TECHNICAL MANUAL

ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL FOR WELDING MACHINE, ARC, CC, XFMR/RECT TYPE 200 AMP SINGLE OPERATOR (MILLER MODEL SRH-222) (FSN-3431-926-3852)

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
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Organizational, Direct Support, General Support and Depot Maintenance Manual

WELDING MACHINE, ARC, CC, XFMR/RECT TYPE 200 AMP

SINGLE OPERATOR

(MILLER MODEL SRH-222)

FSN 3431-926-3852

TM 5-3431-224-15, 15 November 1968, is changed as follows:

1. Insert new page as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove	*Insert*
None	17

2. File this change sheet in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

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The Adjutant General

Distribution

To be distributed in accordance with DA Form 12-25A (qty rqr block No. 182) Organizational Maintenance requirements for Welding.

SUPPLEMENTARY INSTRUCTIONS

In addition to the thermal protection thermostat described under thermal protection paragraph, Page 8, a second thermostat has been installed in the secondary of the main transformer. The thermostat in the main rectifier and main transformer are connected electrically in series with the control circuit of the welding machine. In event of overloading of either the main rectifier or main transformer, their respective thermostat will open, dropping the output of the welding machine to the minimum of the range.

A dc voltmeter and ammeter are furnished with this welding machine. These meters will indicate the amperage and voltage at the welding machines secondary terminals while welding.

INTRODUCTION

GENERAL

This manual has been prepared especially for use in familiarizing personnel with the design, installation, operation and maintenance of the welding machine. In some cases, the contents of this publication are generalized. All information presented herein should be given careful consideration to assure optimum performance and service of the equipment.

Process information is available by contacting the nearest representative.

RECEIVING- HANDLING

To prepare the welding machine for installation, several items should be checked. Clean all packing material from around the unit and carefully inspect for damage that may have been caused by shipping. Any claims for loss or damage that may have occurred in transit must be filed by the buyer with the carrier. Copy of bill of lading and freight bill will be furnished on request if occasion to file claim arises.

Be sure to **read all the instructions** before attempting to operate the welding machine.

When requesting information concerning the welding machine, **be sure** to furnish **Serial and Model Numbers**.

DESCRIPTION

This horizontal design welding machine series is of the selenium rectifier d-c type, designed for d-c metallic arc (coated electrode) welding. Three phase full wave bridge rectifiers are used to convert the output of the transformer from a-c current to d-c welding current.

The horizontal design facilitates stacking to conserve space for either multiple or parallel operation. A convenient lifting eye and low center of gravity construction presents desirable features for easy moving and handling. Overhead mounting is ideal for crowded areas or shop neatness.

These d-c three phase rectifier type welding machines consist of a line power switch, a three phase power transformer, d-c control coil, rectifier stacks, control rectifier, current control rheostat, cooling fan and a thermal protection thermostat.

Closing the line switch supplies proper operating voltages to the fan motor and the power transformer. Figure 1. The power transformer supplies voltage to the control winding, the control rectifier, and the d-c control coil. The d-c control coil controls the current supplied to the main rectifiers. These rectifiers change the a-c current to d-c current and in turn, d-c current is carried to the secondary **Positive** and **Negative** terminals. For straight polarity operation the work is connected to the **Positive** receptacle and the electrode holder is connected to either of the **Negative** receptacles. For reverse polarity, the work is connected to either of the **Negative** receptacles and the electrode holder is connected to the **Positive** receptacle.

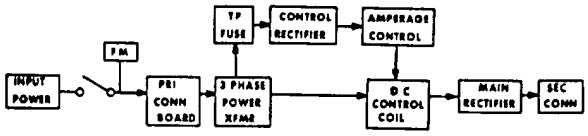


Figure 1 - Block Diagram

SAFETY

Before attempting to make primary or secondary connections, change parts or make repairs, be sure the welding machine is completely disconnected from the main power line.

Caution should be exercised in taking voltage measurements when trouble shooting the unit. Always avoid contact between any part of the human body and any current carrying part of the welding machine.

Be sure that when installing the welding machine, that a ground cable is connected from the stud labeled **GRD** on the primary connection board, to a suitable ground. Before the welding machine is put into operation, the complete safety section at the rear of this manual should be read to avoid possible injury due to misuse or improper welding applications.

SPECIFICATIONS

MODEL	WELDING CURRENT RANGE AMPERES	NEMA OUTPUT RATING AT 460 VOLTS 60% DUTY CYCLE	OPEN CIRCUIT VOLTS	POWER INPUT AT RATED LOAD 50/60 CYCLE AMPERES 230 VOLTS 3 PHASE	AMPERES 460 VOLTS 3 PHASE	KW	KVA	WEIGHT LBS. NET	WEIGHT LBS. SHIP	OVERALL CABINET SIZE
200 Amperes	Low Range 25-225 High Range 30-300	200	70	42	21	13.5	16.7	685	730	30 1/4" Height 22 1/4" Width 35 7/8" Depth

INSTALLATION

1. LINE DISCONNECT SWITCH

Precautionary measures should be taken to provide maximum protection against electrical shock. When electrical connections are made from the welding machine to the main line disconnect switch, **be sure** the line disconnect switch is open or fuses are removed.

a. Proper installation can contribute materially to the satisfactory and trouble-free operation of the welding machine. It is suggested that each step in this section be studied carefully and followed in detail.

2. LOCATION

a. A good installation is essential if the welding machine is to provide satisfactory and depend-

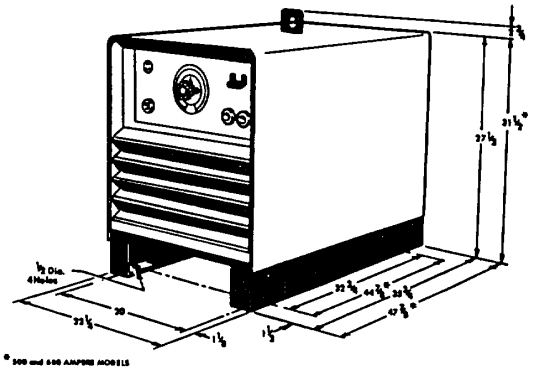


Figure 2- Dimensional Drawing and Base Mounting Hole Layout

able service. Proper component operating temperatures are maintained by the air stream produced by the welding machine fan unit. Therefore, the welding machine should be located so that the air passage into the front of the welding machine is not restricted and the back of the welding machine is away from the wall (18 inches minimum distance) so that the air passage from the fan will not be blocked.

The location should be such that a minimum amount of dirt or dust will be drawn into the air stream. Preventive maintenance will consist of removing the cover and blowing out the dust accumulation inside the welding machine. For this reason it is desirable to locate the unit so that the cover can be removed without much restriction.

3. PRIMARY CONNECTIONS

a. This d-c arc welding machine is a three phase unit and must be connected to a three phase power line.

b. Locate and open the small access door below the fan on the rear panel of the welding machine. The primary input voltage connection terminal board is behind the access door. See Figure 3.

c. The welding machine should be operated from a separately fused or circuit breaker protected circuit. The maximum capacity of the welding machine is affected by the line voltage and if the circuit is overloaded, the performance of the welding machine will be impaired.

