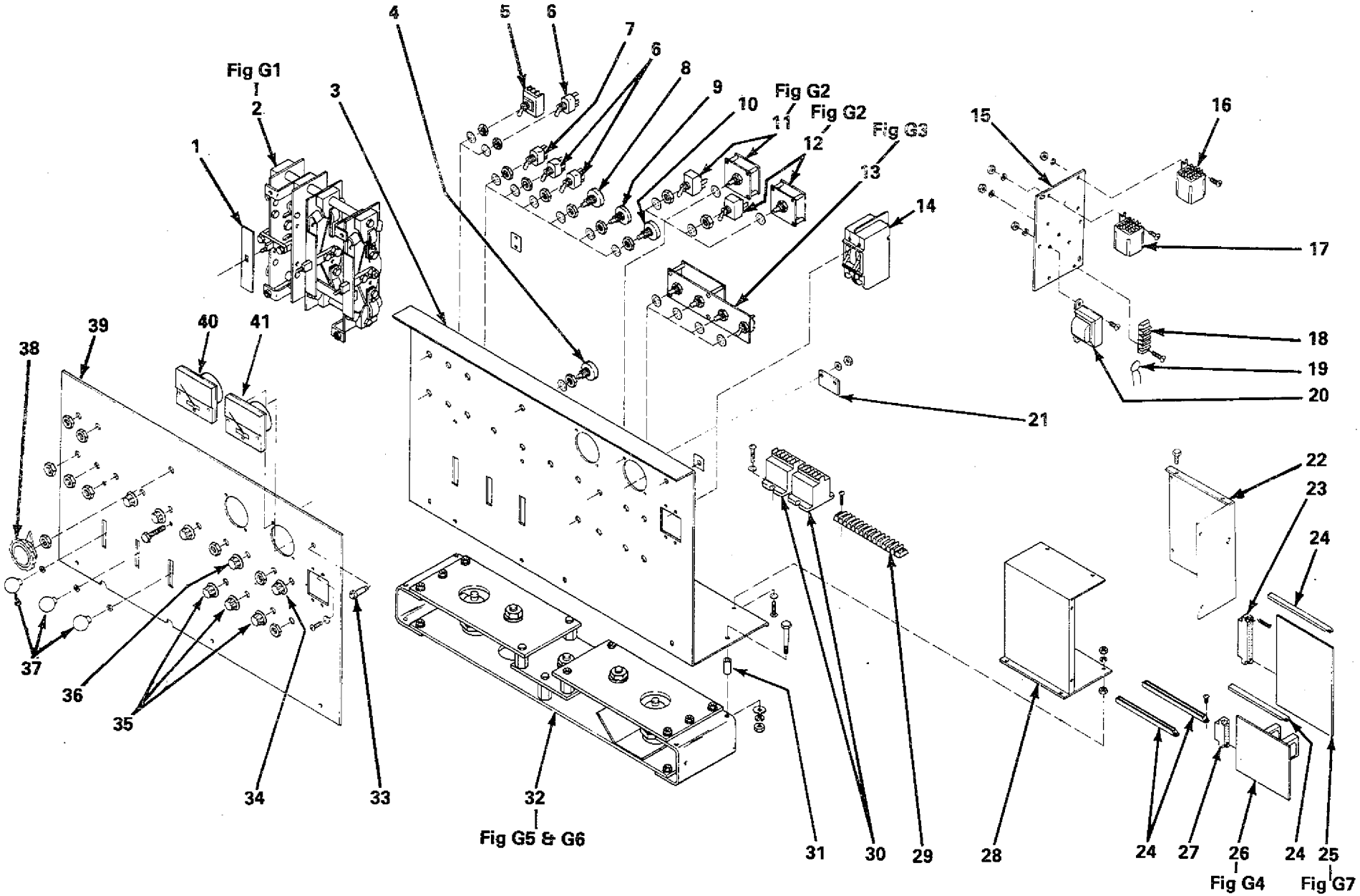

Figure G - Panel, Front-(Upper Section) W/Components

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Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G			**Panel, Front-(Upper Section) W/Components (Fig A Pg 1 Item 16)**		
1		003 053	GUARD, slot-switch selector	3	2
2	S5-7	004 266	SWITCH, range/polarity/selector (Fig G1 Pg 9)	1	
2	S5-7	059 081	SWITCH, polarity/selector (Fig G1 Pg 9)		1
3			PANEL, front (Item 4 Pg 6)		
4	R1	072 462	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm (consisting of)	1	1
		072 590	. LOCK, shaft	1	1
5	S4	011 622	SWITCH, toggle 3PDT 15 amp 125 volts	1	1
6	S10-12	089 085	SWITCH, toggle SPST 20 amp 125 volts	3	3
7	S3	011 610	SWITCH, toggle SPDT 10 amp 125 volts	1	1
8	R14	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	1	1
9	R13	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1	1
10	R15	028 769	POTENTIOMETER, carbon 1 turn 2 watt 750K ohm	1	1
11		†Fig G2	SPOT TIMER (Pg 15)	1	1
12		†Fig G2	PRE-FLOW TIMER (Pg 14)	1	1
13		Fig G3	PULSER CONTROL (Pg 15)	1	1
14	S1	006 966	CIRCUIT BREAKER, 2P 77 amp 600 volts ac	1	
14	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
15		059 152	PANEL, mtg-components	1	1
16	CR1	052 251	RELAY, volt sense 100 volts DPDT	1	1
17	CR2	000 174	RELAY, enclosed 24 volts ac 3PDT	1	1
18	2T	038 081	BLOCK, terminal 20 amp 4 pole	1	1
19	C23	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	1	1
20	T2	035 759	TRANSFORMER, control-miniature 115/36	1	1
21		080 309	CIRCUIT CARD, meter-calibration (consisting of)	1	1
	R601	030 937	. RESISTOR, carbon 0.5 watt 10 ohm	1	1
	R600	032 261	. POTENTIOMETER, cermet 15 turn 0.75 watt 200 ohm	1	1
22		000 020	PANEL, enclosure-circuit card	1	1
23	RC3	039 358	TERMINAL, header 35 socket	1	1
24		035 506	GUIDE, circuit card	4	4
25	PC1	110 459	CIRCUIT CARD, control-main (Fig G7 Pg 19)	1	1
26	PC2	052 790	CIRCUIT CARD, post-flow & HF timer (Fig G4 Pg 16)	1	1
27	RC4	039 347	TERMINAL, header 17 socket	1	1
28		107 794	ENCLOSURE, circuit card	1	1
29	1T	038 833	BLOCK, terminal 20 amp 13 pole	1	1
		601 219	LINK, jumper-terminal block 20 amp (as req'd)	1	1
30	FC1,2	110 142	PULSE MODULE	2	2
	R2	030 965	RESISTOR, WW fixed 100 watt 100 ohm	1	
31		007 097	TUBING, steel 1/2 OD x 0.060 wall	2	2
32	SR1	000 176	RECTIFIER, SCR-main (Fig G5 Pg 17)	1	
32	SR1	059 072	RECITIFER, SCR-main (Fig G6 Pg 18)		1
33	PL1	027 645	LIGHT, indicator 115 volts ac red lens	1	1
34		†097 922	KNOB, indicator (included w/item 11)	1	1
35		097 922	KNOB, indicator	6	4
36		†097 922	KNOB, indicator (included w/item 10)	1	1
37		019 603	KNOB, ball	3	2
38		097 926	KNOB, pointer	1	1
39			NAMEPLATE (order by model and serial number)	1	1
40	V	080 311	METER, volts ac/dc 0-100 scale	1	1
41	A	†080 310	METER, amp ac/dc 0-400 scale	1	
41	A	†049 639	METER, amp ac/dc 0-400/0-40 scale (low range)	1	
41	A	059 494	METER, amp ac/dc 0-750 scale		1

