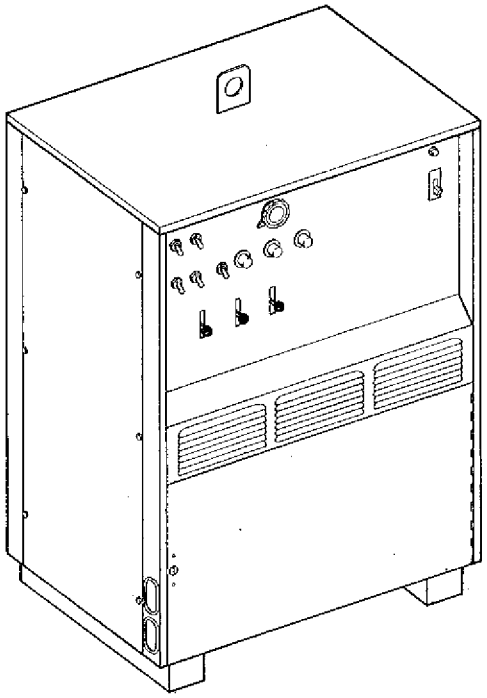
March 1975 FORM: OM-350

Effective with serial No. HF844063

MODEL	STOCK NO.
Syncrowave 300	901 718



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

OWNER'S MANUAL

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

NWSA CODE NO. 4579

PRINTED IN U.S.A.

WARRANTY

MILLER Electric Mfg. Co., Appleton, Wisconsin, warrants all new equipment to be free from defects in material and factory workmanship for the periods indicated below, provided the equipment is installed and operated according to manufacturer's instructions.

MILLER Electric Mfg. Co.'s obligation, under this warranty, is limited to replacing or repairing any defective part or correcting any manufacturing defect without charge during the warranty period if MILLER'S inspection confirms the existence of such defects. MILLER'S option of repair or replacement will be f.o.b. factory at Appleton, Wisconsin or f.o.b. a MILLER authorized service facility, and therefore no compensation for transportation costs of any kind will be allowed.

The warranty period, beginning on the date of sale to the original purchaser-user of the equipment, will be as follows:

1.	Arc welders, power sources, and components	–	1 year
2.	Original main power rectifiers	–	3 years (unconditionally)
3.	MHFC-L1 Feeder, MHG-35C1, 20E, 20K, and all guns and torches	–	90 days
4.	All other Millermatic Feeders	–	1 year
5.	Mag-Diesel engine on DEL-200	–	6 months
6.	All other engines	–	1 year

Engine Warranties are covered by the engine manufacturers, subject to their procedures and to be handled through their authorized local Service Stations or agencies. No warranty will be made in respect to trade accessories, such being subject to the warranties of their respective manufacturers.

MILLER Electric Mfg. Co. will not be liable for any loss or consequential damage or expense accruing directly or indirectly from the use of equipment covered in this warranty.

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

OPTIONAL ACCESSORIES

RHCS-3 Remote Hand Control (Stock No. 041 146)

Controls current output at remote position. 10 foot cord included.

RFCS-23 Remote Foot Control (Stock No. 041 148)

Provides current and contactor control. 10 foot cords included.

Coolmate "12" Water Coolant System (Stock No. 041 174)

Provides a 12 gallon capacity for circulating water. 115 volts AC motor, power source mounts on top for space saving.

No. 1 Running Gear (Stock No. 040 006)

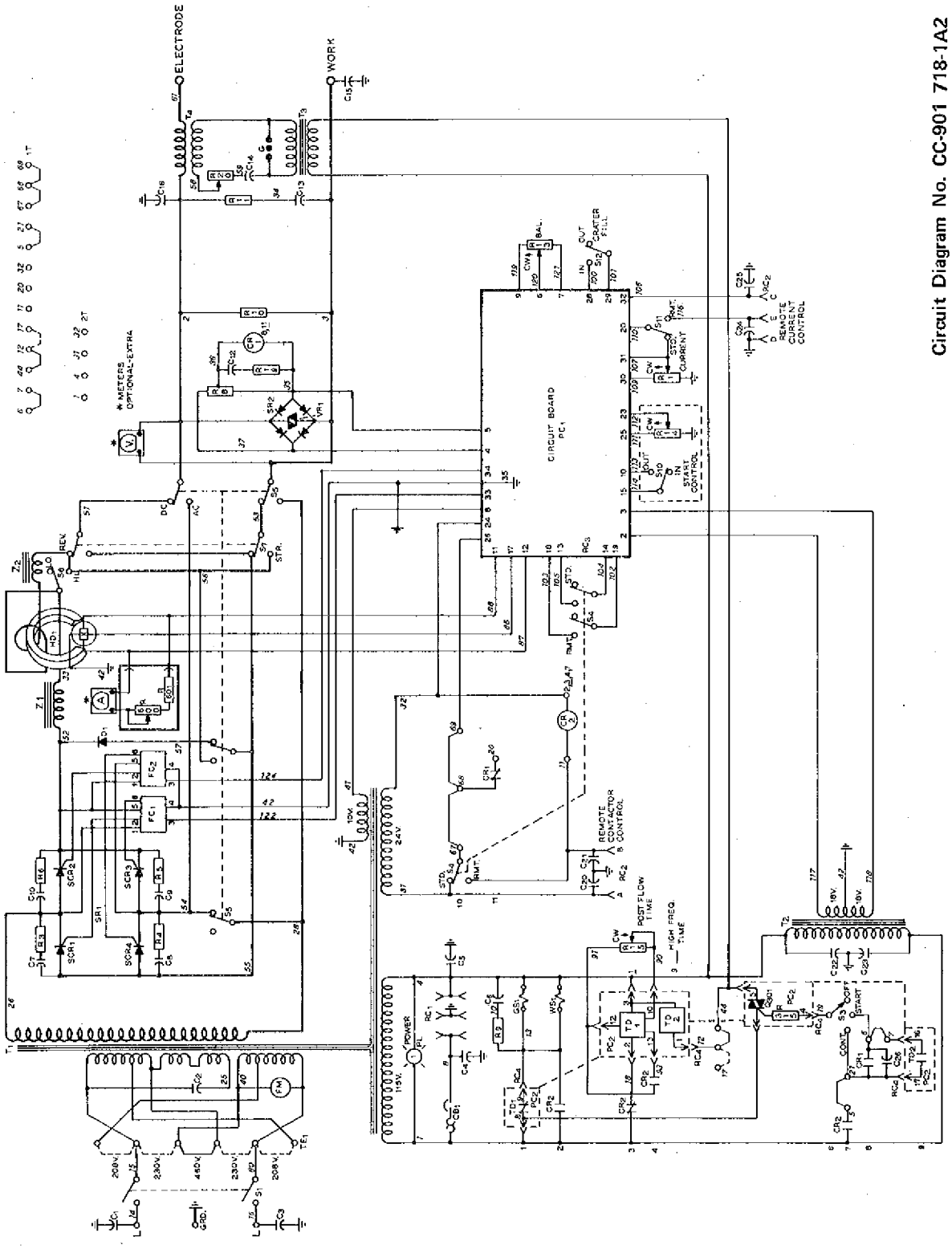
Four 8" steel wheels with towing handle. Carries welder only.

No. 2 Running Gear (Stock No. 040 011)

Four 8" rubber tired wheels with towing handle. Carries welder only.