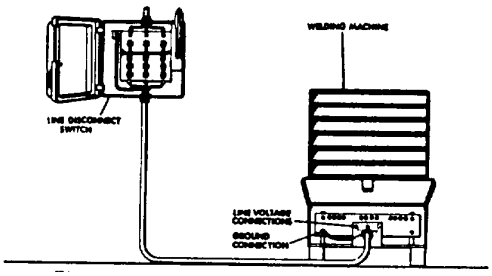


Figure 3- Primary Connections

Install a cable of three primary leads plus one ground wire (see Table I for proper wire and fuse sizes) into the rear of the welding machine through the inlet hole in the support bracket. This opening will take standard conduit fittings and the service wires from the line disconnect switch to the welding machine should be heavy rubber covered cable or run in solid or flexible conduit.

The primary cables connect to terminals labeled **L** or **LINE**. A fourth lead, ground connection should be fastened to the terminal labeled **GRD**. The other end of the ground lead or cable should be attached to a suitable ground such as a water pipe, ground rod, etc. Use whatever grounding means is acceptable to the local electrical inspection authorities.

The stud labeled **GRD** is connected to the welding machine chassis and is for grounding purposes only. **Do not** connect a wire from the terminal labeled **GRD** to one of the three phase line terminals as this may result in a hot welding machine chassis.

TABLE I

MODEL	PRIMARY WIRE SIZE - AWG				GRD WIRE	FUSE SIZE IN AMPERES			
	208 V	230V	460V	575 V		208V	230V	460V	575 V
200 Ampere	#8	#8	#10	#12	#8	70	70	35	30

c. These welding machines are designed to operate on either 230 volts or 460 volts, three phase, 50/60 cycle a-c power line. Facilities for operation on other primary voltages, if ordered, are incorporated at the factory. To connect the welding machine properly for the voltage available, position the copper links as illustrated in Figure 4 and on the **Primary Voltage Link Arrangement,** Figure 5. Welding machines are shipped with the connections in the highest line voltage position for which the particular machine was built.

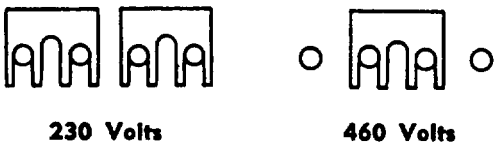


Figure 4- Jumper Link Connections

Whenever only one jumper link connection is necessary for proper input voltage such as 460 volts, connect both jumper links across the same two terminals. This will prevent losing the second jumper link.

d. Recheck all cables and links for tightness and correct connections.

4. SECONDARY WELDING CONNECTIONS

a. It is recommended that the welding cables be kept as short as possible, placed close together and be of adequate current carrying capacity. The resistance of the welding cables and connections cause a voltage drop which is added to the voltage of the arc. Excessive cable resistance may result in overloading as well as reducing the maximum current output of which the welding machine is capable.

The proper operation of any arc welding machine 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 insure welder's safety.**

Select the proper size welding cable from Table II. These figures are based on d-c and a 4 volt drop.

b. **Twistlock Jack Plug Installation:** Two twistlock jack plugs are furnished with the welding machine If the machine is furnished with twistlock receptacles. Follow instructions carefully for proper installation of the twistlock jack plugs to the welding cables.

(1) Remove 3/4 inch of insulation from one end of the welding cables.

(2) Clamp the welding cable in a vise with the uninsulated end protruding upward out of the vise approximately 1-3/4 inches.

(3) Place the steel tie wire (A) (see Figure 6) approximately 1/4 inch (1) from the end of the insulation.

(5) Make a half turn around the cable bringing the looped ends of the tie wire together.

(5) Insert a rod of approximately 3/8 inch diameter through the two looped ends of the tie wire.

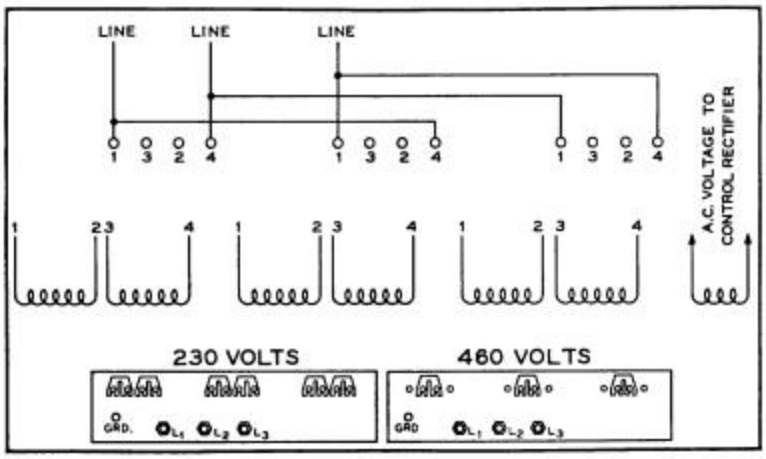


Figure 5-Primary Voltage Link Arrangement

TABLE II

AMPERES	RECOMMENDED WELDING CABLE SIZE Total Welding Cable Length (in feet) For Both Electrode and Work									
	100	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**
100	2	3	3	3	1	1/0	1/0	2/0	2/0	3/0
150	2	2	1	1/0	2/0	3/0	3/0	4/0	4/0	
200	2	1	1/0	2/0	3/0	4/0	4/0			
250	2	1/0	2/0	3/0						
300	1	2/0	3/0	4/0						
350	1/0	3/0	4/0							
450	2/0	4/0								
550	3/0									
700	4/0									

(6) Twist the tie wire (1) until the entire tie wire is twisted and is tight around the insulation of the welding cable.
(7) Clip off the looped ends of the tie wire.
(8) Bend the twisted tie wire over along the side (2) of the uninsulated portion of the welding cable.

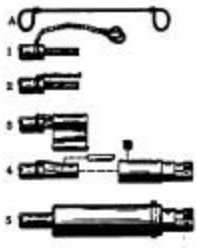


Figure 6-Jack Plug Installation

(9) Drive out the fiber pin holding the fiber insulator in place on the twistlock jack plug.
(10) Remove the fiber insulator from the jack plug.
(11) Loosen the Allen set screw holding the copper foil and metal strip in place.
(12) Wrap the copper foil tightly around the uninsulated end of the welding cable and twisted tie wire (3).
(13) Place the metal strip next to the copper foil (4).
(14) Place the twistlock jack plug on the end of the welding cable and slide it over the copper foil and the metal strip.
(15) Adjust the twistlock jack plug so that when the Allen set screw is tightened, it will clamp the welding cable between the metal strip and the side of the jack plug.
(16) Tighten the Allen set screw.
(17) Replace the fiber insulator and fiber pin (5).
(18) Remove the welding cable from the vise and repeat the above steps for the other welding cable.

c. Electrode Holder and Work Clamp Installation:

(1) Connect a work clamp to one of the unused ends of one of the cables. Connect an electrode holder to the unused end of the other welding cable. The method of connecting the cables to the work clamp and electrode holder will depend on the manufacturer design. Follow the manufacturer instructions carefully.
(2) On the bottom part of the control panel are three (two on the 600 ampere model) twistlock receptacles for connecting the welding jack plugs.
(a) Connect the work cable to the **work** and insert the jack plug on this cable into the receptacle labeled **Positive**. Twist in a clockwise motion to lock the jack plug in its proper position.
(b) Insert the jack plug, on the cable to the electrode holder, into either the **Low** or **High Negative** receptacle with a twisting clockwise motion. Choice of either the **Low** or **High** receptacle will depend on the current range required for the particular welding job. **Note: The 600 ampere model does not have the low and high range receptacle.**
(c) Instructions above are for straight polarity welding; if reverse polarity is desired, reverse the connections.