†Optional Equipment.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1			**Switch, Range/Polarity/Selector (Fig G Pg 8 Item 2)**	004 266	059 081
1	S5	000 880	CONTACT BOARD, selector ac/dc (Fig G1A Pg 10)	1	
1	S5	059 083	CONTACT BOARD, selector ac/dc (Fig G1A Pg 10)		1
2		003 231	TUBING, steel 5/8 OD x 12 ga wall x 1-1/8	2	
2		003 230	TUBING, steel 5/8 OD x 12 ga wall x 2-5/8		2
3		104 935	BRACKET, mtg-switch	2	2
4	S5	000 879	CONTACT BOARD, selector ac/dc (Fig G1B Pg 11)	1	
4	S5	059 084	CONTACT BOARD, selector ac/dc (Fig G1B Pg 11)		1
5		009 229	TUBING, steel 5/8 OD x 12 ga wall x 15/16	2	
5		010 086	SPACER, polarity-switch		2
6	S6	000 878	CONTACT BOARD, polarity (Fig G1C Pg 12)	1	
7		003 230	TUBING, steel 5/8 OD x 12 ga wall x 2-5/8	2	
8		039 256	STUD, steel 1/4-20 x 9	2	
8		028 389	STUD, steel 1/4-20 x 10		2
9	S7	004 265	CONTACT BOARD, range (Fig G1D Pg 13)	1	
9	S7	059 082	CONTACT BOARD, polarity (Fig G1D Pg 13)	1	
10		004 696	BRACKET, mtg-switch	2	2
11		004 267	LINK, jumper-switch ac/dc		1
11		080 346	LINK, jumper-switch	.	1
12		039 260	HANDLE, switch	1	
12		080 348	HANDLE, switch		1
13		019 603	KNOB, ball	2	2
		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

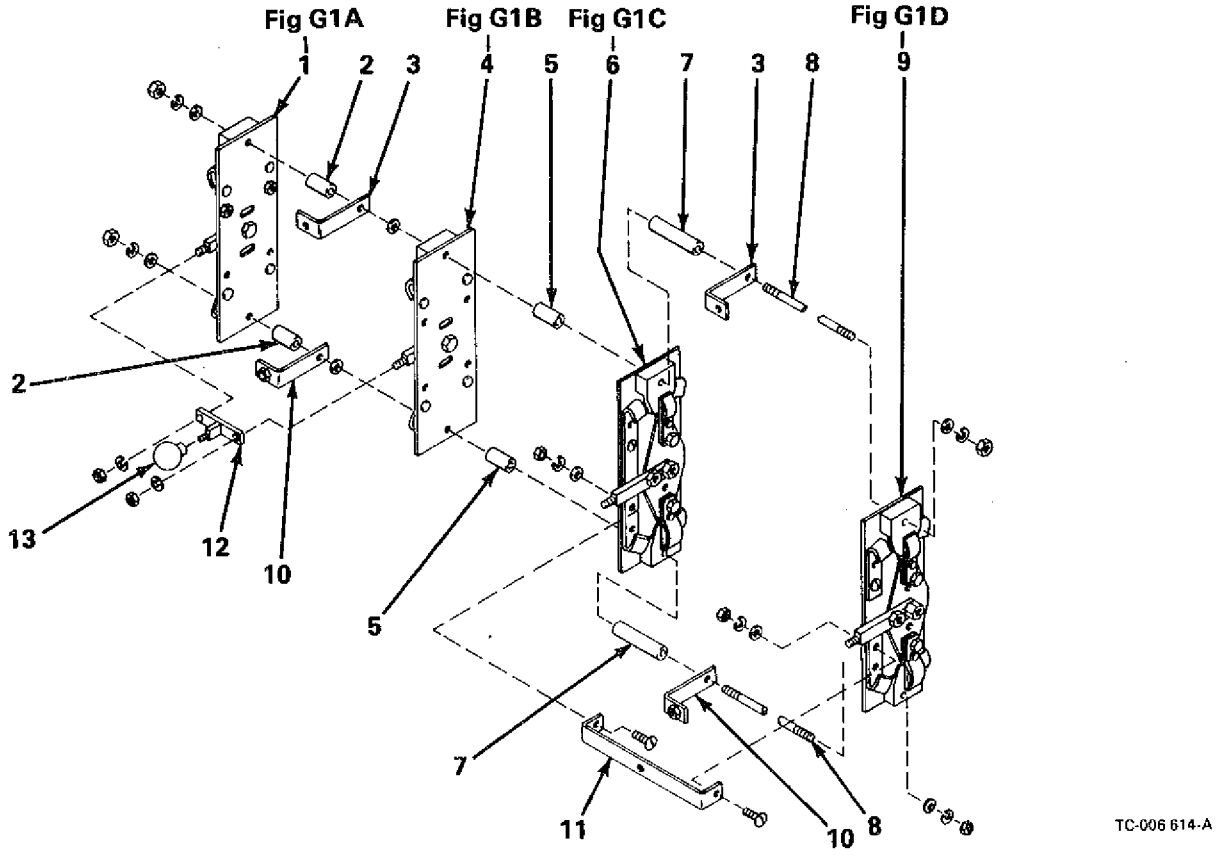

Figure G1 - Switch, Range/Polarity/Selector

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

Item No.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1A		**Contact Board, Switch-Selector AC/DC (Fig G1 Pg 10 Item 1)**	000 880	059 083
1	604 318	NUT, self-locking hex 1/4-20	1	1
2	039 257	HANDLE, switch	1	1
3	024 694	BEARING	1	2
4	011 948	GUIDE, contact	2	4
5	011 950	CONTACT, switch	1	4
6	103 634	MOUNTING BOARD, component	1	1
7	011 951	CONTACT, switch	1	4
8	103 633	BUS BAR, shorting	1	
9	038 769	CONTACT BOARD, switch (consisting of)	1	2
10	103 632	. PLATE, toggle switch	1	1
11	011 645	. CONTACT ASSEMBLY, movable (consisting of)	2	2
12	011 075	. . SPRING, pressure	1	1
13	011 953	. . CONTACT, switch	2	2
14	011 074	. . SPRING, pressure	1	1