ERRATA SHEET

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

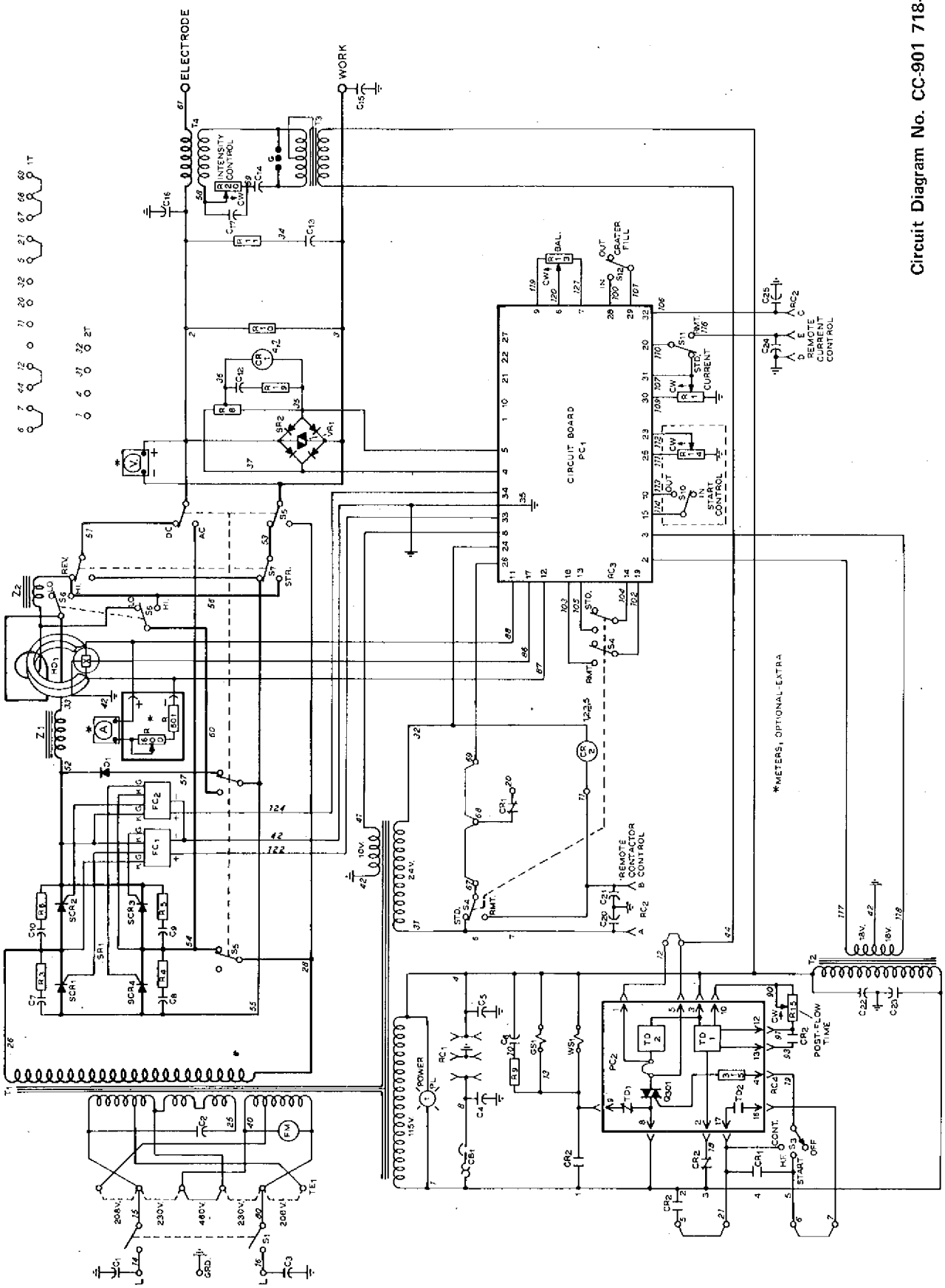


Circuit Diagram For Models Effective With Serial No. HF844603 Thru HF870848 Which Are Equipped With Capacitor C26.

Circuit Diagram No. CC-901 718-1A2

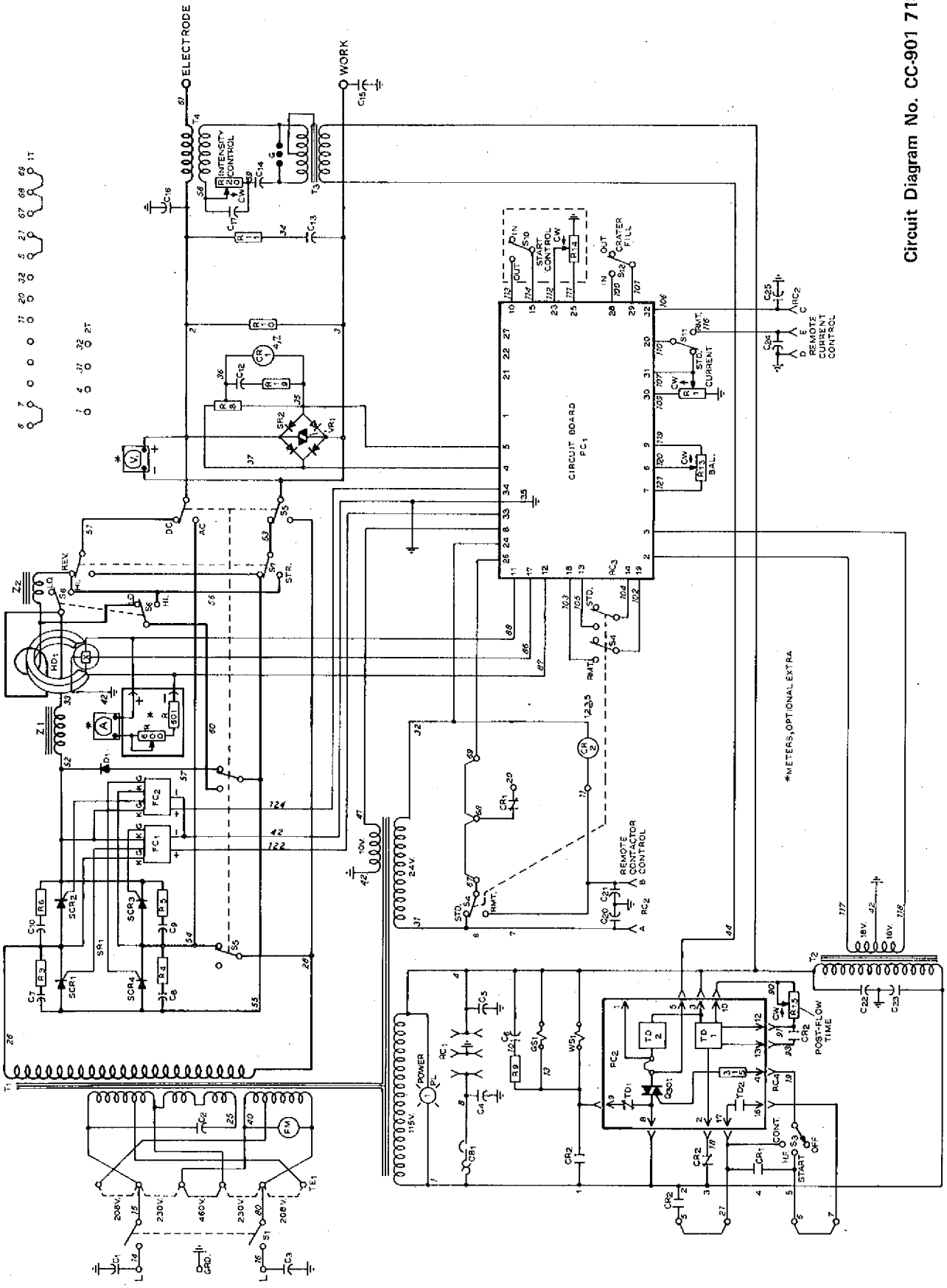
NOTE

Determination as to whether or not the machine in question is or is not equipped with capacitor C26 can be made by visually checking for the presence of C26 across the normally-open contacts of relay CR1.



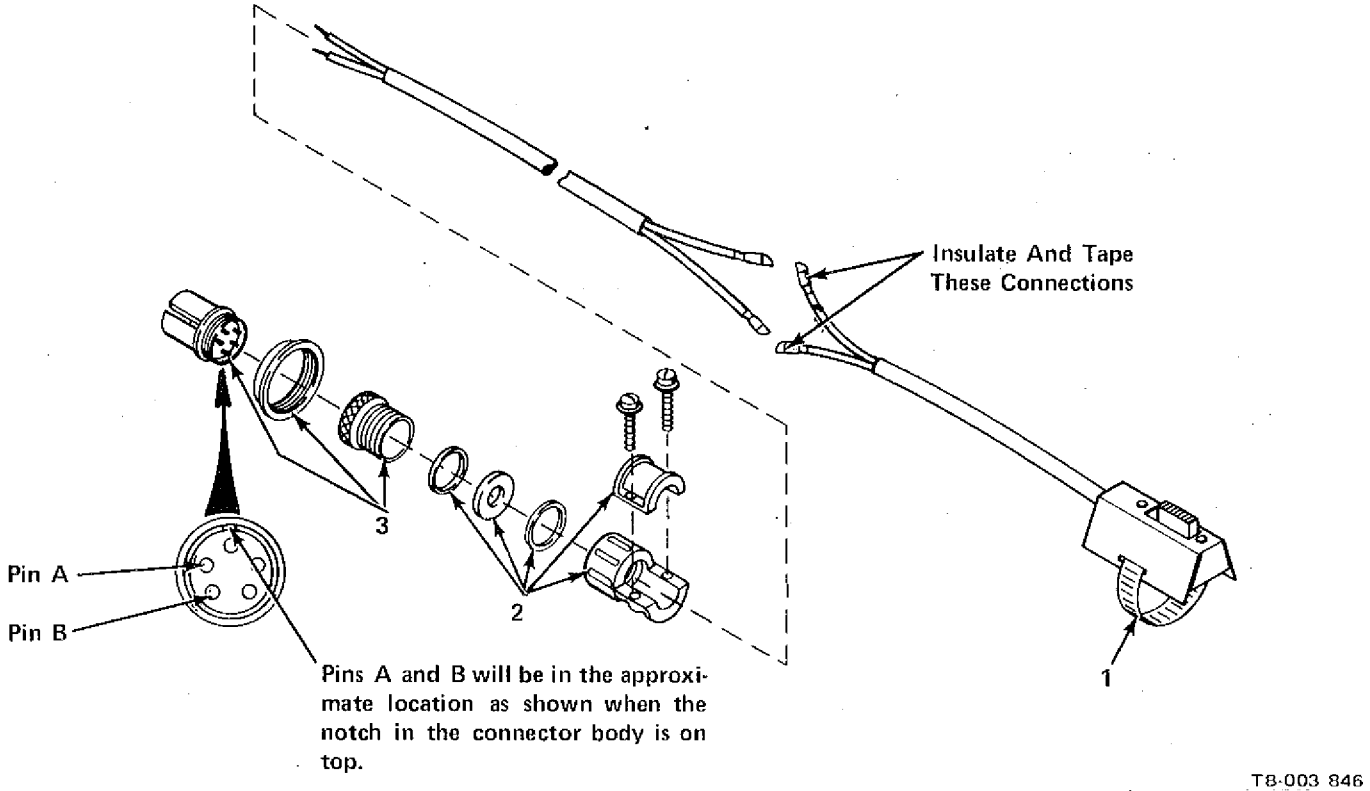
Circuit Diagram No. CC-901 718-1B2

Circuit Diagram For Models Effective With Serial No. HF844603 Thru HF870848 Which Are Not Equipped With Capacitor C26.