5. PARALLEL CONNECTIONS

a. Two or more d-c arc welding machines may be connected in parallel for increased output welding current in excess of the capabilities of one machine. To accomplish this, see Figure 7 and proceed with connections as follows:
(1) Connect separate welding cables of adequate size from the **Positive** twistlock receptacle of each welding machine to the Work. This connection would be for straight polarity welding. Remember, keep welding cables as short as possible.
(2) Connect separate welding cables of adequate size from the **Negative** twistlock receptacles of each welding machine to

the **electrode holder**. Be sure that the connection is made to the same **Negative** receptacle (**Low** or **High**) on each machine. That is, if the **High** range is used on one welding machine the **High** range must be used on all welding machines connected in parallel.

(3) Place the **Weld Current Control** in the **same** position on all welding machines connected in parallel.

6. REMOTE AMPERAGE CONTROL CONNECTIONS (Optional Equipment)

a. If a **remote current control** is to be used, insert the three (3) prong plug from the control into the **Remote Amperage Control Receptacle.** Twist in a clockwise direction to lock the plug in place. This will prevent the plug from pulling out under tension.

b. Place the **Standard-Remote Switch** in the **Remote** position.

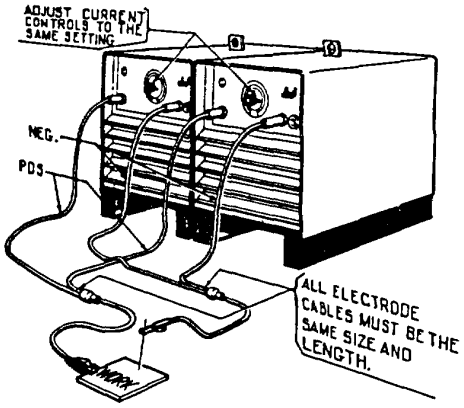


Figure 7 - Parallel Connections

OPERATION

Never, under any circumstances, operate the welding machine with the cover removed. In addition to the safety hazard, improper cooling may cause damage to the welding transformer and welding machine components. **Warranty is void if machine is operated with cover removed.**

7. DUTY CYCLE (Figure 8)

a. Welding machines are rated on a percent duty cycle based on 10 minute intervals. For example: A 60% duty cycle simply means that the welding current is on for 6 minutes, off 4 minutes, on again for 6 minutes and so on. It must be kept in mind that time intervals other than 10 minutes will yield different test rating results. As the output is reduced or increased, the duty cycle will increase or decrease.

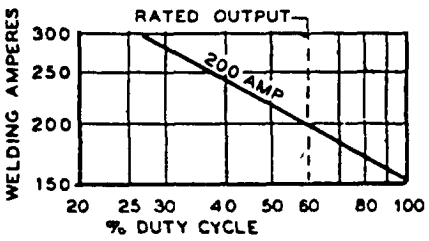


Figure 8 - Duty Cycle Chart

8. VOLT-AMPERE CURVES (Figure 10)

a. The voltage-ampere curves show the output voltage available at any given output current within the limits of the minimum and maximum current control setting on each range. With the use of the volt-ampere curves, it is possible to determine the amperage required for a particular load voltage.

With reference to the volt-ampere curves (Figure 10) the High range (B) or Low range (A) show the arc voltage and welding current for the maximum and minimum settings of the Weld Current Control only. Curves for other settings will fall between the maximum and minimum curves for that particular current range.

9. WELDING AMPERAGE CONTROL

a. **Welding Current Ranges:** A **High** and a **Low** current range is available. Make current selection by inserting the electrode holder twistlock jack plug into either the **High** or **Low** receptacle. See Figure 9. If the required current is in both ranges use the **Low** range as better current control is had at the upper portion of the current range.

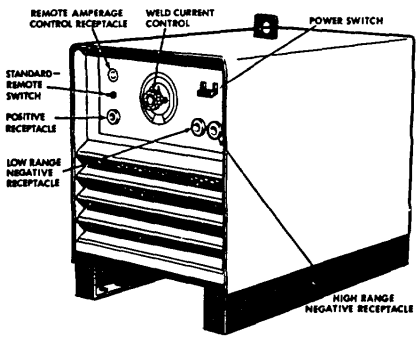


Figure 9-Control Panel View of Welding Machine

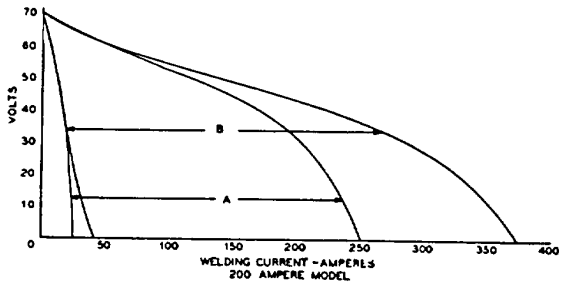


Figure 10- Volt- Ampere Curves

b. **Polarity Selection:** Determine the welding current polarity needed for the particular welding application. Straight polarity is obtained by inserting the jack plug from the **work** cable into the **Positive** receptacle and the jack plug from the electrode holder cable into either of the **Negative** receptacles. For reverse polarity, reverse the connections. See Figure 9.

c. **Weld Current Control:** Fine amperage adjustments within each range are made by means of the **Weld Current Control.** The Weld Current Dial is calibrated for the low and high amperage ranges. "A" calibration shows the amperage settings for the Low Range and "B" calibration for the High Amperage Range. Unless a remote amperage control is used (optional equipment) the Standard-Remote Switch must be in the **Standard** position.

d. **Remote Amperage Control** (Optional Equipment) : If ordered, a Remote Amperage Control Receptacle is provided for connecting a **RHC-3 (Remote Hand Control)** or a **RFC-3A (Remote Foot Control).** For parallel connected welding machines, standard remote amperage controls may be used with either, or all machines. For fine amperage adjustments, remote control on only one machine may be used. Gang operated remote hand controls, which gang equally on all welding machines connected to the remote amperage control are available. The **Remote Amperage Control Receptacle** is located on the upper left hand side of the control panel. A switch labeled **Standard-Remote** is located immediately below the receptacle and must be placed in the **Remote** position when a remote amperage control is used.

Do not operate the welding machine with the **Standard-Remote** switch in the **Remote**, position unless a **Remote** Control is plugged into the receptacle as this may damage the switch and the d-c control coil.

Operating the welding machine with the **Standard-Remote** switch in the **Remote** position without a remote control plugged into the receptacle, causes an inductive kick to be developed in the d-c control coil. This may damage the switch or the d-c control coil. Removing the remote control plug, with the switch in the **Remote** position and the welding machine in operation, will have the same effect.

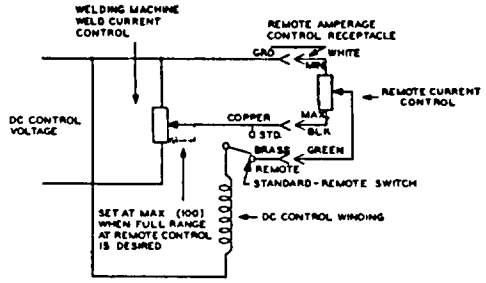


Figure 11- Remote Current Control

e. **Crater Elimination:** The crater at the end of the weld deposit does not present a good appearance and may affect the strength of the joint. Reducing the current at the end of a weld, helps to minimize crater formation by gradually decreasing the size of the molten pool.

Crater elimination can be accomplished by using a **Remote Foot Control RFC-3A**. Backing off slightly on the remote control's foot pedal at the end of the weld will decrease the current low enough to minimize crater formation.