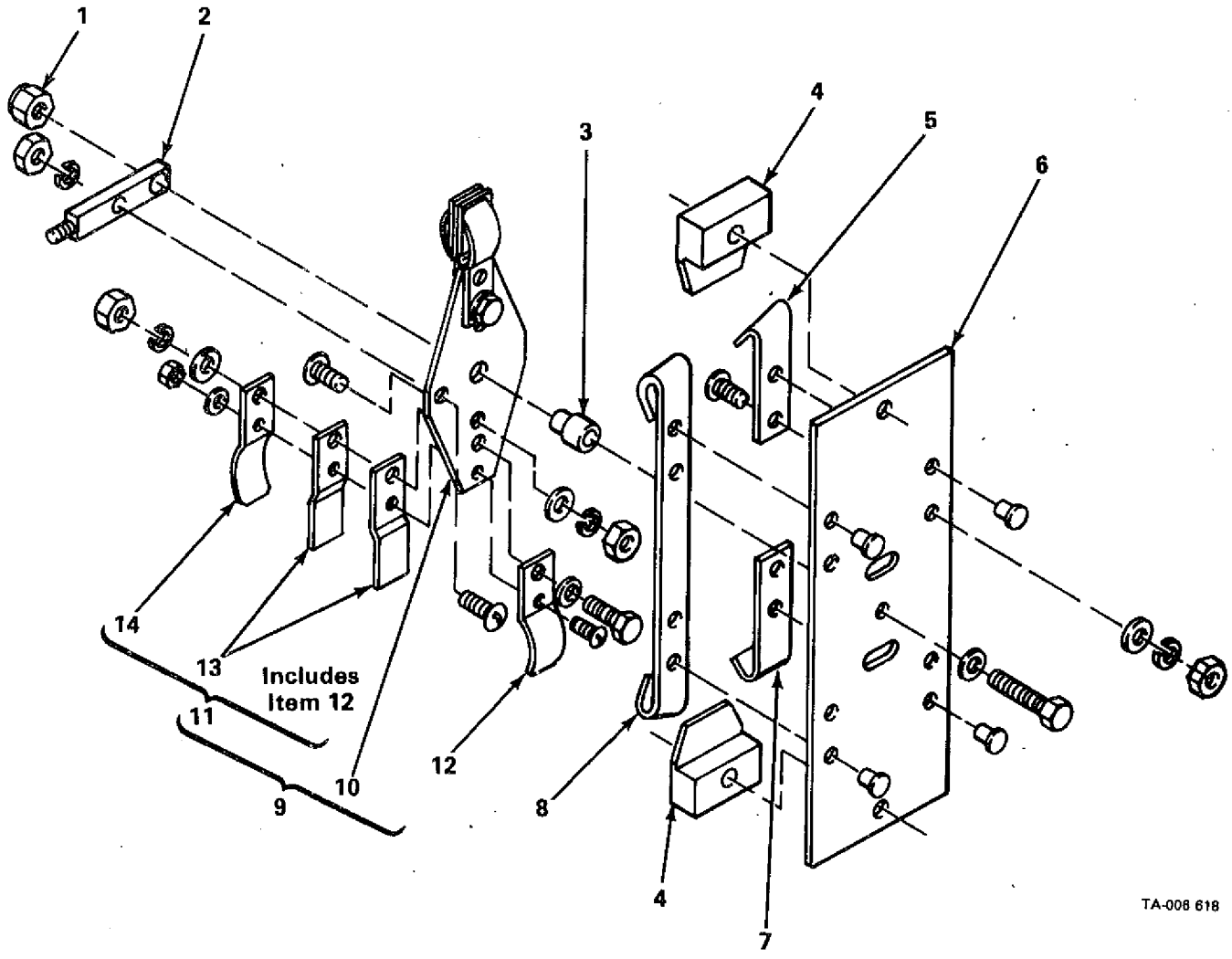

Figure G1A - Contact Board, Switch Selector AC/DC

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

Item No.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1B		**Contact Board, Selector AC/DC (Fig G1 Pg 10 Item 4)**	000 879	059 084
1	038 769	CONTACT BOARD, switch (consisting of)	1	2
2	011 645	. CONTACT ASSEMBLY, movable (consisting of)	2	2
3	011 074	. . SPRING, pressure	1	1
4	011 953	. . CONTACT, switch	2	2
5	011 075	. . SPRING, pressure	1	1
6	103 632	. PLATE, toggle switch	1	1
7	011 948	GUIDE, contact	2	4
8	011 951	CONTACT, switch	2	2
9	011 950	CONTACT, switch	2	2
10	103 634	MOUNTING BOARD, component	1	1
11	024 694	BEARING	1	1
12	039 257	HANDLE, switch	1	1
13	604 318	NUT, 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		2

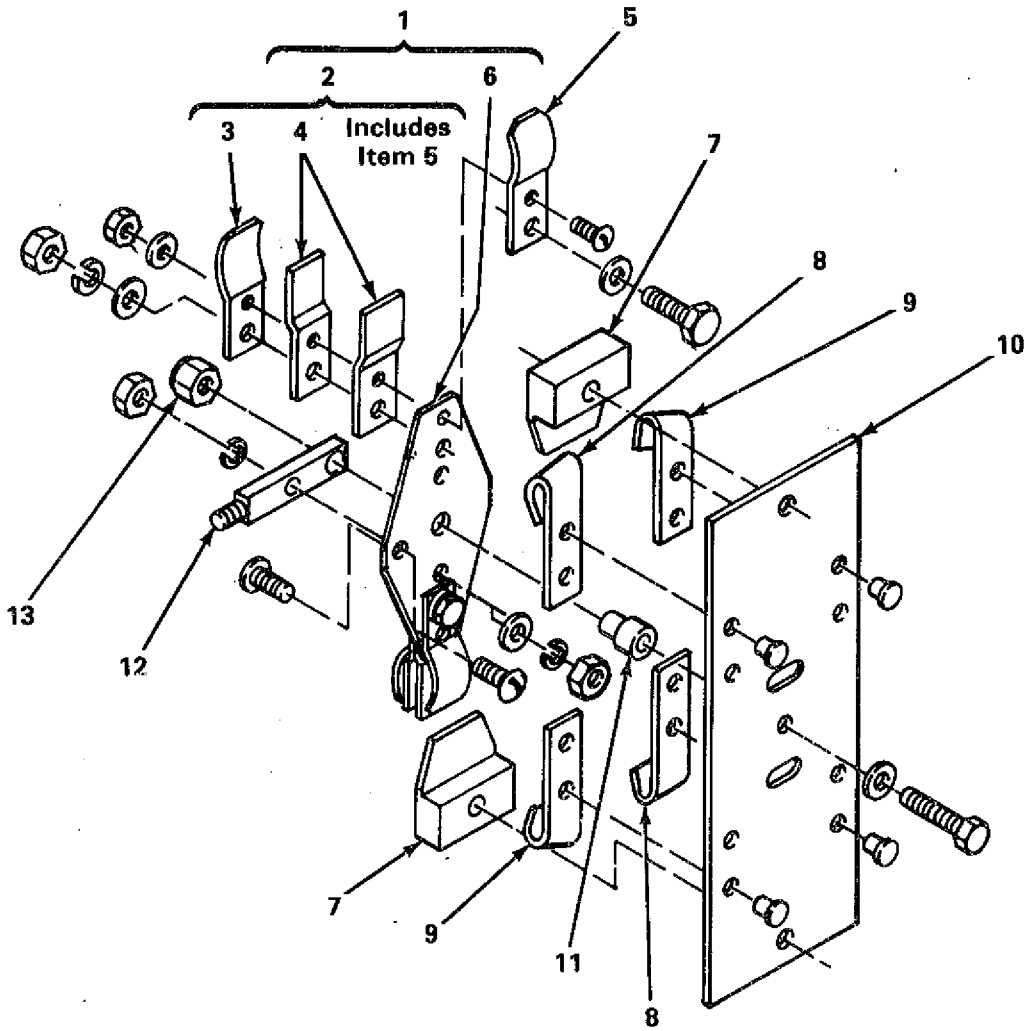

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Figure G1B - Contact Board, Selector AC/DC

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

Item No.	Part No.	Description	Quantity
Figure G1C	**000 878**	**Contact Board, Switch-Polarity (Fig G1 Pg 10 Item 6)**	300 Amp Models Only
1	103 634	MOUNTING BOARD, component	1
2	011 948	GUIDE, contact	2
3	103 633	BUS BAR, shorting	2
4	038 769	CONTACT BOARD, switch-polarity (consisting of)	1
5	103 632	. PLATE, toggle switch	1
6	011 645	. CONTACT ASSEMBLY, movable (consisting of)	2
7	011 075	. . SPRING, pressure	1
8	011 953	. . CONTACT, switch	2
9	011 074	. . SPRING, pressure	1
10	604 318	NUT, self-locking hex 1/4-20	1
11	010 805	HANDLE	1
12	024 694	BEARING	1