Circuit Diagram No. CC-901 718-1C

Circuit Diagram For Models Effective With Serial No. HF870849 And On.



T8-003 846

Remote control of the solid-state contactor in the welding power source can be achieved through use of the supplied maintained contact slide switch. The switch is supplied with a clamp for attachment to the TIG electrode holder handle. An 18/2 conductor cord of desired length will have to be supplied for making connections between the slide switch leads and pins A and B of the supplied amphenol plug.

IMPORTANT

Do not attempt to inject 115 volts into pins A and B as 24 volts is present at these pins. Failure to comply will result in damage to the welding power source.

Page No.	Dia. Mkgs.	Part No. Listed In Parts List	Replaced With Part No.	Description	Quantity
Page 1	C26	031 699	+Deleted		
Page 1	PC1	000 062	004 223	CIRCUIT CARD ASSEMBLY, control	1
Page 2	R20	603 942	605 828	RHEOSTAT, WW 50 watt 1.5 ohm	1
Page 2	S5-7	039 261	004 266	SWITCH, range/polarity/selector	1
Page 2	S6	000 877	004 265	CONTACT BOARD ASSEMBLY, range	1
Page 2	S6	011 948	011 948	GUIDE (quantity changes)	2
Page 2	S6	011 950	011 950	CONTACT, switch-top front & bottom rear (quantity changes)	2
Page 2	S6	011 951	011 951	CONTACT, switch-top rear & bottom front (quantity changes)	2
Page 2	S6	020 760	038 769	CONTACT BOARD ASSEMBLY, movable	1
Page 3		010 736	003 231	TUBING, steel 5/8 OD x 12 ga wall x 1-1/8	2
Page 3		022 309	003 230	TUBING, steel 5/8 OD x 12 ga wall x 2-5/8	2
Page 3		025 181	Deleted		
Page 3		039 255	004 267	LINK, jumper - switch (range & polarity)	1
Page 3		000 797	004 602	HF PANEL (Eff with S/N HF865855)	1
Page 4		000 015	003 043	DOOR, access - front (Eff with S/N HF865861)	1
Page 4		000 017	003 045	PANEL, front - louvered (Eff with S/N HF865861)	1
Page 4		039 305	004 517	PANEL, front (Eff with S/N HF865861)	1
Page 4		039 297	003 034	BASE (Eff with S/N HF865861)	1
	C17		031 602	CAPACITOR, mica 0.002 uf 5000 volts dc	1
	D27		+028 351	DIODE, 10MA 75 volts straight polarity	1
			+011 754	SWITCH, slide - maintained w/cord & clamp	1
			+039 685	CLAMP, cable AN-3057-8	1
			+039 273	PLUG, 5 pin MS3106A-16S-8P	1

+These items are effective with serial No. HF858556.

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

CERTIFICATE

NAME OF EQUIPMENT:_____ MODEL NO._____

SERIAL NO._____ DATE_____

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

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

USER'S CERTIFICATION

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

Date Installed_____ Signed_____

TABLE OF CONTENTS

SECTION 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.

Responsibilities of installer, user, and serviceman. Installation, operation, checking, and repair of this equipment must be done only by a competent person, experienced with such equipment.

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 these safety rules. ANSI Z49.1 is the most complete.

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

1-2. GENERAL PRECAUTIONS

A. Burn Prevention

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

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

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

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

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

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

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

B. Toxic Fume Prevention

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

Lead, cadium, 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. The space will then be safe to re-enter, if downstream valves have been accidently opened or left open.

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 trichlorethylene or perchlorethylene.

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 can not be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

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

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

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

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

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

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

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

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

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

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

D. Compressed Gas Equipment

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

1. Pressure Regulators

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

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

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

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

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

2. Cylinders

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

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

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

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

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

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

Secure from falling. Chain or secure cylinders upright when a regulator (and hose) are connected to it.

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 metal 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. For metal-to-metal seating, use correct wrenches, available from your supplier. For O-ring connections, hand tighten.

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.
Before opening cylinder valve, check that hoses are connected and that downstream valves are closed.

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. It will reduce backfiring and chance of flashbacks.

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

E. User Responsibilities

Remove leaky or defective equipment from service immediately and repair them only if recommended in equipment instruction manual. Send others for repair to manufacturer's designated repair center where special techniques and tools are used by trained personnel. Refer to User Responsibilities 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 1-2 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. 9 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.

*Trademark of Proctor & Gamble.

3. Protection of Nearby Personnel

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

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

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

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

B. Toxic Fume Prevention

Comply with precautions in 1-2B.

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

C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

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

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

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

D. Compressed Gas Equipment

Comply with precautions in 1-2D.

E. Shock Prevention

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

To protect against shock:

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

1. Grounding the Equipment

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

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

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

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

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

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

6. Electrode Wire

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

7. Safety Devices

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

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

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

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

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

1-4. STANDARDS BOOKLET INDEX

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

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

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

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

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

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

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

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

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

SMAW - Shielded Metal-Arc (Stick Electrode) Welding
GTAW - Gas Tungsten-Arc (TIG) Welding

Figure 2-1. Specifications

2-1. GENERAL

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

2-2. RECEIVING-HANDLING

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

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

2 - 3. DESCRIPTION

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

2-4. SAFETY

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

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

CAUTION

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

IMPORTANT

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

NOTE

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

SECTION 3 - INSTALLATION

3-1. LOCATION (Figure 3-1)

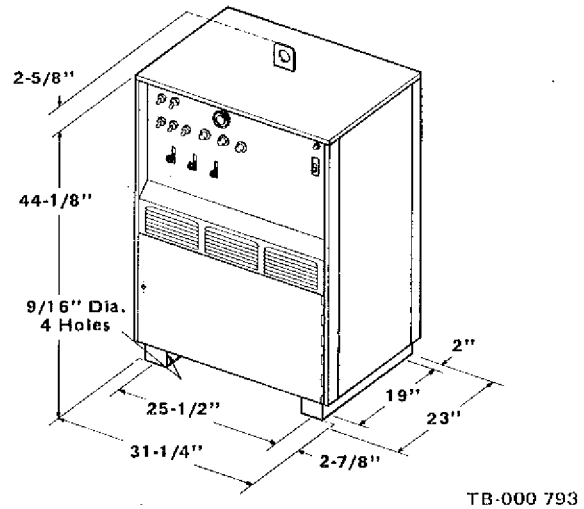


Figure 3-1. Overall Dimensions and Mounting Hole Layout

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

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

IMPORTANT

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

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

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

IMPORTANT

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

3-2. ELECTRICAL INPUT CONNECTIONS

NOTE

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

CAUTION

Before making electrical input connections to the welding power source, "machinery lockout procedures" should be employed. If the connection is to be made from a line disconnect switch, the switch should be padlocked in the open position. If the connection is made from a fuse box, remove the fuses from the box and padlock the cover in the closed position. If locking facilities are not available, attach a red tag to the line disconnect switch (or fuse box) to warn others that the circuit is being worked on.

A. Input Electrical Requirements

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

B. Input Conductor Connections

CAUTION

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

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

Table 3-1. Input Conductor and Fuse Size

Input Conductor Size -- AWG			Fuse Size -- Amps		
200(208)V	230V	460V	200(208)V	230V	460V
3/0 (6)	2/0 (6)	3 (8)	200	175	90

Parenthetical numbers ( ) refer to ground conductor size.

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

NOTE

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

Connect the two input conductors to the terminals on the primary terminal board labeled L or LINE and connect the ground conductor to the terminal labeled GRD (See Figure 3-2). The remaining end of the ground conductor should be connected to a proper ground. Use whatever grounding method that is acceptable to the local electrical inspection authority.

CAUTION

The terminal labeled GRD is connected to the welding power source chassis and is for grounding purposes only. Do not connect a conductor from the terminal labeled GRD to any one of the L or LINE terminals as this will result in an electrically hot welding power source chassis.