The remote control circuit is so arranged that the **Weld Current Control** on the welding machine will determine the maximum welding output. Current adjustment from the setting of the **Weld Current Control** on the welding machine, to minimum of the current range in use, will be obtained by the remote control. See Figure 11. If full range of control is desired, set the Weld Current Control on the welding machine to the maximum position.

10. ON-OFF POWER SWITCH

a. To place the welding machine in operation, place the **On-Off** Power Switch in the **ON** position. This will energize the machine. On machines ordered with Thermo-Shunt (optional equipment) the fan motor will not start to operate until an arc of approximately 100-150 amperes is drawn.

All four (4) thermostats of the Thermo-Shunt kit are open under normal idling conditions, preventing the fan from running. When an arc of approximately 100-150 amperes is drawn, the heating of the Thermo-Shunt or rectifier will close one or more of the thermostats. The closing of one or more of the thermostats will energize the fan motor. All thermostats are self-resetting.

SEQUENCE OF OPERATION

11. METALLIC ARC (Stick Electrode) WELDING

a Make secondary welding connections as explained in step number 4c.

b. Determine the proper electrode for the welding application and insert it into the electrode holder.

c. If a remote amperage control is used, connect the plug from the remote control into the **Remote Amperage Control Receptacle.** Place the **Standard-Remote Switch** in the **Remote** position.

d. Adjust the **Weld Current Control for the** approximate desired welding current. The A scale current indications correspond with the **Low Range Negative receptacle** and the B scale with the **High Range Negative receptacle.**

e. Place the **On-Off** Power Switch in **ON** position.

f. If a **remote foot current control** is used, press the foot pedal to the maximum down position.

g. Commence welding.

h. Readjust the Weld Current Control if necessary.

12. BATTERY CHARGING

a. In general, all rectifier type d-c or a-c/d-c welding machines, using the **Miller Gold Star Rectifier**, may be used for battery charging and starter boosting. Because of design characteristics of this rectifier type welding machine, they may be applied directly to charging of batteries of any voltage up to 64 volt batteries, with no necessity for voltage adjustment of any kind.

As a general rule, most lead-acid type of storage batteries will take a 1/2 hour fast charge at an ampere value approximately equal to the battery ampere hour capacity, i.e., 100 ampere hour rated battery should very readily take a 100 ampere charge for 1/2 hour.

b. **Battery Connections**

1. Remove battery vent caps and make sure electrolyte is up to prescribed level.
2. Clean top of battery (if dirty) with water and brush. Accumulated acid soaked mud on top of battery will discharge even a good battery in a short period of time.
3. If the battery is not fitted with venting type caps, loosen caps prior to charging. Keep all flame or sparks away from battery during and after charging. Liberated hydrogen gas may form explosive mixture.
4. The regular welding electrode and work leads will serve admirably for connecting to the battery.
   (a) Connect the cable from the Low (A) Negative Receptacle on the welding machine to the negative (-) terminal on the battery.
   (b) Connect the cable from the Positive Receptacle on the welding machine to the positive (+) terminal on the battery.

Should a mistake be made in the polarity of the connections, there will be no harm done to either the battery or the welding machine. It just won't charge.

Note: Do not have vehicle lights, ignition, fan or heater motors, radio, etc., On while charging the battery.

c. **Charging the Battery or Batteries**

1. Place the power switch on the welding machine in the On position.
2. Check time if 1/2 hour is desired and adjust current if required.
3. For booster charging, if it is at all possible, allow the battery to charge at least 5 minutes, and preferably 15 minutes, at the 1/2 hour charge rate prior to attempting to start the engine. After this charge time, which will warm the battery permitting far better performance, proceed with starting in the normal manner. After the engine starts, shut off the welding machine **first**, then remove the connecting cables.

Note: Never remove cables from the battery while the welding machine is On as resultant arcing will eventually deteriorate the terminals and the arc may trigger an explosion, as mentioned in step 13 b 3.

4. If the welding machine is not equipped with a welding current ammeter, charging current selection can be closely determined from marked welding ampere scales or ranges. Charging rates for 6 and 12 volt batteries will be approximately 25% above marked welding amperes for a given setting of the welding machine. Charging rate for a 24 volt battery will be almost identical to marked welding amperes. These values presume good quality, serviceable batteries in the discharged condition.

Note: Avoid excessive charging rates, as this can cause buckling of plates with resultant battery failure and possibly even internal explosion.

Batteries which have stood in a discharged condition for a period of time may not accept charging without excessive gassing.

If the battery has not been permanently damaged, it can usually be brought back to usefulness by repeated short charge periods followed by an immediate discharge. This procedure may have to be repeated many times until the battery accepts a satisfactory charge.

MAINTENANCE

Be sure the branch circuit, main disconnect switch or circuit fuses are removed before attempting any inspection or work on the inside of the welding machine. Placing the **On-Off** power switch on the welding machine in the **Off** position does not remove voltage from the power terminal inside of the machine. **Be safe and be alive, open the branch circuit.**

RECTIFIER

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

A clean dry air stream should be used for cleaning the rectifier and should be directed across the entire length of the air opening in front of the welding machine and between each louver. The welding machine should be in operation so that the exhaust fan will draw the dirt out the rear of the welding machine. The welding machine case cover should not be removed for this cleaning operation.

When used in a dusty, oily atmosphere, heavy accumulation of foreign material will collect on rectifier plates used on rectifier type welding machines. Removal of an oily substance from the rectifier plates, using an air stream only, is difficult and next to impossible.

A solvent which will loosen dirt accumulations without damage to the rectifier stack is available from the factory. This solvent comes in one gallon containers and when ordering refer to part number 37-730, rectifier cleaning solvent.

Spraying generous quantities of this solvent onto the rectifier stack will loosen and remove the dirt accumulation from the rectifier plates. Directing an air stream between the rectifier plates will then readily dry them.

FAN MOTOR

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

TRANSFORMER

Occasional blowing out the dust and dirt from around the transformer is recommended. This should be done periodically depending upon the location of the unit and the amount of dust and dirt in the atmosphere. The welding machine case cover should be removed and a clean dry air stream should be used for this cleaning operation.

CONTROL CIRCUIT FUSING

The control circuit fuse is of 10 ampere plug type size and is mounted behind the rear panel access door. Do not use anything other than a 10 ampere size. The purpose of this fuse is to provide protection to the control rectifier and the circuit components.

The symptom of a blown fuse is complete loss of control of the welding current. Before replacing the fuse, examine leads for short circuit or other signs of trouble, especially at the point where the leads enter the remote control case. Examine the Weld Current Control Rheostat in the welding machine, and, if a remote amperage control is used, also examine the rheostat in the remote control.

THERMAL PROTECTION

This welding machine is protected with a safety thermostat located in the rectifier. Any excessive overloading will actuate the thermostat and temporarily open the control circuit. If, while welding at excessive loads or duty cycles, the output is suddenly reduced, stop welding and allow about 3 minutes for the rectifier to cool. Normal operation can then be resumed.