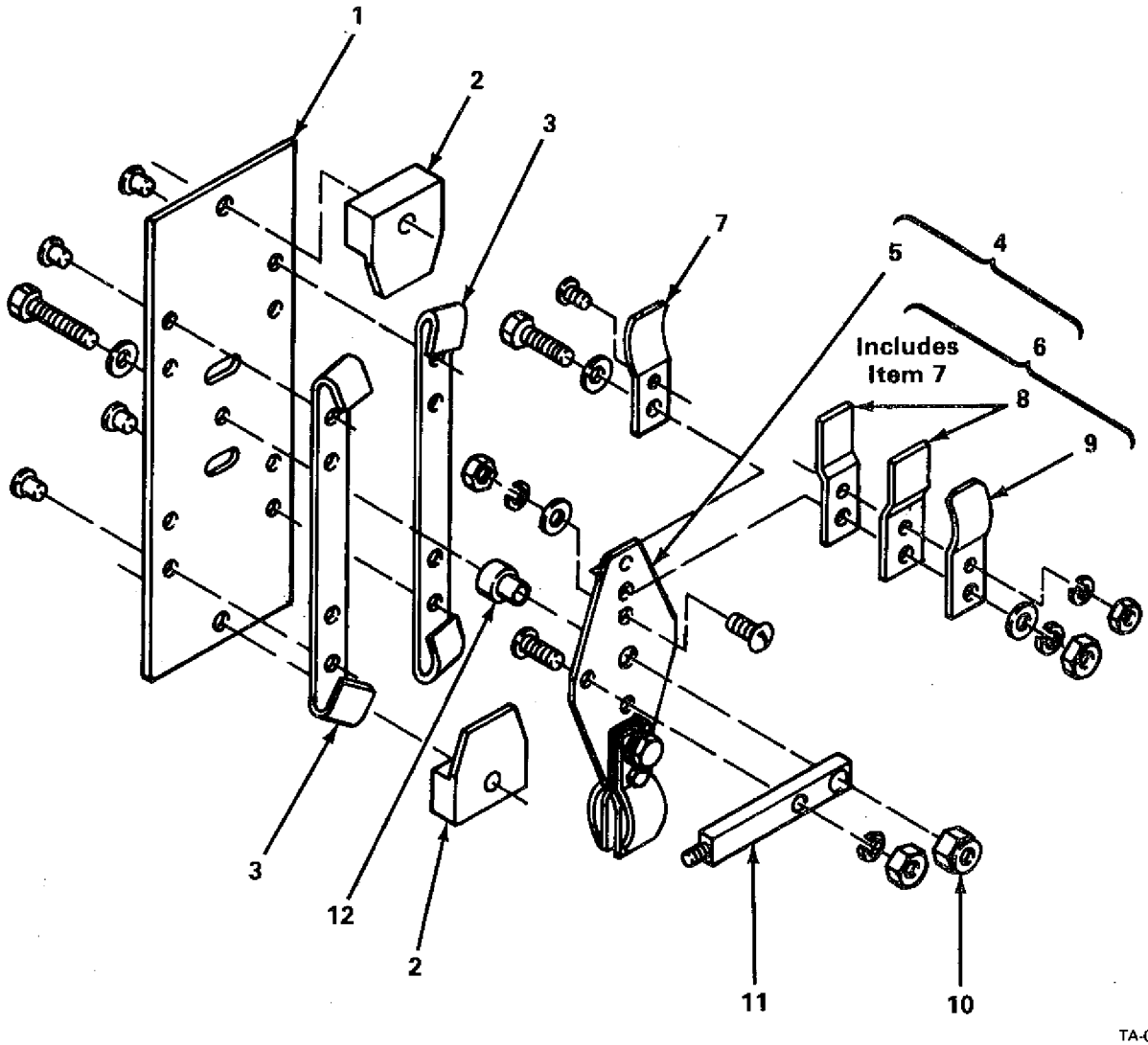

Figure G1C – Contact Board, Switch-Polarity

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

Item No.	Part No.	Description	Quantity Model 300 Amp	Quantity Model 500 Amp
Figure G1D		**Contact Board, Switch-Range (Fig G1 Pg 10 Item 9)**	004 265	059 082
1	103 634	MOUNTING BOARD,	1	1
2	011 948	GUIDE, contact	2	2
	021 193	GUIDE, contact		2
3	011 951	CONTACT, switch	2	
3	103 633	BUS BAR, shorting		4
4	038 769	CONTACT BOARD, switch-polarity (consisting of)	1	2
5	103 632	. PLATE, toggle switch	1	1
6	011 645	. CONTACT ASSEMBLY, movable (consisting of)	2	2
7	011 075	. . SPRING, pressure	1	1
8	011 953	. . CONTACT, switch	2	2
9	011 074	. . SPRING, pressure	1	1
10	604 318	NUT, self-locking hex 1/4-20	1	1
11	010 805	HANDLE	1	
11	039 257	HANDLE		1
12	024 694	BEARING	1	2
13	011 950	CONTACT, switch	2	

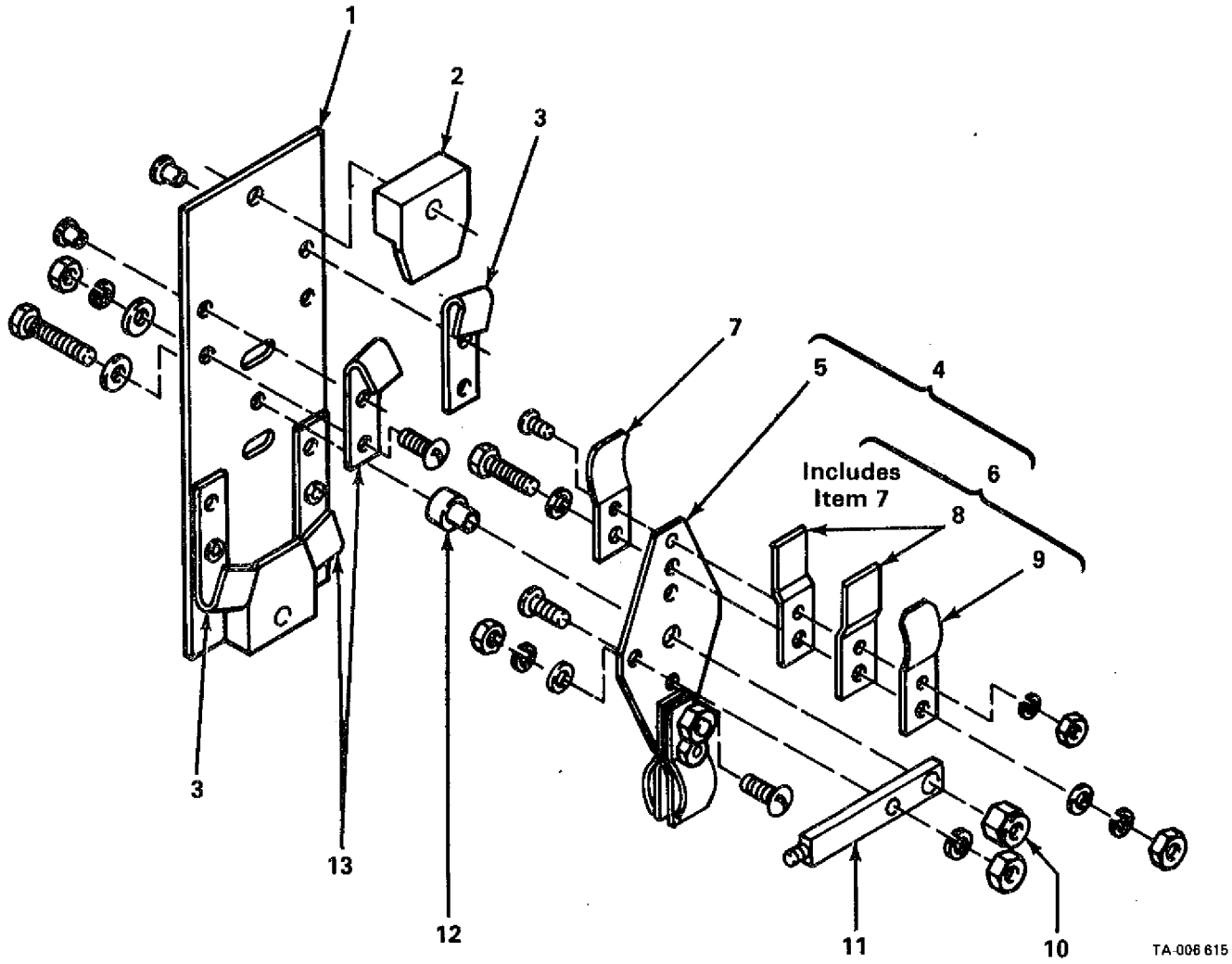

Figure G1D - Contact Board, Switch-Range

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model: Spot Timer 041 170	Quantity Model: Pre-flow Timer 041 172
Figure G2			**Spot Timer and Pre-flow Timer (Fig G Pg 8 Items 11 & 12)**		
1	S200	011 609	SWITCH, toggle SPDT 15 amp 125 volts	1	
1	S200	011 611	SWITCH, toggle DPDT 15 amp 125 volts		1
2		000 821	STRIP, mounting-circuit card	1	1
3		106 625	SPACER, 1/4 OD x 9/64 ID x 1	4	4
4		006 797	CIRCUIT CARD, spot timer (consisting of)	1	
		048 325	. CIRCUIT CARD, spot timer (consisting of)	1	
4		006 799	CIRCUIT CARD, pre-flow timer (consisting of)		1
		048 324	. CIRCUIT CARD, pre-flow timer (consisting of)		1
5	R205	028 769	. . POTENTIOMETER, carbon 1 turn 2 watt 750K ohm	1	
5	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
	D201	037 449	. . DIODE, zener, 15 volts 1 watt SP	1	1
	D202,203	026 202	. . DIODE, rectifier 1 amp 400 volts SP	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	028 769	. . 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
		048 105	. . TERMINAL, header 7 pin	1	1
		000 873	. . PLUG, protection	1	1
		048 104	. . HOUSING, terminal header 7 pin	1	1