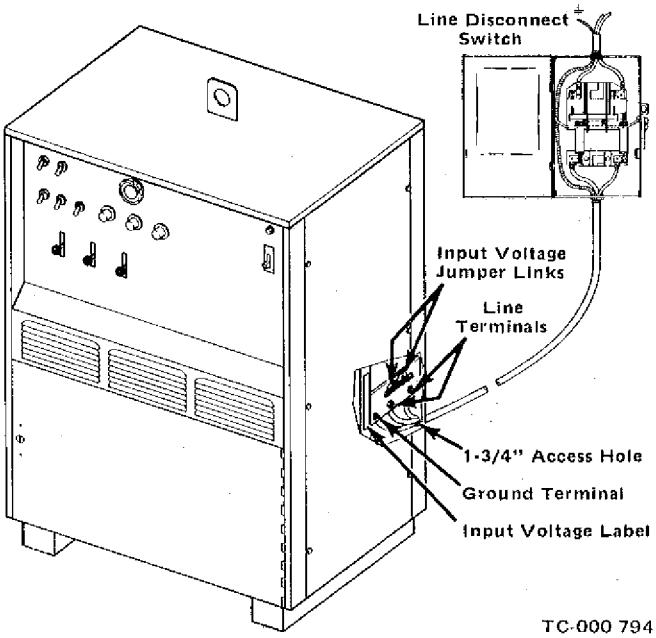


Figure 3-2. Input Conductor Connections

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

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

NOTE

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

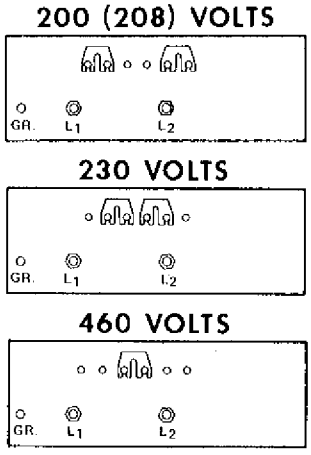


Figure 3-3. Input Voltage Jumper Link Arrangement

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

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

A. Welding Cables

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

Table 3-2. Secondary Cable Sizes

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

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NOTE: *A. 50 FEET OR LESS.
B. CABLE SIZE IS BASED ON DIRECT CURRENT (DC), 60% DUTY CYCLE AND EITHER A 4 VOLTS OR LESS DROP OR A CURRENT DENSITY OF NOT OVER 300 CIRCULAR MILS PER AMP.
C. WELD CABLE INSULATION WITH A VOLTAGE RATING TO WITHSTAND THE OPEN-CIRCUIT VOLTAGE (OCV) OF THE WELDING POWER SOURCE MUST BE USED. WHILE MOST WELDING POWER SOURCES HAVE AN OPEN-CIRCUIT VOLTAGE OF LESS THAN 100 VOLTS, SOME WELDING POWER SOURCES OF SPECIAL DESIGN MAY HAVE HIGHER OPEN-CIRCUIT VOLTAGE.

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

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

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

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

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

NOTE

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

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

3 - 6. 115 VOLTS AC RECEPTACLE (Figure 4-1)

A grounded duplex receptacle is provided to furnish 115 volts ac to operate external accessories. A 10 Ampere circuit breaker (see Figure 4-1) limits the current obtainable from the duplex receptacle.

SECTION 4 - FUNCTION OF CONTROLS

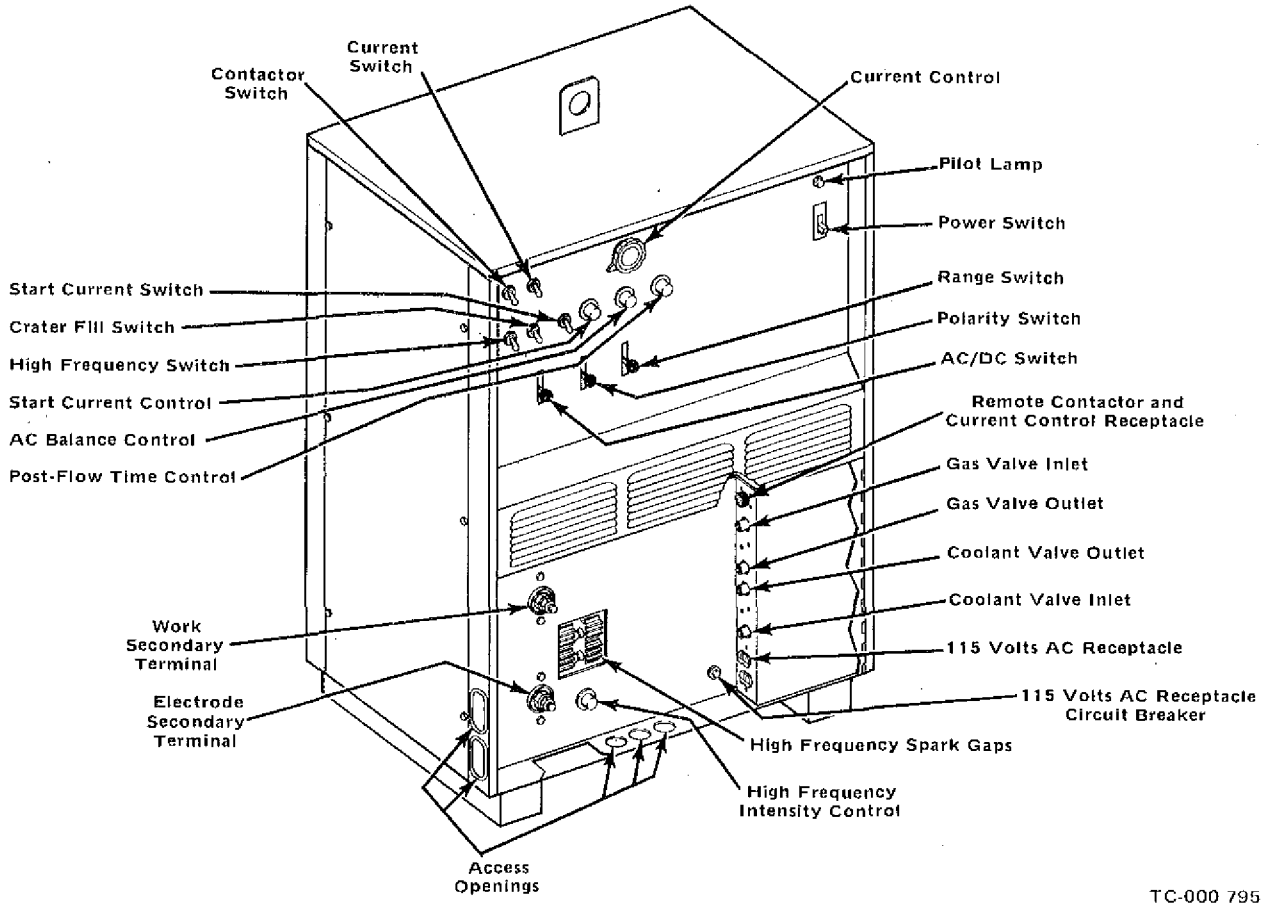


Figure 4-1. Front Panel View

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

CAUTION

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

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

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

A. Range Switch

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

Fine amperage adjustment within the coarse range selected is to be accomplished by the CURRENT CONTROL. The complete function of this control is explained in item 4-1B.

IMPORTANT

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

B. Fine Current Control

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

NOTE

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

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

C. Current Switch

If a Remote Current Control is to be used, make connections from the Remote Current Control to the REMOTE CONTACTOR AND CURRENT CONTROL Receptacle as instructed in item 3-5.

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

D. Polarity Switch

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

Placing the POLARITY Switch in the STRAIGHT position will cause the ELECTRODE Secondary Terminal to be of negative polarity and the WORK Secondary Terminal to be of positive polarity. Conversely, if the POLARITY Switch is placed in the REVERSE position, the ELECTRODE Secondary Terminal will be of positive polarity and the WORK Secondary Terminal will be of negative polarity. The POLARITY Switch has no effect on the welding operations when the AC/DC Switch is in the AC position.

IMPORTANT

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

E. AC/DC Switch

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

IMPORTANT

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

4 - 3. START CURRENT CONTROL (Figure 4-1)

The Start Current Control facility in this welding power source permits the operator to select an amperage setting for arc initiation which is different from the setting of the CURRENT CONTROL. The starting current which is selected will be in effect for approximately the first second of the weld. After this time period, the weld current will go 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 will be functional. Placing the START CURRENT Switch to the ON position will make the START CURRENT Control operative. The OFF position will make the START CURRENT Control inoperative and 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 will either slope up or down to the setting of the CURRENT CONTROL.

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

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

The Contactor Control Circuitry in this welding power source provides a means of making weld output available whenever desired without having to position the POWER Switch ON or OFF.

If a Remote Contactor Control is to be used, make connections to the REMOTE CONTACTOR AND CURRENT CONTROL Receptacle as instructed in item 3-5.

If a Remote Contactor Control is not to be used, place the CONTACTOR Switch to the STANDARD position. When in the STANDARD position, weld output will be available as soon as and for as long as the POWER Switch is positioned to ON.

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

CAUTION

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

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

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

A. Start Position

When in the START position, high-frequency will be present at the welding electrode when the arc is initiated and for approximately 2.5 seconds thereafter. Once the 2.5 second time interval has expired, and even though the Remote Contactor Control Switch is closed, the high-frequency will be de-energized. High-frequency will be present again automatically whenever the arc requires high-frequency.

B. Continuous Position

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

C. Off Position.

High-frequency will not be available when in the OFF position, even if the Remote Contactor Control Switch is closed.

CAUTION

The high-frequency unit 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 HIGH FREQUENCY Switch. To prevent high-frequency from being present at the secondary terminals when the Shielded Metal-Arc (Stick Electrode) Welding process is used, ensure that the CONTACTOR Switch is in the STANDARD position and also that the Remote Contactor Control is disconnected from the welding power source.

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

An adjustable 0 to 60 second Coolant-Gas POST-FLOW TIME Control is provided for controlling the period of time shielding gas and coolant will be allowed to flow after the arc is extinguished. The POST-FLOW TIME Control governs the operation of a Post-Flow Timer within the welding power source.

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

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

NOTE

The Post-Flow Timer is automatically disabled whenever the CONTACTOR Switch is in the STANDARD position and the Remote Contactor Control is disconnected from the welding power source, despite the position of the POST-FLOW TIME Control. To prevent the Gas/Coolant Valves from being operable when the Shielded Metal-Arc (Stick Electrode) Welding process is used, ensure that the CONTACTOR Switch is in the STANDARD position and also that the Remote Contactor Control is disconnected from the welding power source.