COMPONENT FUNCTIONS

a. **Rheostat**

R1 Weld Current Control Rheostat

1. Varies the d-c control voltage.

b. **Receptacles**

RC1 Remote Amperage Control

1. Outlet to connect a remote current control rheostat for remote amplitude control of welding current.

c. **Switches**

S1 ON-OFF Power Switch

1. Provides on-off operation of the welding machine.

S2 Standard-Remote Amperage Control Switch

1. Provides selection of remote or standard control of welding current.
2. Remote position Welding current within each range is controlled by a remote current control connected to RC1. The remote current control will control the current between minimum and the maximum setting of R1.
3. Standard position Welding current within each range is controlled by rheostat R1.

d. **Rectifiers**

SR1 Main Power Rectifier

1. Rectifies a-c welding current to d-c welding current.

SR2 Current Control Rectifier

1. Rectifies control circuit voltage necessary to control welding current output.

e. **Overload Protection Devices**

F1 Control Circuit Fuse

1. Provides overload protection for d-c control circuit.

TP Thermostat

1. Provides overload protection for main rectifier and for welding machine components.

T1	Weld Transformer
PRI	Primary Windings
SEC	Secondary Windings
MA_1	Magnetic Amplifier
CWD	D.C. Control Windings
CF	Current Feedback Windings
Z	Stabilizer
SHUNT	Cable Shunt
A	D.C. Ammeter
V	D.C. Voltmeter
SR_1	Main Rectifier
SR_2	Control Rectifier
TE_1	Primary Terminal Board
FM	Fan Motor
S_1	Power Switch
S_2	Control Rectifier
TP_1	Thermostat
TP_2	Thermostat Assy
F_1	Fuse
R_1	Control Rheostat
RC_1	Remote Control Receptacle

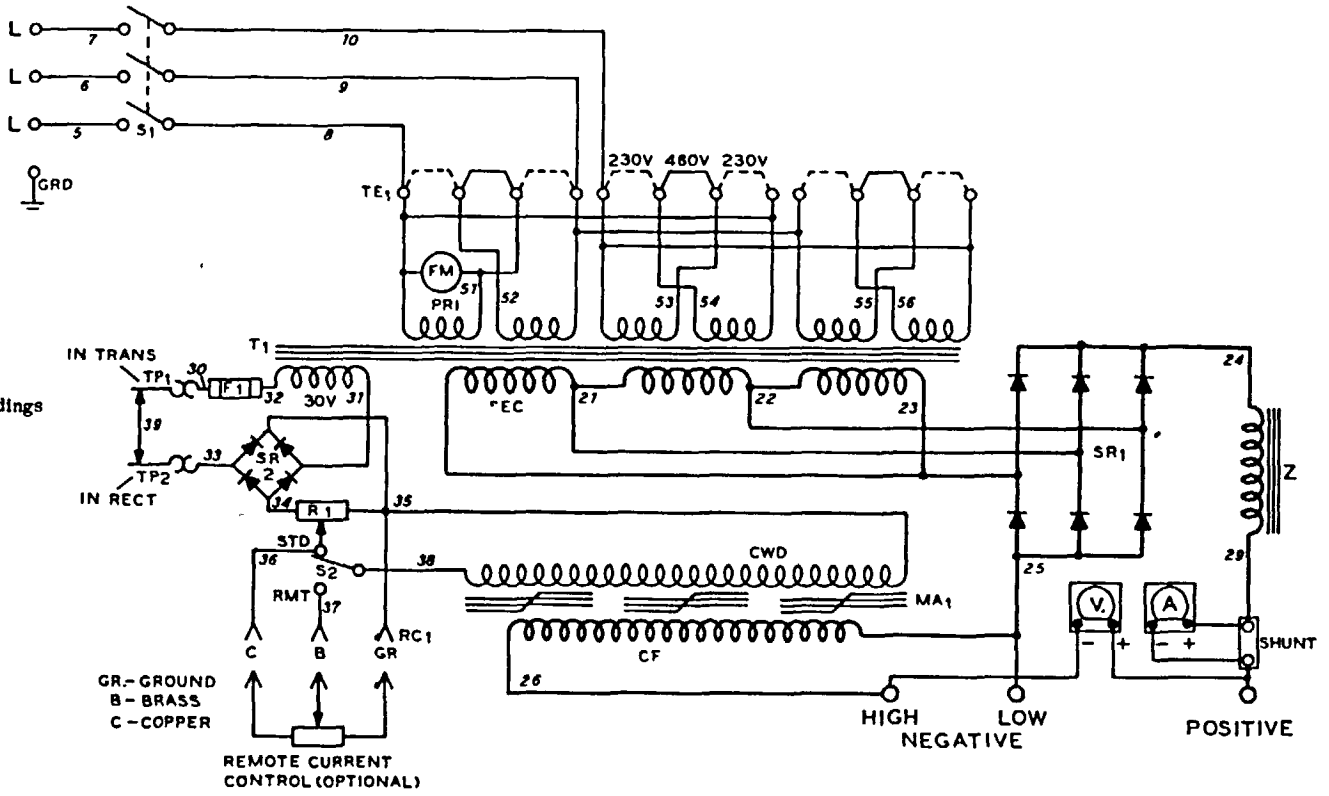


Figure 12 - Circuit Diagram

TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Limited output and low open circuit voltage (55 volts or less)	Operation on single phase. Blown line fuse on one phone. Primary jumper links connected to wrong terminals.	Check incoming three phase power for correct voltage. Replace fuse if blown. See jumper link arrangement diagram.
No current control. Current reduces to minimum of range.	"Standard - Remote" Current Control Switch in REMOTE position with no Remote Control plugged into receptacle. Control fuse F1 blown. Thermostat open. Defective rheostat.	Either place "Standard - Remote" switch in STANDARD position or connect Remote Control to Remote Current Control receptacle. Replace fuse. See Control Circuit fusing See THERMAL PROTECTION under MAINTENANCE. replace rheostat.
Fan runs slow.	Jumper links on primary board connected for incorrect primary voltage.	Check jumper links on primary board for proper voltage connections. Change links to correspond with Figure 5.
Fan does not run.	Line fuse blown. Power switch defective. Fan motor defective.	Check line fuses and replace, if blown. check for continuity and replace switch, if defective. Check fan motor and leads. If O.K. and fan motor turns freely, the fan motor could be burned out. Replace if necessary.
Fan motor noisy, runs hot.	Defective fan motor bearings.	Replace bearings.
Erratic weld current.	Incorrect welding rod. Wrong polarity. Incorrect welding current. Welding cable size too small. Loose welding cable connections.	Use correct welding rod. Change polarity. Use correct welding current. Use larger welding cable (see Table II). Tighten welding connections.

Safety Rules For Operation Of Arc Welding Machine

These rules apply to both a-c and d-c Welding Generators and a-c Transformer d-c and a-c/d-c Transformer Rectifier Welding Machines.

Electricity, like fire, is a good slave but a bad master. In arc-welding operations where certain energized parts are exposed a welder must be especially careful to observe certain safety rules in order to insure a maximum amount of personal safety and, incidentally, to protect those working near him. In most cases, safety is a matter of common sense. Accidents due to electricity can be eliminated by strict observance of the following safe practice rules.

THE WELDING MACHINE

1. **WELDING CABLES:** Welding cables must not be operated at currents in excess of their rated capacity since this is uneconomical and will cause overheating and rapid deterioration of the insulation. The cables should be inspected frequently and all breaks in the insulation repaired with rubber and friction tapes. Any joints not made with proper connectors should be adequately insulated. In addition to the potential hazard to personnel, a hazard occurs when exposed sections of the cable come in contact with metallic objects grounded in the welding circuit, causing an arc. If flammable materials, such as oil or grease, happen to be in the vicinity, a fire may result. In addition, elimination of these accidental grounds will improve the efficiency and quality of welding. For the same reasons, all cable connections should be maintained tight.

   DON'T permit cables to operate hot.

   DON'T operate with worn or poorly connected cables.
2. **ELECTRODE HOLDER:** The jaws of the electrode holder should be maintained tight and the gripping surfaces in good condition to provide close contact with the electrodes. Defective jaws will permit the electrode to wobble and render control of the welding operations difficult. The connections of the electrode lead to the holder should be maintained tight at all times.