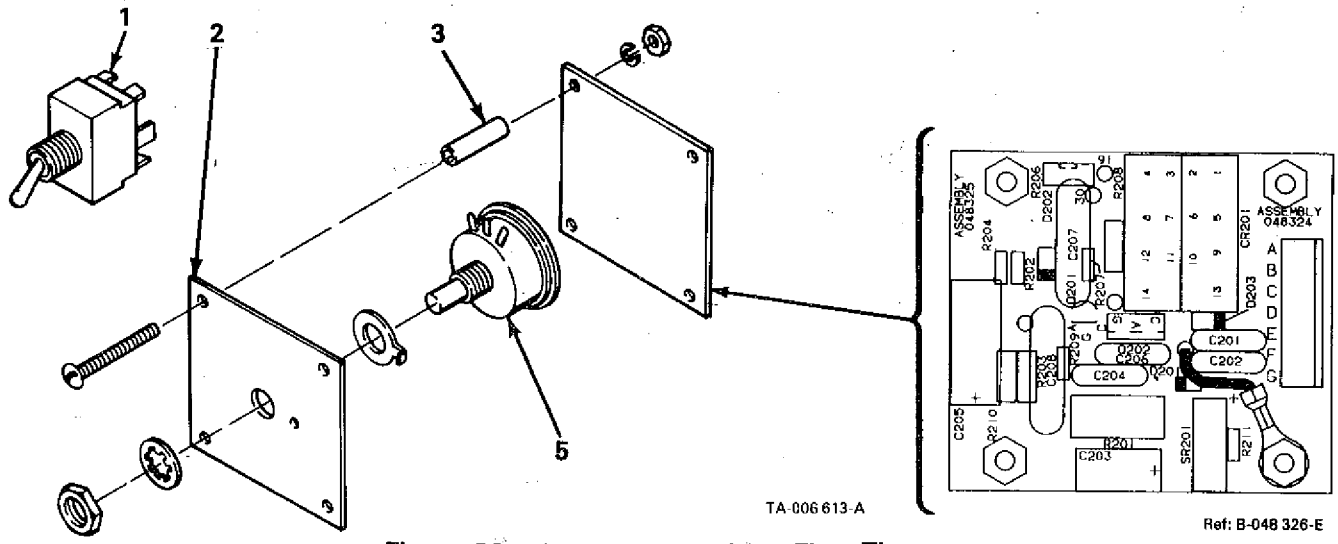

Figure G2 - Spot Timer And Pre-Flow Timer

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure G3			**Pulser Control (Fig G Pg 8 Item 13)**	
1		003 513	STRIP, mtg	1
2	R422	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	1
3	R420	004 186	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
4		106 625	SPACER, 1/4 OD x 9/64 ID x 1 inch	4
5		072 810	CIRCUIT CARD, pulser (consisting of)	1
	A400-402	035 845	. IC, linear	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	000 340	. CAPACITOR, ceramic 0.01 uf 50 volts	2
	C405	031 670	. CAPACITOR, ceramic 0.05 uf 500 volts dc	1
	C410	052 141	. CAPACITOR, ceramic 33 pf 1000 volts	1
	D400-403	028 351	. DIODE, 10MA 75 volts SP	4
	D404	026 202	. DIODE, 1 amp 400 volts SP	1
	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	035 885	. RESISTOR, carbon film 0.25 watt 68K 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
	R424	076 712	. RESISTOR, carbon 0.25 watt 220K ohm	1
	RC50	048 105	. TERMINAL, header 7 pin	1
	RC51	072 670	. TERMINAL, header 9 pin	1
6	R421	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
7	S400	011 609	SWITCH, toggle SPDT 10 amp 125 volts	1

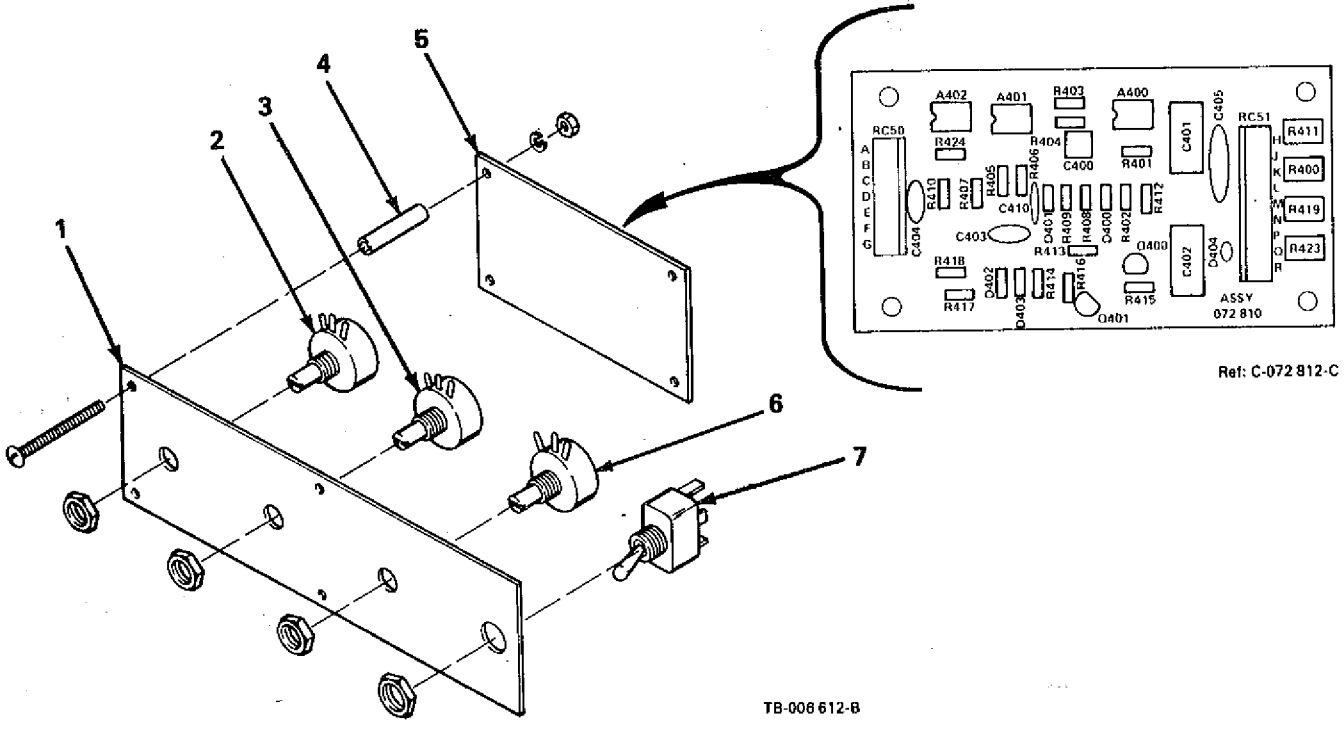

Figure G3 - Pulser Control

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

Dia. Mkgs.	Part No.	Description	Quantity
Figure G4	**052 790**	**Circuit Card, Post-Flow & HF Timer (Fig G Pg 8 Item 26)**	
A50	008 971	IC, linear	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, 1 amp 400 volts SP	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 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
R64	030 720	RESISTOR, carbon 1 watt 10K ohm	1
	039 348	TERMINAL, header 17 pin	1