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

The CRATER FILL Switch provides a means for selecting whether the Crater-Fill circuit will be operative or not. Placing the CRATER FILL Switch in the IN position allows the Crater-Fill circuit to be operative whereas placing the Switch in the OUT position disables the Crater-Fill circuitry.

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

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

If the START CURRENT Switch is in the ON position and also the CRATER FILL Switch is in the IN position, about seven seconds must be allowed between the time the Remote Contactor Control Switch is opened and the time the Remote Contactor Control Switch is again closed. This time delay is to assure proper reset of the Start Control circuitry.

If the HIGH FREQUENCY Switch is in the CONTINUOUS position and the CRATER FILL Switch is in the IN position, the high-frequency unit will be de-energized during the Crater-Fill current decline time period.

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

NOTE

The CRATER-FILL Switch should be placed in the OUT position when employing the Shielded Metal-Arc (Stick Electrode) welding process.

4 - 8. AC BALANCE CONTROL (Figure 4-1)

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

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

NOTE

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

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

NOTE

When employing either Shielded Metal-Arc Welding or DC Tungsten-Arc Welding processes, the AC BALANCE CONTROL should be rotated to the BALANCED position.

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

The pilot lamp, when illuminated, indicates that the welding power source is in a ready-to-weld state.

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 will increase the intensity of the high-frequency.

NOTE

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

4-11. DUTY CYCLE (Figure 4-2)

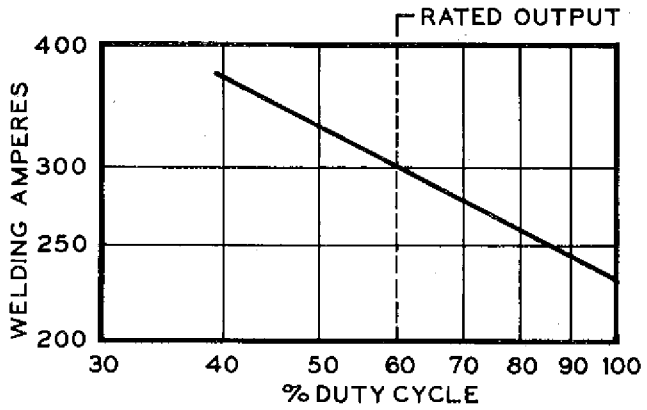


Figure 4-2. Duty Cycle Chart

The duty cycle of the welding power source is the percentage of a ten minute period that a welding power source can safely be operated at a given output current. This welding power source is rated 300 amperes, 60 percent duty cycle. This means the welding power source can be safely operated at 300 amperes welding current for six minutes out of every ten. If the welding current is decreased, the duty cycle will increase. Figure 4-2 enables the operator to determine the safe output of the welding power source at various duty cycles.

IMPORTANT

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

4-12. VOLT-AMPERE CURVES (Figure 4-3)

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

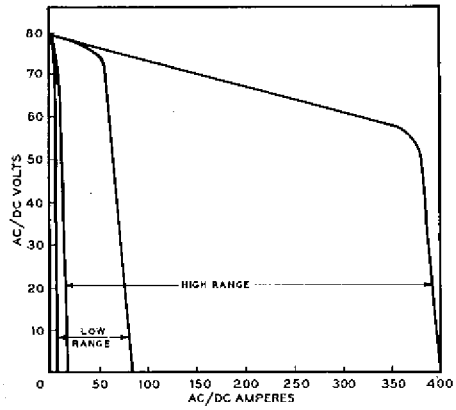


Figure 4-3. Volt-Ampere Curves

SECTION 5 - SEQUENCE OF OPERATION

CAUTION

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

5-1. SHIELDED METAL-ARC (STICK ELECTRODE) WELDING

1. Make all necessary connections as instructed in section 3.
2. Place the CONTACTOR Switch in the STANDARD position and disconnect the Remote Contactor Control from the welding power source. (Under these circumstances, the POST-FLOW TIME and HIGH FREQUENCY functions will automatically be disabled.)
3. If a Remote Current Control is not to be used, place the CURRENT Switch in the PANEL position. If a Remote Current Control is to be used, place the CURRENT Switch in the REMOTE position.
4. Place the CRATER FILL Switch in the OUT position.
5. Place the START CURRENT Switch in the desired position. If this switch is placed to ON, rotate the START CURRENT Control to the desired position.
6. Rotate the AC BALANCE Control to the BALANCED position.
7. Place the AC/DC Switch in the desired position.
8. If the AC/DC Switch has been placed in the DC position, place the POLARITY Switch in the desired position. (The POLARITY Switch is disabled when the AC/DC Switch is placed in the AC position.)
9. Place the RANGE Switch in the desired position; HIGH position being preferred for most welding applications.
10. Rotate the CURRENT CONTROL or Remote Current Control, if used, to the desired position.

11. Place the POWER Switch to the ON position.

CAUTION

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

12. Commence welding.

5 - 2. GAS TUNGSTEN-ARC (TIG) 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 when ac welding.
   c. 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.
9. Place the AC/DC Switch in the desired position.
10. If the AC/DC Switch has been placed in the DC position, place the POLARITY Switch in the desired position. (The POLARITY Switch is disabled when the AC/DC Switch is placed in the AC position.)
11. Place the RANGE Switch in the desired position.
12. Rotate the CURRENT Control or Remote Current Control, if used, to the desired position.
13. Place the POWER Switch in the ON position.

CAUTION

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

14. Commence welding.

5 - 3. SHUTTING DOWN

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

CAUTION

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

SECTION 6 - MAINTENANCE

CAUTION

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

6 - 1. FAN MOTOR

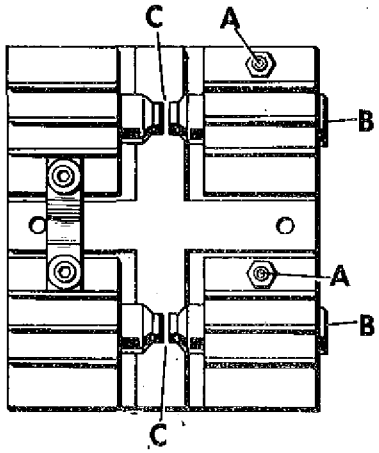
All models are equipped with an exhaust fan and rely on forced draft for adequate cooling. The fan motor is manufactured with lifetime-lubricated sealed ball bearings and no attention should be required.

6 - 2. INTERNAL CLEANING

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

6 - 3. SPARK GAP ADJUSTMENT (Figure 6-1)

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



TA-020 623-A2

Figure 6-1. Spark Gap Adjustment

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

NOTE

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

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

To Adjust Spark Gaps, Proceed As Follows:

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

6-4. 115 VAC OVERLOAD PROTECTION (Figure 4-1)

The 115 VAC duplex receptacle is protected from current overload by a 10-Ampere Circuit Breaker. If this breaker should open, depress the breaker button protruding from the front panel. This action will reset the breaker. If continual opening of the breaker is observed, remove any load applied to this receptacle in excess of 10-Amperes

SECTION 7 - TROUBLESHOOTING

The data collected here, discusses some of the common problems which may occur in this welding power source.

The assumption of this data is that a proper welding condition had been achieved and had been used until trouble developed. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly adhered to and followed.

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

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

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 item 3-2 for proper input connections.
	Input voltage jumper links not in proper configuration.	Refer to item 3-2C for proper input voltage jumper link configuration.
No weld output; fan operative.	Improper electrical input and/or secondary connections.	Refer to items 3-2 and 3-3 for proper electrical input and secondary connections.
	CONTACTOR Switch in REMOTE position without a Remote Contactor Control connected to the welding power source.	If Remote Contactor Control is not desired, place the CONTACTOR Switch in the STANDARD position. If Remote Contactor Control is desired, retain the CONTACTOR Switch in the REMOTE position and make Remote Contactor Control connections as instructed in item 3-5.
Low weld output; fan operative.	Improper electrical input and/or secondary connections.	Refer to items 3-2 and 3-3 for proper electrical input and secondary connections, respectively.
	Improper placement of input voltage jumper links.	Refer to item 3-2C for proper input voltage jumper link placement.
High or low weld output; CURRENT CONTROL inoperative.	CURRENT Switch in REMOTE position without a Remote Current Control connected to the welding power source.	If Remote Current Control is not desired, place the CURRENT Switch in the PANEL position. If Remote Current Control is desired, retain the CURRENT Switch in the REMOTE position and make Remote Current Control connections as instructed in item 3-5.
Insufficiency or absence of high-frequency.	Improper spark gap.	Check for and correct spark gap as instructed in item 6-3.
	HIGH FREQUENCY INTENSITY Control set too low.	Rotate Control clockwise to increase high-frequency.
Fan inoperative.	Defective fan motor.	Cehck for and replace defective fan motor.
	Fan motor leads open or shorted.	Check for and correct open or shorted fan motor leads.
	Propellor obstructions.	Check for and remove propellor obstructions.