   Only fully insulated electrode holders should be used.

   Never touch at the same time two electrode holders from two separate welding machines. Always avoid contact between any part of the human body and any electrode holder, or electrode, particularly the exposed or non-insulated parts of any holders or the metallic part of any electrode when gripped in the holder.

   DON'T operate electrode holders with defective jaws.

   DON'T operate electrode holders with loose cable connections.
3. **WIRING:** All wiring must be in compliance with the National Electrical Code and local requirements.
4. **PARALLEL CONNECTIONS:** See diagrams in the instruction manual applying to the welding machine used.

5. **POLARITY SWITCH:** The polarity switch, when supplied, is provided for changing the electrode lead from positive (reverse polarity) to negative (straight polarity) and should never be operated while under the load of a welding current. All operations of this switch should be performed while the machine is idling and the welding circuit is open. The potential dangers here are, first: that the contact surfaces of the switch become severely burned due to the arcing at high current; second: the person throwing the switch is liable to receive a severe burn from this arcing.
   DON'T operate the polarity switch under load.
6. **RANGE SWITCH:** The range switch, when supplied, which is provided for obtaining the desired current settings, must not be operated while the machine is under the load of a welding current. Operation of the range switch should be performed while the machine is idling and the welding circuit is open. The potential danger here is that the arcing caused by opening the circuit carrying high current will severely burn the contact surfaces. Repeated occurrences of this arcing will eventually render the contacts inoperative.
   DON'T operate the range switch under load.
7. **EXHAUST GASES:** If gasoline driven welding machines are operated indoors, provision must be made to pipe the exhaust gases to the outside air to avoid carbon monoxide poisoning.
   DON'T operate gas engine units in confined spaces without provision for venting exhaust gases.
8. **POWER CIRCUIT GROUND:** Every power circuit must be grounded to prevent accidental shock by stray current. Therefore, when connecting the welding machine, be sure that the machine is properly grounded. The potential hazard here is that development of a stray current may give a severe shock should the welder, for example, place one hand on the welding machine and the other on the switch box, or other grounded equipment.
   DON'T operate welding machine without a power ground.

WELDING OPERATIONS

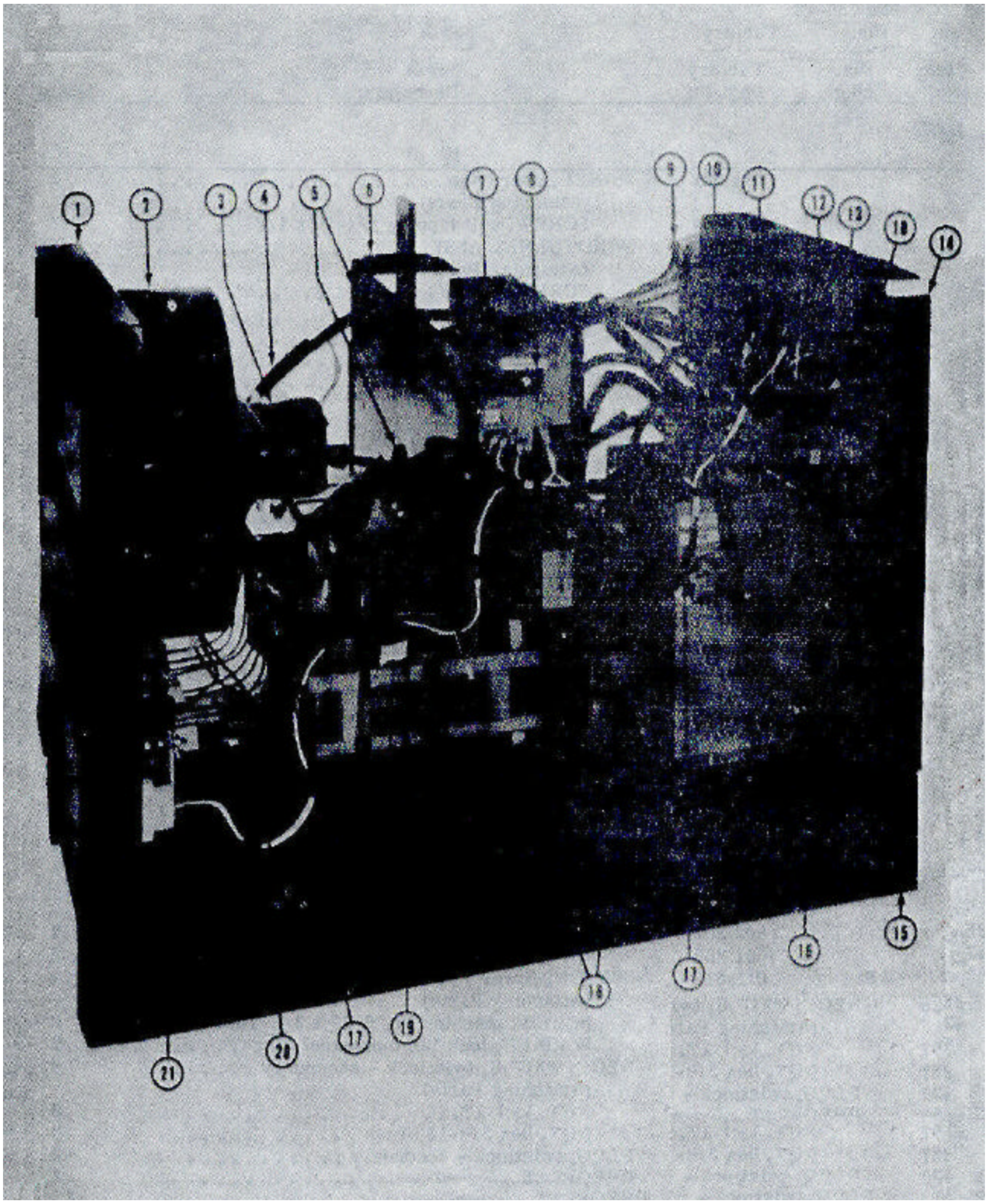
9. **CONTAINERS WHICH HAVE HELD COMBUSTIBLES:** Welding on containers which have held flammable or combustible materials can be an extremely hazardous operation. The recommendations of the American Welding Society pamphlet A6.0 for "Welding or Cutting Containers Which Have Held Combustibles" should be observed in this type of work. Some of the rules stressed in this section should also be reviewed.
   Avoid welding on hollow (cored) castings that have not been properly vented. This mistake has caused loss of lives.
   DON'T weld on containers which have held combustible or flammable materials or materials which when heated give off flammable or toxic vapors without proper cleaning, purging or inerting.
10. **EXPLOSION HAZARDS:** Welding should never be performed near flammable liquids or vapors (gasoline, alcohol, etc.) or combustible dusts.
    DON'T weld in or near explosive atmospheres.
11. **VENTILATION:** Welding in confined spaces without adequate ventilation can conceivably be a hazardous operation because the oxygen supply will be depleted and this, together with the heat of welding and the fumes given off may cause the welder severe discomfort or serious illness. Therefore, when welding in confined spaces always provide for adequate ventilation by blowers, air lines, or other acceptable means. Provide ventilation in accordance with American Standards Z-49.1.
    DON'T weld in confined spaces without adequate ventilation.
12. **FIRE HAZARDS:** Because fires can be caused by the arc, slag, weld metal or sparks, combustibles should be kept at least 35 feet from the arc or suitably protected. If the welding must be done in a particular area, move the combustibles away. If they cannot be moved, cover them completely with fire resistive screens. Cover cracks or openings in floors or walls; sweep floor free of combustibles and wet down, if wood, being sure welder wears insulation shoe coverings. If practicable, have fire watcher standby with extinguishers, at least until one half hour after the welding is completed (see National Fire Protection Association Standard 51B).
    DON'T weld near flammable or combustible materials.
13. **LIVE CIRCUITS:** in most welding shops, the power supply used for the arc welding machines will be 230 or 460 volts. The welder should be impressed with the fact that although these are high voltages capable of inflicting severe, and often fatal, injuries, it is equally important to avoid the open circuit voltages which can be harmful under abnormal conditions. It is, therefore, important that no work be done on the wiring, switches, controls, etc., without first ascertaining that the main power line disconnect-switch is open. All checking of machines must be performed on dead circuit.
14. **DAMP WORKING CONDITIONS:** Dampness between the body and an energized part lowers the resistance to the passage of current to the welder's body and may produce a harmful electric shock. To prevent harmful body shocks, keep hands and clothing dry. Also, the welder should never stand or lie in puddles of water or on damp ground when welding. Always find a dry board or rubber mat to stand on.
    DON'T work in a damp area. Keep hands, clothing and work area dry at all times.