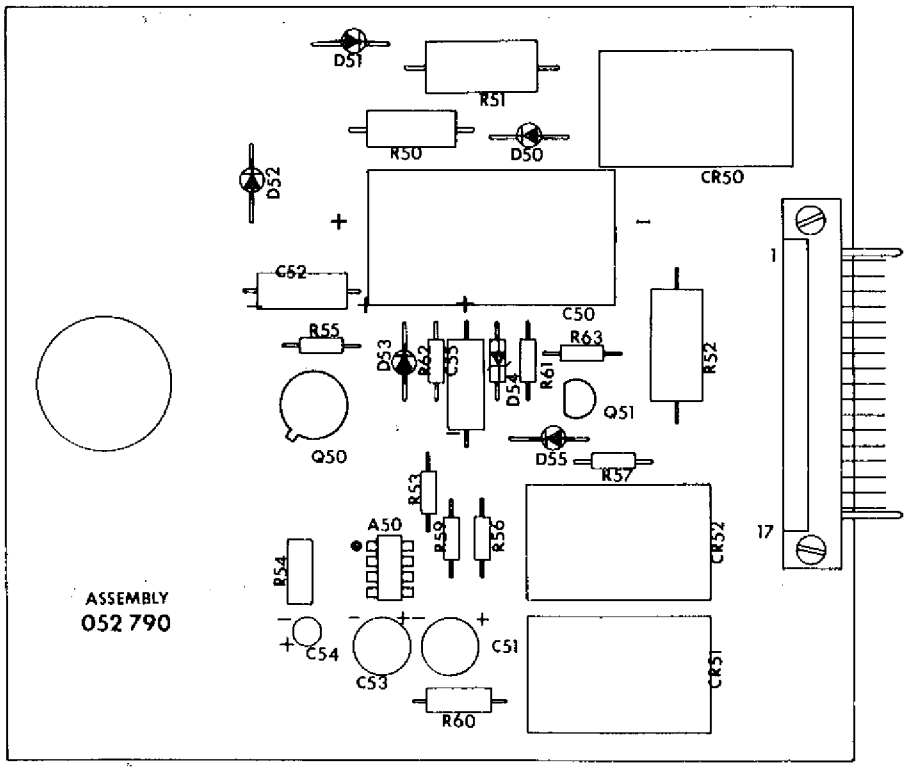

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Figure G4 - Circuit Card, Post-Flow & HF Timer

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure G5		**000 176**	**Rectifier, SCR Main (300 Amp) (Fig G Pg 8 Item 32)**	
1		044 604	SUPPRESSOR	4
2		010 311	CLAMP, 3/4 dia. x 1/2 wide	4
3	SCR1-4	000 251	THYRISTOR, 250 amp 300 volts	4
4		025 248	INSULATOR, stand-off	6
5	D1	037 957	DIODE, 275 amp 300 volts RP	1

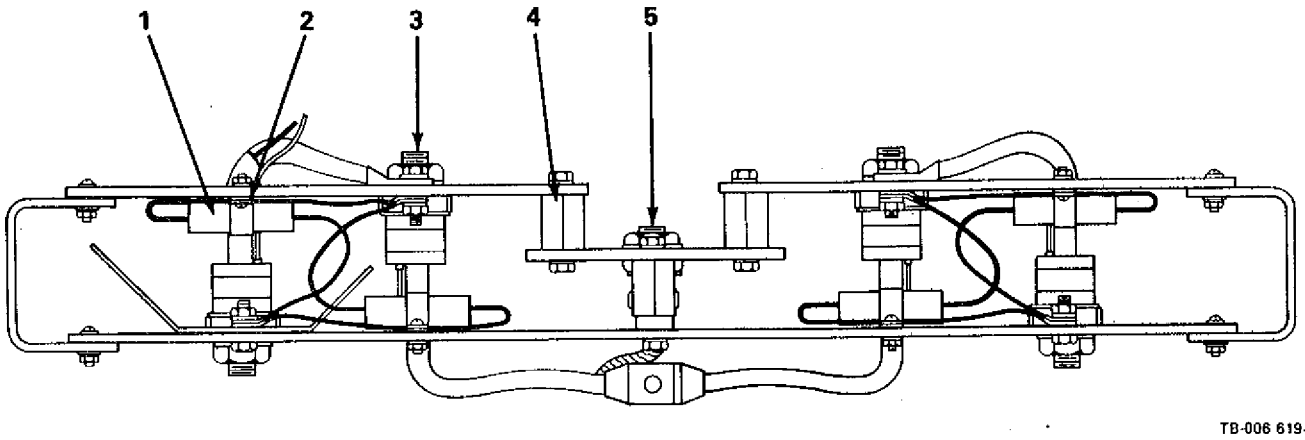


Figure G5 - Rectifier, SCR Main (300 Amp Models)

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

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure G6		**059 072**	**Rectifier, SCR Main (500 Amp) (Fig G Pg 8 Item 32)**	
1		083 884	CLAMP, thyristor	4
2		010 311	CLAMP, 3/4 dia x 1/2 wide	4
3	C7-10,R3-6	044 603	SUPPRESSOR	4
4		059 075	HEAT SINK	2
5	D1	023 178	DIODE, rectifier 275 amp 300 volts RP	2
6		005 212	HEAT SINK	2
7		028 516	PIN, 1/8 x 1/4	8
8	SCR1-4	059 512	THYRISTOR, 850 amp 300 volts	4