Figure 7-1. Troubleshooting Chart

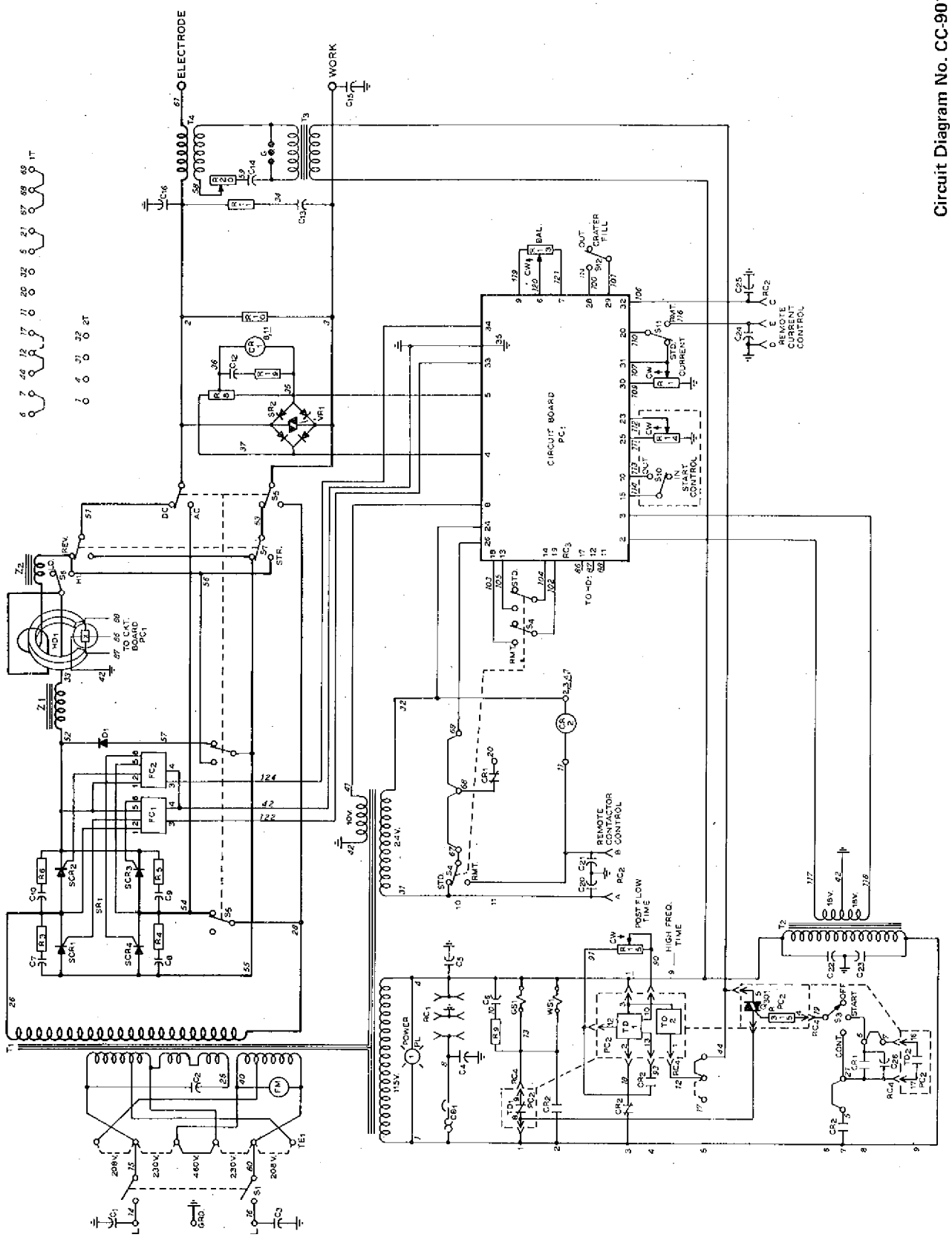


Figure 7-2. Circuit Diagram

Abbreviations Used In Flow Chart

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

PRESUPPOSITIONS: CONTACTOR Switch in REMOTE
HIGH FREQUENCY Switch in either CONTINUOUS or START

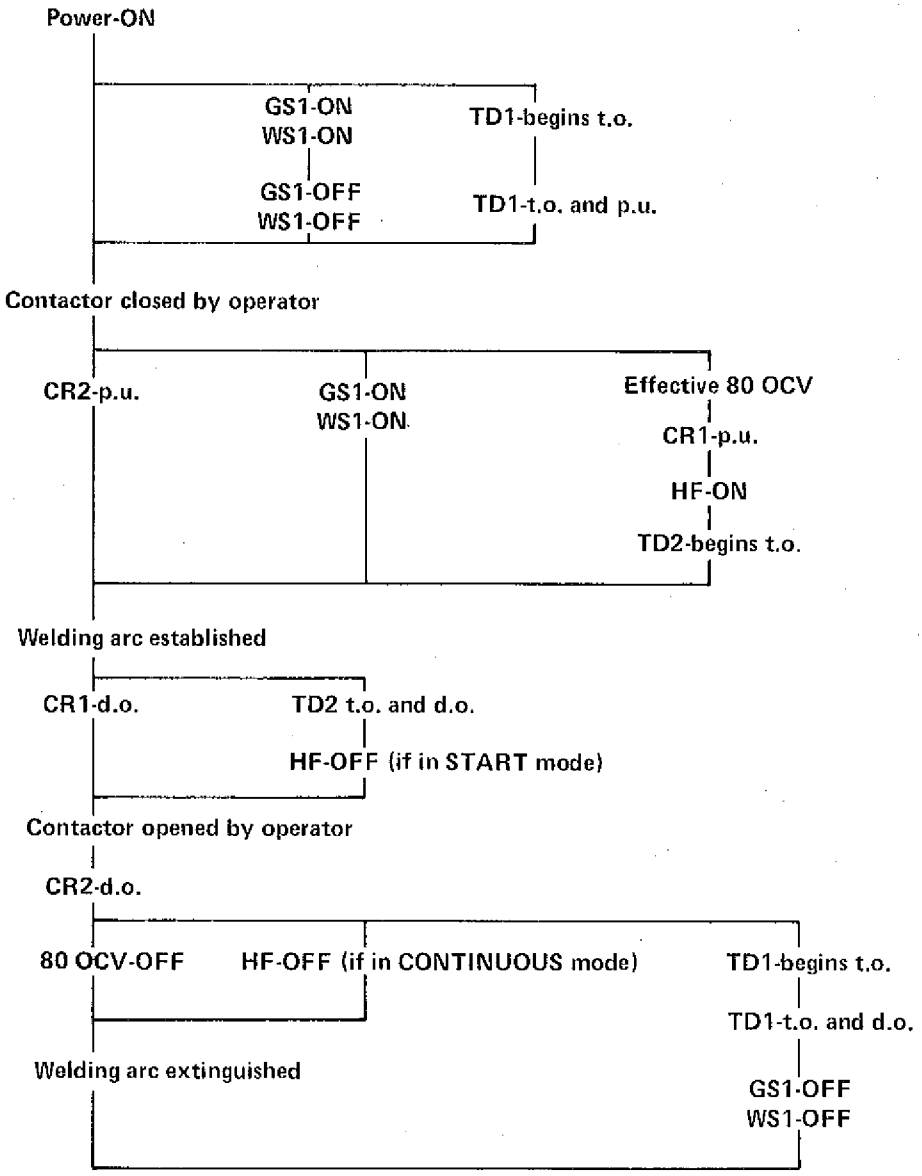


Figure 7-3. AC/DC Gas Tungsten-Arc Welding Flow Chart

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

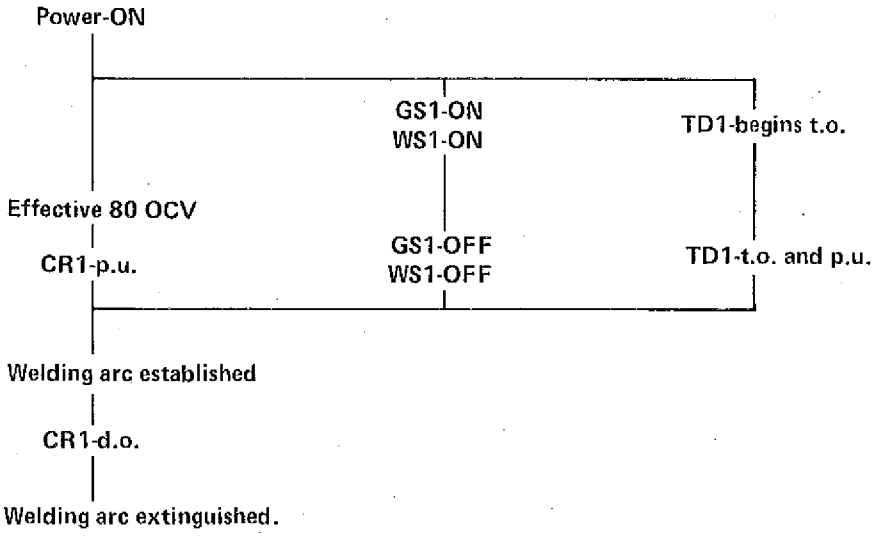


Figure 7-4. AC/DC Shielded Metal-Arc Welding Flow Chart

SECTION 8 - CERTIFICATION FOR HIGH FREQUENCY ARC WELDING EQUIPMENT

8 - 1. GENERAL

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

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

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

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

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

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

8 - 2. GENERAL INFORMATION

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

1. Direct radiation from the welding machine. This is radiation that escapes directly from the Welding Machine case. This is very pronounced if access doors are left open and unfastened and if the Welding Machine case is not properly grounded. Any opening in the metal Welding Machine case will allow some radiation to escape. The high frequency unit of this certified equipment is adequately shielded to prevent direct radiation of any consequences if proper grounding is carried out.

2. Direct feedback to the power line. High frequency energy may get on the power line by direct coupling inside the equipment or the high frequency unit, the power line then serving as a radiating antenna.