15. **WELDING CIRCUIT:** The electrode holder, when not in use, must never be left in contact with the table top or other metallic surface in direct contact with the welding ground. An insulated hook or holder should be provided for the electrode holder when not in use. A potential hazard here is that the holder in contact with the ground circuit provides a dead short circuit on the welding transformer. If the machine should be started up, this short circuit would cause an excessive load on the transformer and may damage the insulation.
    DON'T leave the electrode holder on the table top or in contact with a grounded metallic surface.
16. **FACE PROTECTION:** The helmet, hand shield or face shield should be maintained in good condition. If cracks occur in the fibre material, the shield should be immediately replaced, since the leakage of arc rays may cause serious burns.
    DON'T use cracked or defective helmets or shields.
17. **EYE PROTECTION:** The protection of the eyes is such an important matter that it merits individual consideration. The filter glass plate provided in the helmets and shields should be of reputable manufacture conforming to the latest ASA Standards. Cracked or ill-fitting filter plates should be replaced promptly. The clear cover glass should always be maintained in front of the filter plate for the protection thereof. Frequent renewal of these cover glasses is necessary since they become covered with spatter which reduces vision.
    In some types of arc welding, namely, inert-gas-shielded arc welding, ultra-violet and infra-red radiation from the arc is particularly intense and requires constant attention to avoid arc flashes when striking the arc and from nearby welders.
    Caution: Make sure that flash goggles are used under the welding helmet at all times particularly while doing inert-gas-shielded arc welding.
    Welders should be impressed with the danger of looking at an electric arc. They should be cautioned never to strike an arc without ascertaining that those in the vicinity either have the necessary protective equipment or are looking in the opposite direction. For welding operations in open areas, portable screens should be provided to shield persons nearby from the rays of the arc. Eye burns from the arc are not generally permanent injuries, although they are known to be exceedingly painful. Such burns are frequently referred to as "flashes" and feel like hot sand in the eye.
    For eye burns consult your first aid station or doctor.
    DON'T under any circumstances look at an electric arc with the unprotected eye.
    DON'T use cracked, ill-fitting or defective filter plates.
    DON'T use filter plates without a protecting cover glass.
18. **CLOTHING:** Proper clothing is essential for protection of the welder. Clothing must not only keep off the spatter and molten particles but must also obstruct the rays of the arc. An arc burn on the skin resembles a sunburn except that it is usually more intense. Gloves should be worn at all times to protect the hands and wrists. Dark colored shirts are preferred to light ones for the reason that the arc rays readily penetrate light colored fabrics. In the case of inert gas arc welding, light colors are more reflective and may cause eye burns due to the intense ultra-violet rays given off by the process. Cotton fabrics should be avoided with inert gas arc welding. Clothing can be rendered flame resistant by treatment with a solution of $^{3}/_{4}$ pound of sodium stannata in 1 gallon of water, then wrung out and dipped in a solution of $^{1}/_{4}$ pound ammonium sulphate per gallon of water. Clothing so prepared should not be washed in water but dry cleaned. When welding operations are to be performed in the vertical and overhead positions, leather sleevelets, aprons and in some cases leggings, should be employed to prevent severe burns from spatter and molten metal.
    DON'T use poor, inadequate or worn-out clothing. Wear heavy shoes, tightly laced.
19. **HOT METAL:** Welders should be cautioned against picking up pieces of metal which have just been welded or heated, either with bare or gloved hands. Similarly, the stub ends of electrodes which have been discarded should be avoided. In spite of repeated warnings of this nature, it will be found that the welders will unconsciously pick up hot objects until through sad experience they learn to exercise good judgment.
    DON'T pick up hot objects.
20. **GRINDING AND CHIPPING:** Whenever it is necessary to grind or chip metal, protective goggles specifically designed for this purpose should be worn. Serious eye injuries may result from failure to wear protective goggles.
    DON'T do any chipping or grinding without protective goggles.
21. **COMPRESSED GAS CYLINDERS:** Great care should be exercised to avoid accidental contact of the electrodes, electrode holder, or other energized parts with compressed gas cylinders or any other pressure vessel. Very serious accidents or fires may occur from this cause.
    DON'T under any circumstances strike an are on compressed gas cylinders.
    GENERAL: Welders should be impressed with the fact that failure to observe these safety precautions may expose not only themselves, but fellow workers as well to serious injuries. Once these rules are learned and kept in mind the welders can proceed with a maximum amount of assurance.

PARTS LIST
SRH-222(S)