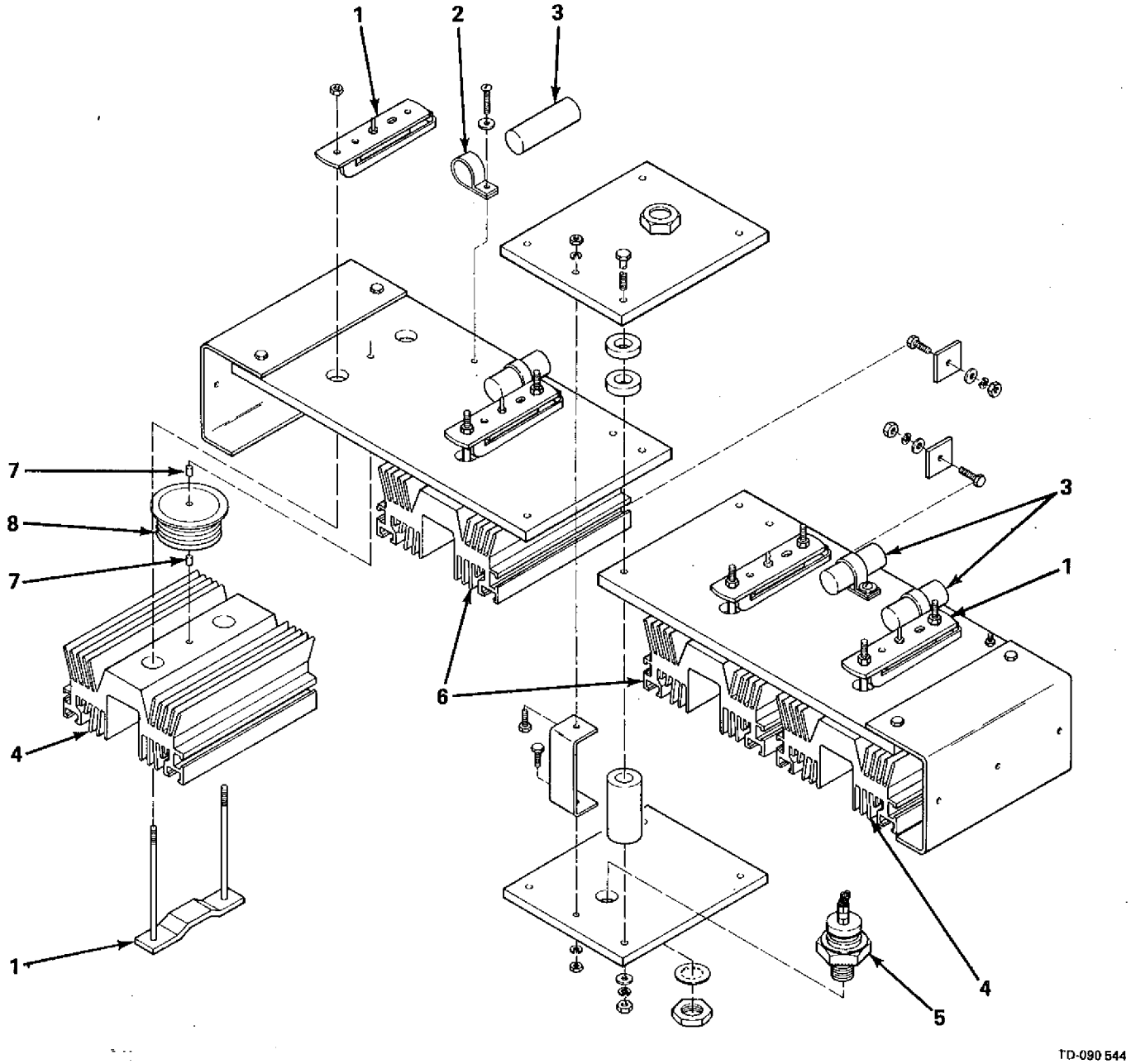
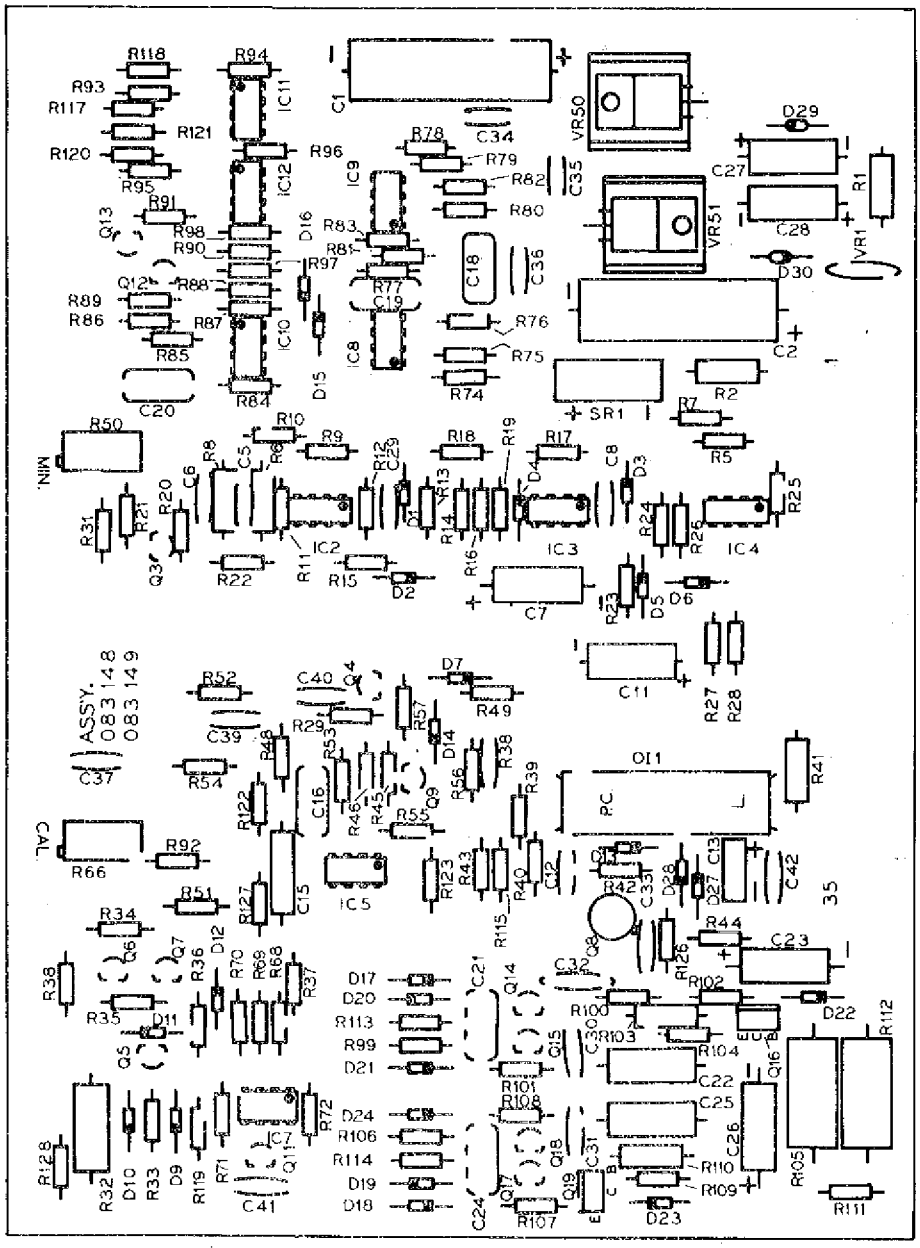


Figure G6 - Rectifier, SCR Main (500 Amp Models)

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

Dia. Mkgs.	Part No.	Description	Quantity
Figure G7	**110 459**	**Circuit Card, Control - Main (Fig G Pg 8 Item 25)**	
C1,2,23,26	000 859	CAPACITOR, electrolytic 220 uf 35 volts dc	4
C5,6,8,12	059 122	CAPACITOR, ceramic 0.01 uf 500 volts	4
C7	072 935	CAPACITOR, electrolytic 33 uf 35 volts dc	1
C11,27,28	007 742	CAPACITOR, electrolytic 10 uf 35 volts	3
C13	091 378	CAPACITOR, tantalum 33 uf 25 volts dc	1
C15	081 319	CAPACITOR, metal film 0.47 uf 50 volts dc	1
C16,19,20	034 286	CAPACITOR, poly film 0.1 uf 100 volts dc	3
C18	003 065	CAPACITOR, mylar 0.15 uf 100 volts dc (300 amp models only)	1
C18	059 231	CAPACITOR, poly film 0.18 uf 100 volts (500 amp model only)	1
C21,24	039 341	CAPACITOR, mylar 0.003 uf 100 volts dc	2
C22,25	003 530	CAPACITOR, ceramic 1 uf 50 volts	2
C29,33-42	053 991	CAPACITOR, ceramic 0.05 uf 500 volts	11



Components to be Replaced
By Qualified Personnel Only

Figure G7 - Circuit Card, Control-Main

Dia. Mkgs.	Part No.	Description	Quantity
Figure G7	**110 459**	**Circuit Card, Control - Main (Fig G Pg 8 Item 25) (Cont'd.)**	
C30-32	059 228	CAPACITOR, ceramic 0.02 uf 500 volts	3
D1-7, 9-11, 13-24, 27,28	028 351	DIODE, signal 0.02 amp 75 volts straight polarity	24
D12	004 145	DIODE, zener 18 volts 1 watt	1
D29,30	026 202	DIODE, rectifier 1 amp 400 volts straight polarity	2
IC2-5,7-12	035 845	IC, linear 307	10
OI1	039 351	ISOLATOR, photocell	1
Q3,5-7,9,11,12, 14,15,17,18	037 200	TRANSISTOR, 200 MA 40 volts NPN	11
Q4,13	037 201	TRANSISTOR, 200 MA 40 volts PNP	2
Q8	052 582	TRANSISTOR, 800 MA 40 volts NPN	1
Q16,19	039 354	TRANSISTOR, 4 amp 400 volts PNP	2
R1,2	030 089	RESISTOR, carbon 0.5 watt 2.7 ohm	2
R5,7,9,10, 23,36,51	035 884	RESISTOR, carbon film 0.25 watt 100K ohm	7
R6,8	028 278	RESISTOR, carbon 0.5 watt 4700 ohm	2
R11,12	039 336	RESISTOR, carbon film 0.25 watt 220K ohm	2
R13,17,20,72, 97,98,127	035 825	RESISTOR, carbon film 0.25 watt 1K ohm	7
R14,19,81	035 886	RESISTOR, carbon film 0.25 watt 22K ohm	3
R15,22,27,29,37, 40,57,70,82,86,89, 91,104,111, 119,126	035 827	RESISTOR, carbon film 0.25 watt 10K ohm	16
R16,92	035 826	RESISTOR, carbon film 0.25 watt 6800 ohm	2
R18	053 225	RESISTOR, carbon film 0.25 watt 39K ohm	1
R21,88,90,99,101, 106,108,128	039 331	RESISTOR, carbon film 0.25 watt 4700 ohm	8
R24,26,42,55	039 335	RESISTOR, carbon film 0.25 watt 47K ohm	4
R25,87	038 584	RESISTOR, carbon film 0.25 watt 470K ohm	2
R28,71	035 887	RESISTOR, carbon film 0.25 watt 3300 ohm	2
R31,45,46,48,49, 56,78,100,107, 113,114	035 888	RESISTOR, carbon film 0.25 watt 2200 ohm	11
R32	030 711	RESISTOR, carbon 1 watt 330 ohm	1
R33,35,75,85	039 332	RESISTOR, carbon film 0.25 watt 15K ohm	4
R34,52,102,109	039 330	RESISTOR, carbon film 0.25 watt 3900 ohm	4
R38,80,93,94-96	035 896	RESISTOR, carbon film 0.25 watt 33K ohm	6
R39	035 823	RESISTOR, carbon film 0.25 watt 100 ohm	1
R41	052 140	RESISTOR, carbon 0.5 watt 330 ohm	1
R43,44,115,123	039 329	RESISTOR, carbon film 0.25 watt 2700 ohm	4
R50	039 360	POTENTIOMETER, cermet 20 turn 0.5 watt 25K ohm	1
R53,122	039 106	RESISTOR, carbon film 0.25 watt 470 ohm	2
R54	003 272	RESISTOR, carbon film 0.25 watt 1 meg ohm	1
R66	004 596	POTENTIOMETER, cermet 25 turn 0.5 watt 2K ohm	1
R68,69	035 885	RESISTOR, carbon film 0.25 watt 68K ohm	2
R74,83,84	039 333	RESISTOR, carbon film 0.25 watt 18K ohm	3
R76	039 334	RESISTOR, carbon film 0.25 watt 47K ohm	1
R77	039 337	RESISTOR, carbon film 0.25 watt 330K ohm	1
R79	039 338	RESISTOR, carbon 0.25 watt 3.9 ohm	1
R103,110	030 038	RESISTOR, carbon 0.25 watt 220 ohm	2
R117,118,120,121	035 824	RESISTOR, carbon film 0.25 watt 270 ohm	4
SR1	021 939	RECTIFIER, integrated 1.5 amp 400 volts	1
VR1	035 227	VARISTOR, 8 joule 150 volts	1
VR50	081 832	IC, linear 78M15	1
VR51	046 932	IC, linear 7915	1
	035 505	TERMINAL, header 35 pin	1