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

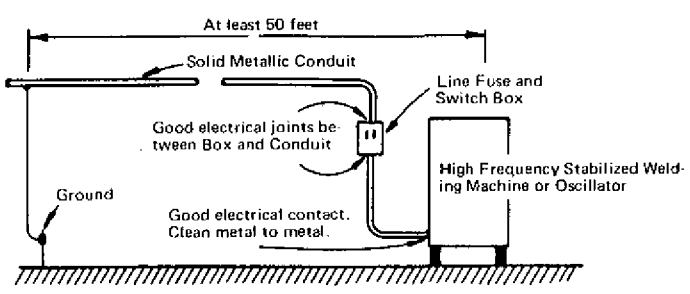


Figure 8-1. Power Service Installation H.F. Stabilized Arc Welding Machine

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

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

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

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

8 - 3. POWER SERVICE

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

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

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

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

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

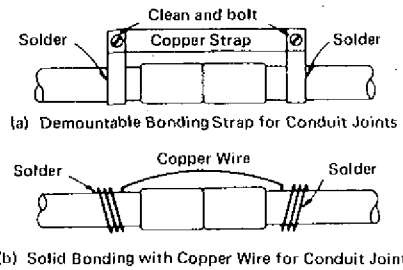


Figure 8-2. Two Recommended Methods For Electrical Bonding Across Poor Conductivity Conduit Joints

8 - 4. WELDING MACHINE

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

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

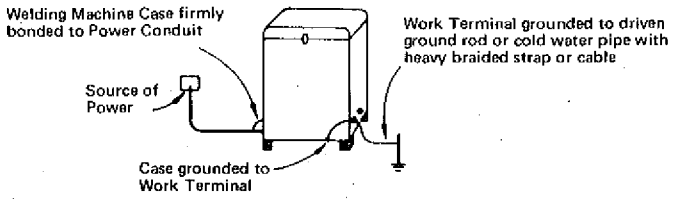


Figure 8-3. Ground Connections At Welding Machine

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

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

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

8 - 5. WELDING LEADS

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

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

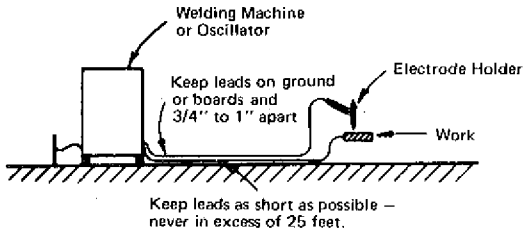


Figure 8-4. General Rules For Welding Leads

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

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

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

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

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

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

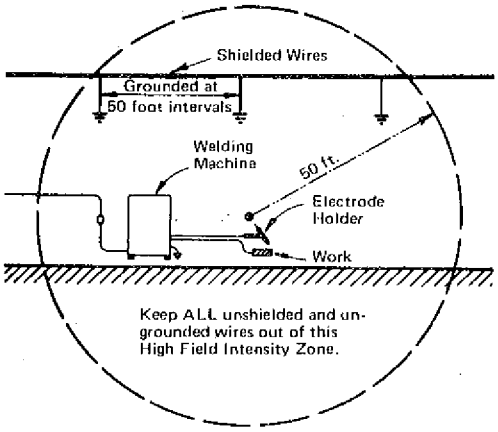


Figure 8-5. General Requirements to Minimize Reradiation Pick-Up In the Vicinity of the Weld Zone

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

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

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

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

NOTE

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

8 - 7. GROUNDS

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

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

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

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

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

8 - 8. METAL BUILDING

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

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

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

8 - 9. INDIVIDUAL INSTALLATION CERTIFICATION

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

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

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

8-10. CHECK LIST

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

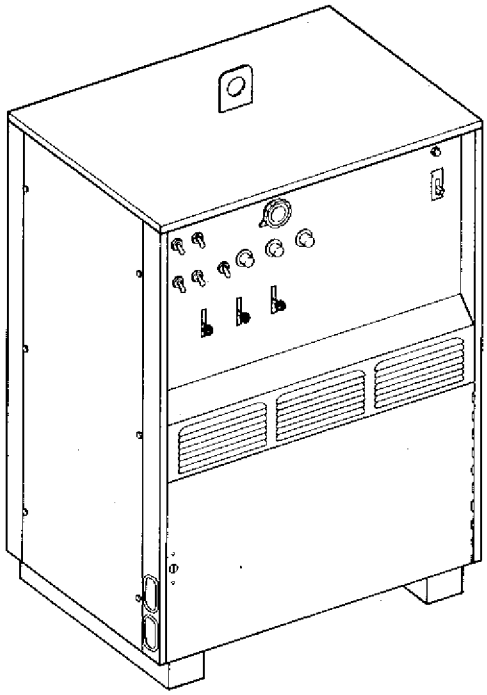
1. Has the equipment been located so that ground leads can be kept short?
2. Are the power leads, serving the unit, in conduit?
3. Is there good electrical contact between power conduit and case?
4. Do the conduit couplings make good electrical contact? (If in doubt, use bonding).
5. Is there good electrical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

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

June 1975 FORM: OM-350A

Effective with serial No. HF858556

MODEL	STOCK NO.
Syncrowave 300	901 718



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

PARTS LIST

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

NWSA CODE NO. 4579

PRINTED IN U.S.A.

Dia. Mkgs.	Factory Part No.	Description	Quantity
		Complete Assembly	
C1,3	031 636	CAPACITOR, ceramic 0.001 uf 2000 volts dc	2
C2	025 315	CAPACITOR, paper oil 30 uf 460 volts ac	2
	025 142	BRACKET, mounting - capacitor	1
C4,5	031 718	CAPACITOR, suppressor 115 volts ac 2 x 1	2
C6	028 294	CAPACITOR, mylar 1 uf 200 volts dc	1
C12	031 610	CAPACITOR, electrolytic 40 uf 250 volts dc	1
C15,16, C20-25	031 670	CAPACITOR, ceramic 0.05 uf 500 volts dc	10
C26	031 699	CAPACITOR, mylar 0.0022 uf 200 volts dc	1
CB1	011 972	CIRCUIT BREAKER, 250 volts 10 amp	1
CR1	034 601	RELAY, 24 volts dc DPDT	1
CR2	000 174	RELAY, enclosed 24 volts ac 3PDT	1
Elect,Work	038 878	TERMINAL, power output - black (consisting of)	2
	038 129	. BUS BAR	1
	038 885	. TERMINAL BOARD	1
	038 912	. BOLT, shoulder - round hd sq neck 1/2-13 x 1-11/16	1
	038 913	. NUT, brass - hex special 1/2-13	1
	601 839	. NUT, brass - hex full 1/2-13	1
FC1,2	000 105	PULSE MODULE	2
FM	032 603	MOTOR, fan 230 volts (consisting of)	1
	024 601	. BEARING	2
	032 604	BLADE, fan 60 Hz 14 inch 3 wing 19 degree	1
GS1,WS1	003 538	VALVE, 115 volts ac 2 way 1/4 IPS port 1/8 orifice (consisting of)	2
	003 539	. COIL	1
	010 295	ELBOW, brass - pipe street 90 degree 1/4 MPT 5/8-18 left hand	2
	010 296	ELBOW, brass - pipe street 90 degree 1/4 MPT 5/8-18 right hand	2
HD1	000 171	SENSOR, current	1
PC1	000 062	CIRCUIT CARD ASSEMBLY, control	1
PC2	039 195	CIRCUIT CARD ASSEMBLY, HF & post flow timers (consisting of)	1
C300,303	031 630	. CAPACITOR, electrolytic 20 uf 50 volts dc	2
C301,304	031 651	. CAPACITOR, tandelum 68 uf 20 volts dc	2
C302, 307,308	031 637	. CAPACITOR, ceramic 0.02 uf 500 volts dc	3
C305,306	034 286	. CAPACITOR, polyester film 1 uf 100 volts	2
CR300,301	039 346	. RELAY, enclosed 24 volts dc DPDT	2
D300,302	037 449	. DIODE, zener 15 volts 1 watt	2
D301,303	026 202	. DIODE, 1 amp 400 volts straight polarity	2
Q300,302	039 355	. TRANSISTOR, 15 amp 40 volts	2
Q301,303	022 135	. THYRISTOR, 4 amp 200 volts	2
Q304	605 841	. THYRISTOR, 6 amp 500 volts	1
R300,307	030 819	. RESISTOR, carbon 2 watt 270 ohm	2
R301	030 033	. RESISTOR, carbon 0.5 watt 470 ohm	1
R303,304, 310,311	035 886	. RESISTOR, carbon film 0.25 watt 22K ohm	4
R305,312	039 361	. POTENTIOMETER, cermet 1 turn .25 watt 50K ohm	2
R306, 309,314	030 937	. RESISTOR, carbon 0.5 watt 10 ohm	3
R308	030 936	. RESISTOR, carbon 0.5 watt 33K ohm	1
R313	039 340	. RESISTOR, WW fixed 3 watt 250 ohm	1
R315	030 711	. RESISTOR, carbon 1 watt 330 ohm	1
SR300,301	021 939	. RECTIFIER, integrated 1.5 amp 400 volts	2
T300,301	039 350	. TRANSFORMER, signal	2
	039 348	. CONNECTOR, edge - PC card 17 pin 5 amp	1
	039 196	. PRINTED WIRING BOARD	1
	035 506	GUIDE, circuit card 9 inch	4