CA-900 736-18

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
1		014 622	PANEL, rear case	1
			(Attaching Parts)	
		602 154	SCREW, self tapping 1/4-20 x 1/2	4
2		014 601	WINDTUNNEL ASSY	1
			(Attaching Parts)	
		601 954	SCREW, cap 1/4-20 x 3/4	4
		602 207	WASHER, lock 1/4 split	4
		601 865	NUT, hex 1/4-20	4
		032 604	BLADE, fan	1
3	FM	032 603	MOTOR, fan	1
			(Component Parts)	
		024 601	BEARING, front	1
		024 602	BEARING, rear	1
			(Attaching Parts)	
		602 203	WASHER, lock No. 10 split	4
		601 862	NUT, hex No. 10-32	4
4		023 655	HARNESS, wiring - power switch	1
			(Attaching Parts)	
		602 091	SCREW, machine No. 10-32 x 1/2 Rd. head.	6
		602 238	WASHER, flat 3/16	6
		602 204	WASHER, lock No. 10 external star	6
		602 203	WASHER, lock No. 10 split	6
		601 862	NUT, hex No. 10-32	6
5		015 714	GROMMET, rubber 1-3/4 dia	2
6		026 627	SEAL, rubber - weather	1
7	SR2	037 601	RECTIFIER, control	1
			(Attaching Parts)	
		602 131	SCREW, maching 1/4-20 x 2-1/4 rd. head	1
		602 207	WASHER, lock 1/4 split	1
		602 209	WASHER, lock 1/4 internal star	1
		601 865	NUT, hex 1/4-20	1
8		014 019	BRACKET, mounting rectifier	1
			(Attaching Parts)	
		601 954	SCREW, cap 1/4-20 x 3/4	2
		602 207	WASHER, lock 1/4 split	2
		601 865	NUT, hex 1/4-20	2
9	S1	011 615	SWITCH, power	1
			(Attaching Parts)	
		602 070	SCREW, machine No. 6-32 x 3/8 truss head	2
		602 199	WASHER, lock No. 6 external star	2
10		039 628	RECEPTACLE, twistlock - secondary	3
			(Attaching Parts)	
		010 907	NUT, lock 1"	3
		601 837	NUT, hex 3/8-16 brass	3
		039 629	PLUG, twistlock - secondary	2
11	R1	030 653	RHEOSTAT, current control	1
			(Attaching Parts)	
		601 924	SCREW, cap 1/4-20 x 3/8	2
		602 209	WASHER, lock 1/4 internal star	2
		019 627	KNOB, current control	1
12	RC2	039 607	RECEPTACLE, twistlock 3 prong-remote control	1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Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
			(Attaching Parts)	
		602 080	SCREW, maching, No. 8-32 x 3/8 rd. head	2
		601 860	NUT, hex No. 8-32	2
		602 200	WASHER, lock No. 8 split	2
		602 202	WASHER, lock No. 8 internal star	2
13	S2	011 609	SWITCH, standard - remote	1
			(Attaching Parts)	
		602 222	WASHER, lock 7/16 internal star	1
14		014 747	PANEL, front case	1
			(Attaching Parts)	
		602 154	SCREW, self tapping 1/4-20 x 1/2	3
		012 198	PLATE, operate in accordance with M&O	1
			(Attaching Parts)	
		601 890	RIVET, blind 1/8 dia. x 1/8 grip	2
15		017 863	BASE ASSY	1
16	SR1	037 645	RECTIFIER ASSY, main	1
			(Attaching Parts)	
		602 154	SCREW, self tapping 1/4-20 x 1/2	4
		601 954	SCREW, cap 1/4-20 x 3/4	4
		601 955	SCREW, cap 1/4-20 x 1"	1
		602 241	WASHER, flat 1/4 S.A.E.	10
		602 207	WASHER, lock 1/4 split	5
		601 865	NUT, hex 1/4-20	5
		600 320	CABLE, No. 1 welding (order by foot)	1 ft.
			(Attaching Parts)	
		600 748	LUG, terminal No. 2 wire 1/4 stud	1
		600 719	LUG, terminal No. 2 wire 8/8 stud	1
TP2		012 605	THERMOSTAT ASSY	1
17		023 656	HARNESS, wiring - control circuit	1
18	T1,MA1, Z	036 170	TRANSFORMER AND STABILIZER ASSY	1
			(Attaching Parts)	
		601 954	SCREW, cap 1/4-20 x 3/4	2
		601 797	BOLT, 1/4-20 x 5-1/2 hex head	2
		602 195	WASHER, fiber 3/8 I.D. x 7/8 O.D. x 3/32	6
		602 241	WASHER, flat 1/4 S.A.E.	8
		602 207	WASHER, lock 1/4 split	4
		601 865	NUT, hex 1/4-20	4
		603 525	TUBING, 5/16 plastic (order by foot)	1 ft.
		026 622	BOARD, glastic - insulating	1
		600 320	CABLE, No, 1 welding (order by foot)	4-1/2 ft.
			(Attaching Parts)	
		600 748	LUG, terminal No. 2 wire 1/4 stud	4
		600 719	LUG, terminal No. 2 wire 3/8 stud	2
		600 684	CONNECTOR, No. 1/0	2
		600 317	CABLE, No. 4 welding (order by foot)	7 ft.
			(Attaching Parts)	
		600 705	LUG, terminal No. 4 wire 1/4 stud	3
		600 682	CONNECTOR, No. 2	3
		603 533	TUBING, 7/8 plastic (order by foot)	2-1/2 ft.
19	TP1	012 372	THERMOSTAT ASSY, overload protection	1
20	TE1	038 637	PANEL ASSY, primary	1
			(Component Parts)	
		038 773	PANEL	1

CA-900 736-18

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity
		038 618	LINK, jumper - voltage connection	6
		601 835	NUT, hex No. 10-32 brass	36
		601 836	NUT, hex 1/4-20 brass	9
		038 887	STUD, No. 10-32 x 1-3/8 brass	12
		038 888	STUD, 1/4-20 x 1-1/2 brass	3
		010 913	WASHER, flat 3/16 I.D. brass	24
		010 915	WASHER, flat 1/4 I.D. brass	3
		602 203	WASHER, lock No. 10 split	24
		602 207	WASHER, lock 1/4 split	6
		026 631	INSULATION, terminal stud	12
			(Attaching Parts)	
		601 954	SCREW, cap 1/4-20 x 3/4	1
		601 955	SCREW, cap 1/4-20 x 1	1
		602 241	WASHER, flat 1/4 S.A.E	2
		601 865	NUT, hex 1/4-20	3
21		012 602	HOLDER, fuse	1
			(Attaching Parts)	
		602 082	SCREW, machine No. 8-32 x 1/2 rd. head	2
	F1	012 601	FUSE, 10 ampere plug type	1
		017 947	WRAPPER, case	1
			(Attaching Parts)	
		602 154	SCREW, self tapping 1/4-20 x 1/2	8
		601 925	SCREW, cap 1/4-20 x 1/2	13
		602 207	WASHER, lock 1/4 split	13
		601 865	NUT, hex 1/4-20	13
		025 713	METER ASSY	1
			(Component Parts)	
	V	025 604	METER, volt 0-100 volts dc	1
	A	025 603	METER, amp 0-300 amperes do	1
		103 965	WRAPPER	1
		103 966	PANEL, front	1
		103 967	PANEL, rear	1
		015 712	GROMMET, rubber 7/8 I.D.	1
		600 852	LEAD, meter No. 14-2 twisted pair (order by foot)	6 ft.
			(Attaching Parts)	
		600 717	LUG, terminal wire 16-14-1/4 stud	5
		600 697	LUG, terminal wire 12-10-3/8 stud.	2
			(Attaching Parts)	
		602 080	SCREW, machine No. 8-32 x 3/8	2
		602 168	SCREW, sheet metal No. 8 x 3/8 hex head	10
		601 860	NUT, hex No. 8-32	2
		010 859	CLAMP, meter No. 10H suretite	1
		012 248	PLATE, identification	1
			(Attaching Parts)	
		601 890	RIVET, blind 1/8 dia. x 1/8 grip	4

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

BASIC ISSUE-ITEMS-LIST-AND ITEMS TROOP

INSTALLED OR AUTHORIZED LIST

Section I. INTRODUCTION

1. Scope

This appendix lists items required by the operator for operation of the welder.

2. General

This list is divided into the following sections:

a. Basic Issue Items List-Section II. Not applicable.

b. Items Troop Installed or Authorized List Section III. A list of items in alphabetical sequence, which at the discretion of the unit commander may accompany the welder. These items are NOT SUBJECT TO TURN-IN with the welder when evacuated.

3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items List, Section II, and Items Troop Installed or Authorized List, Section III.

a. Source, Maintenance and Recoverability Code(s) (SMR): (Not applicable).

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required.

d. Unit of Measure (U/M). A two character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Furnished with Equipment (BIIL). (Not applicable).

f. Quantity Authorized (Items Troop Installed or Authorized). This column indicates the quantity of the item authorized to be used with the equipment.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1)	(2)	(3) Description		(4)	(5)
SMR Code	Federal Stock Number	Ref No & Mfr Code	Usable on Code	Unit of Meas	Qty Auth
	7520-559-9618	Case, Manual		EA	1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON. D.C., *15 November 1968*.

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By Order of the Secretary of the Army:

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General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

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