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

(OPTIONAL)

SYNCROWAVE® PROGRAMMERS
SP1 SP2 SP3 SP4

For Semi-automatic or Fully Automatic Weld Programming

— with **Electroslope®** . . . for exact control of weld current buildup or decay.

— with **Pulser**. . . for improved penetration and better control of the weld puddle.

— with **Sequencer**. . . for automated welding and programmed procedures.

Provides timer accuracies within ± .01 second (1 cycle) repeatability.

STANDARD FEATURES

- Line Voltage Compensated
- Convenient Up-Front Controls
- Low Cost . . . Dependable Integrated Circuitry Throughout
- Available for 50 or 60 Hz Operation
- Digital Timers in SP3, SP4, for Precise Accuracy
- Programs AC or DC Welding Current
- Pulses AC or DC Welding Current (SP2 and SP4 only)
- Top Tool Storage Area with Lock
- Syncrowave 300 Lifting Eye Remains Accessible

APPLICATIONS

- Fully Automated AC or DC Welding
- Precision Fixtured Welding Applications
- Aerospace/Aircraft Assembly of Components
- Nuclear Piping & Subassembly
- Power Plant Construction & Components
- Chemical Industry Apparatus
- Automated Tube Mills
- Food Processing Equipment
- Military Hardware
- High Volume Specialty Production

Electroslope Only
Stock No. **041 197** (Factory) **041 609** (Field)
Controls the rate of weld heat input during initial starting and final phases of the weld. Minimizes cratering problems. Upslope and Downslope timers are 0-10 seconds. Includes an RHS-46 remote single button torch switch with 20 ft. cord to manually trigger the slope operations. Operates on 50 or 60 Hz. Pre-flow option installed in Syncrowave 300 is recommended.
Field installed Pulser Stock No. **041 327**

Electroslope and Pulser
Stock No. **041 198** (Factory) **041 610** (Field)
Pulsed current provides controlled penetration, reduced warping and better control of the weld puddle. Excellent for out-of-position GTAW (TIG) and SMAW (stick) applications. Includes Electroslope features of SP1. Includes RHS-46 remote torch switch.
Pre-flow option installed in Syncrowave 300 is recommended.

Electroslope and Sequencer
Stock No. **041 199** (Factory) **041 611** (Field)
Provides weld programming by means of solid state timers. Incorporates the features of Electroslope plus three timed intervals:
Initial current, dwell to time interval from start of weld current to beginning of upslope. 0-88.9 sec.
Upslope and weld, begins at end of initial current. Times upslope and weld current. 0-99.99 min.
Downslope and final current, starts at end of weld current. Times downslope and final current. 0-99.99 sec.
Pre-flow option installed in Syncrowave 300 is recommended.
SP3-50 Stock No. **041 234** Same as SP3 except with 50 Hz Timers.
Field installed Pulser Stock No. **041 328**

Electroslope, Pulser and Sequencer
Stock No. **041 200** (Factory) **041 612** (Field)
For weld repeatability on high volume production runs. Has all the features and performs functions of SP1, SP2 and SP3. Used on fully automatic welding applications to eliminate manual variables. Pre-flow option installed in Syncrowave 300 is recommended.
SP4-50 Stock No. **041 235** Same as SP4 except with 50 Hz Timers.

OPTIONAL EQUIPMENT (POWER SOURCE)

SPOT WELD TIMER
Stock No. **041 170** (Factory)
Stock No. **041 171** (Field Kit)
Provides an adjustable spot weld time from 0 to 5 seconds. On/Off switch included.

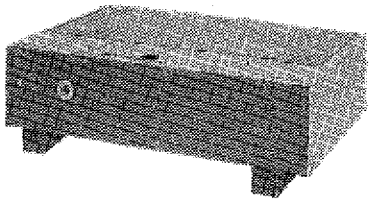
PULSER
Stock No. **003 265** (Factory)
Stock No. **003 266** (Field Kit)
Permits welding of extra thin materials, easier and better welding of piping with inserts. Provides heating and cooling effect of the weld puddle with pulsed current.

PRE-FLOW TIMER
Stock No. **041 172** (Factory)
Stock No. **041 173** (Field Kit)
Provides 0 to 15 seconds of gas pre/flow time. On/Off switch included.

LOW AMP RANGE
Stock No. **041 402** (Factory) **041 403** (Field)
Replaces Standard low range (5-75) with 2 to 37 amperes.

VOLT AND AMMETERS (for 300 only)
Stock No. **000 544** (Factory)
Stock No. **000 545** (Field)
Indicates ac and dc output. Meters mount in control panel. Meters are standard on 500 model. Low range meters for use with LOW AMP RANGE modification (300 model only).
Stock No. **041 400** (Factory) Stock No. **041 401** (Field)

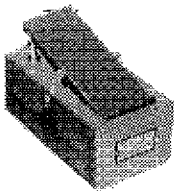
No. 17 RUNNING GEAR
Stock No. **004 563**
Three 8" (20.3 cm) rubber tired wheels with towing handle and rack for two cylinders.



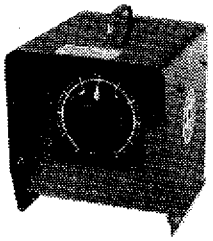
COOLMATE 12 WATER COOLANT SYSTEM
Stock No. **041 174** (for 300 only)
Provides a 12 gallon (45.4 liter) capacity for circulating water. 115 volts AC motor, 115 volts receptacle provided on power sources. Power source mounts on top for space saving. Use with No. 16 and 17 running gear.

RADIATOR 1 AND 2 WATER COOLANT SYSTEM
1.5 gal (5.7 L) capacity
Radiator 1, 115 volts Stock No. **041 398**
Radiator 2, 230 volts Stock No. **041 399**
For use with Syncrowave 300 and 500 models.

RFCS-23 REMOTE FOOT CONTROL
Stock No. **041 148**
Provides current and contactor control. 10 ft. (3 meters) cord included.



RHCS-3 REMOTE HAND CONTROL
Stock No. **041 146**
Controls current output at remote position. 10 ft. (3 meters) cord included.



RHC-23
Stock No. **041 326**
Remote hand current and contactor control with 20' (6 m) cord and plug.

RHS-24
Stock No. **041 203**

Remote rocker type hand switch with momentary and maintained contact. Includes 28 ft. (8.5 m) cable and plug pre-wired.

FTC-23
Stock No. **006 342**

Remote fingertip control can be taped to TIG torch allowing operator contactor control and variable control of welding current. Includes 28 ft. cable and plug pre-wired.

EXTENSION CORDS FOR REMOTE CONTROLS
25' (7.6 m) Stock No. **041 294**
50' (15 m) Stock No. **041 293**