Dia. Mkgs.	Factory Part No.	Description	Quantity
		Complete Assembly (continued)	
	039 349	SPRING, retainer - circuit card	2
PL1	027 645	LIGHT, indicator - 115 volts ac red lens	1
R1,14	035 897	POTENTIOMETER, carbon 1 turn 2 watt 1000 ohm	2
	019 627	KNOB, pointer (used with R1)	1
	019 666	KNOB, line indicator (used with R13, 14, 15 & 20)	4
R8	030 601	RESISTOR, WW adj 25 watt 1000 ohm	1
R9	030 761	RESISTOR, carbon 1 watt 10 ohm	1
R10	030 060	RESISTOR, WW adj 375 watt 20 ohm	1
R13	030 109	POTENTIOMETER, carbon 1 turn 2 watt 5000 ohm	1
R15	028 769	POTENTIOMETER, carbon 1 turn 2 watt 750K ohm	1
R19	604 178	RESISTOR, carbon 2 watt 100 ohm	1
R20	603 942	RHEOSTAT, WW 150 watt 5 ohm	1
RC1	604 176	RECEPTACLE, duplex - grounded straight 2P3W	1
RC2	035 523	RECEPTACLE, Amphenol 3102A-16S-85	1
RC3	039 358	CONNECTOR, edge - PC card 35 socket	1
RC4	039 347	CONNECTOR, edge - PC card 17 socket 5 amp	1
S1	021 793	SWITCH, 2P 600 volts 100 amp non auto	1
S3	011 610	SWITCH, toggle SPDT 15 amp 125 volts center off	1
S4	011 622	SWITCH, toggle 3PDT 15 amp 125 volts	1
S5-7	039 261	SWITCH, range/polarity/selector (consisting of)	1
S5	000 880	. CONTACT BOARD ASSEMBLY, selector ac/dc (consisting of)	1
	604 318	. . NUT, steel - self locking hex 1/4-20	1
	039 257	. . HANDLE, switch	1
	038 769	. . CONTACT BOARD ASSEMBLY, movable	1
	024 694	. . BEARING	1
	103 633	. . BUS BAR	1
	011 950	. . CONTACT, switch (top half)	1
	011 951	. . CONTACT, switch (bottom half)	1
	103 634	. . MOUNTING BOARD	1
	011 948	. . GUIDE, contact	2
S5	000 879	. CONTACT BOARD ASSEMBLY, selector ac/dc (consisting of)	1
	604 318	. . NUT, steel - self locking hex 1/4-20	1
	039 257	. . HANDLE, switch	1
	038 769	. . CONTACT BOARD ASSEMBLY, movable	1
	024 694	. . BEARING	1
	011 951	. . CONTACT, switch (top front & bottom rear)	2
	011 950	. . CONTACT, switch (top rear & bottom front)	2
	103 634	. . MOUNTING BOARD	1
	011 948	. . GUIDE, contact - movable	2
S7	000 878	. CONTACT BOARD ASSEMBLY, polarity (consisting of)	1
	103 634	. . MOUNTING BOARD	1
	011 948	. . GUIDE, contact - movable	2
	103 633	. . BUS BAR	2
	024 694	. . BEARING	1
	038 769	. . CONTACT BOARD ASSEMBLY, movable	1
	010 805	. . HANDLE, switch	1
	604 318	. . NUT, steel - self locking hex 1/4-20	1
S6	000 877	. CONTACT BOARD ASSEMBLY, range (consisting of)	1
	103 634	. . MOUNTING BOARD	1
	011 948	. . GUIDE, contact - movable	1
	011 950	. . CONTACT, switch (top front)	1
	011 951	. . CONTACT, switch (top rear)	1
	024 694	. . BEARING	1
	020 760	. . CONTACT BOARD ASSEMBLY, movable	1
	010 805	. . HANDLE, switch	1
	604 318	. . NUT, steel - self locking hex 1/4-20	1
	039 256	. STUD, steel 1/4-20 x 9	2
	104 935	. BRACKET, mounting - switch	4

Dia. Mkgs.	Factory Part No.	Description	Quantity
		Complete Assembly (continued)	
	010 736	. TUBING, steel 5/8 OD x 12 ga wall x 5/8 lg	4
	022 309	. TUBING, steel 5/8 OD x 12 ga wall x 2 lg	2
	010 047	. TUBING, steel 5/8 OD x 12 ga wall x 1 lg	2
	025 181	. TUBING, steel 5/8 OD x 12 ga wall x 1/2 lg	2
	039 260	. HANDLE, switch (connecting the 2 ac/dc contact boards)	1
	039 255	. LINK, jumper - switch (ac/dc)	1
	019 603	. KNOB, ball	3
	003 053	GUARD, slot - switch	3
S10-12	011 609	SWITCH, toggle SPDT 10 amp 125 volts	3
SR1	000 176	RECTIFIER, silicon diode - main (consisting of)	1
C7-10	031 683	. CAPACITOR, paper oil 0.5 uf 200 volts dc	4
D1	037 957	. DIODE, 275 amp 250 volts reverse polarity	1
R3-6	030 055	. RESISTOR, carbon 2 watt 10 ohm	4
SCR1-4	000 251	. THYRISTOR, 250 amp 300 volts	4
	010 311	. CLAMP, nylon 3/4 dia	4
	025 248	. INSULATOR, stand off	6
SR2	035 704	RECTIFIER, integrated 6 amp 600 volts	1
T1	000 047	TRANSFORMER, power - main (consisting of)	1
	**000 048	. TRANSFORMER SUBASSEMBLY	1
	**000 190	. COIL, primary/secondary (left hand)	1
	**000 191	. COIL, primary/secondary (right hand)	1
T2	035 759	TRANSFORMER, control - miniature 115/36 volts	1
TE1	038 442	TERMINAL ASSEMBLY, primary (consisting of)	1
	038 887	. STUD, brass 10-32 x 1-3/8 with hex collar	6
	038 888	. STUD, brass 1/4-20 x 1-1/2 with hex collar	2
	026 754	. INSULATION, stud barrier	6
	010 913	. WASHER, flat - brass 3/16	6
	601 835	. NUT, brass - hex 10-32	12
	601 836	. NUT, brass - hex jam 1/4-20	4
	038 618	. LINK, jumper - terminal board	2
	038 622	. BLOCK, terminal 30 amp 5 pole	1
	038 620	. LINK, jumper terminal block	1
	038 662	. TERMINAL BOARD	1
VR1	028 001	VARISTOR, 150 volts	1
Z1	**039 313	REACTOR, square wave (consisting of)	1
	**039 254	. REACTOR SUBASSEMBLY	1
	**000 192	. COIL, reactor - right hand	1
	**003 031	. COIL, reactor - left hand	1
Z2	000 051	REACTOR, square wave low range	1
1T	038 833	BLOCK, terminal 20 amp 13 pole	1
	601 219	LINK, jumper - terminal block	5
2T	038 081	BLOCK, terminal 20 amp 4 pole	1
	000 797	HF PANEL, 115 volts (consisting of)	1
C13	031 601	. CAPACITOR, paper oil 10 uf 600 volts dc	1
	014 159	. BRACKET, mounting - capacitor	1
C14	031 602	. CAPACITOR, mica 0.0002 uf 5000 volts dc	2
	020 623	. SPARK GAP ASSEMBLY (consisting of)	1
	010 888	.. CONNECTOR	1
G	*020 603	.. POINT	4
	020 621	.. BASE	1
	020 622	.. HOLDER, points	4
R11	030 602	. RESISTOR, WW fixed 100 watt 10 ohm	1
T3	036 865	. TRANSFORMER, 115 volts	1
T4	033 373	. COIL, coupling (consisting of)	1

Dia. Mkgs.	Factory Part No.	Description	Quantity
		Complete Assembly (continued)	
	010 147	. . STRIP, conductor	2
	010 883	. STRIP, conductor - spark gap to capacitor 8 inches lg	1
	010 884	. STRIP, conductor - capacitor to mounting board 6-3/4 inches lg	1
	010 885	. STRIP, conductor - spark gap to mounting board 5-3/8 inches lg	1
	010 886	. STRIP, conductor 1-7/8 inches lg	1
	038 887	. STUD, brass 10-32 x 1-3/8 with hex collar	2
	602 042	. SCREW, machine - brass round hd 10-32 x 1	1
	603 737	. SCREW, machine - brass round hd 3/8-16 x 1-3/4	1
	038 804	. STUD, brass 3/8-16 x 2-1/2	1
	601 835	. NUT, brass - hex 10-32	8
	601 838	. NUT, brass - hex jam 3/8-16	6
	016 601	. MOUNTING BOARD	1
	603 107	HOSE, neophrene - slit (20 inches req'd - order by foot)	2 ft.
	039 244	COVER, top	1
	026 627	GASKET, lifting eye	1
	039 248	PANEL, side	2
	000 015	DOOR, access - front	1
	000 765	LATCH, cabinet - access door	1
	000 017	PANEL, front - louvered	1
	039 305	PANEL, front	1
	000 022	ENCLOSURE, circuit card	1
	000 020	PANEL, enclosure	1
	016 258	CHAMBER, phenum	1
	039 247	PANEL, rear	1
	039 297	BASE	1
		NAMEPLATE (order by stock, model, and serial numbers)	1

* Recommended Spare Parts.

** Replace at Factory or Authorized Service Station.

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