LINCOLN WELDERS

IM-228-A

IM228
Idealarc TIG
4306; 4310; 4316; 4317; 4319; 4321; 4322; 4323; 4324; 4325; 4326; 4327; 4328; 4329; 4330; 4332; 4333; 4334; 4345; 4365

OPERATING MANUAL

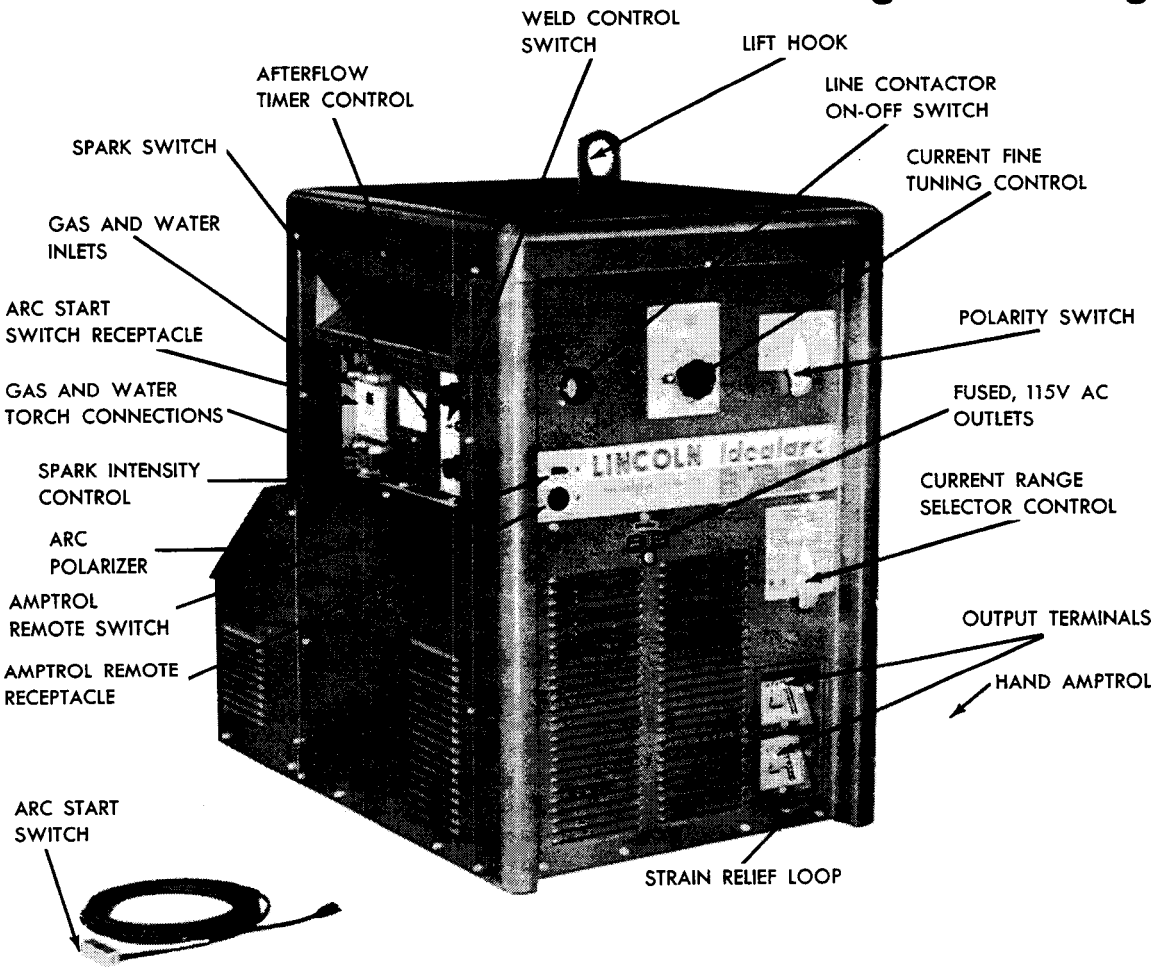
'IDEALARC - TIG'

300 AMPERE

AC and Combination AC/DC Welders

for conventional electrode and inert gas welding

This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.



THE LINCOLN ELECTRIC COMPANY

The World's Largest Manufacturer of Arc Welding Equipment and Electrodes

CLEVELAND 17, OHIO

DAMAGE CLAIMS

When Lincoln equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

INSTALLATION

Have a qualified electrician connect the input leads to AC power of the voltage and frequency specified on the nameplate. Use a single phase line or one phase of a two or three phase line. More than one Idealarc can be balanced across a three phase line to obtain the lowest current consumption from the line. Unbalanced line conditions are easily avoided by proper installation of the Idealarc and other machinery. If your machine is not equipped with a line contactor and a start-stop push button (straight AC's only), install a suitable switch in the input power lines. Fuse the input circuit with the recommended super lag fuses. Choose an input wire size according to local requirements or use the table below.

RECOMMENDED INPUT WIRE SIZES
60 Cycle, Single Phase

Based On The 1953 National Electric Code

Welder	Volts Input	Amps Input		Wire Size - Type R in Conduit				Super-Lag Fuse Size in Amps.	
				2 Input Wires		1 Ground Wire			
		With Cond.	Without Cond.	With Cond.	Without Cond.	With Cond.	Without Cond.	With Cond.	Without Cond.
300	220	86	108	2	1	6	6	150	150
	440	43	54	6	6	8	8	70	80
	550	34	43	8	6	10	8	60	60

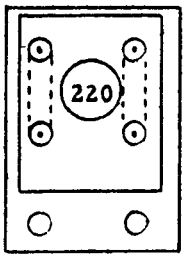
DUAL INPUT VOLTAGE MODELS

Two input voltage models not equipped with a line contactor (Accessory L) have three input leads extending out of the case. For operation on 220 volts, connect the power lines to H_1 and H_2. For operation on the higher voltage, connect to leads H_1 and H_3. Tape the lead not used.

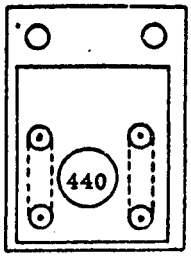
Idealarcs equipped with a dual voltage input panel are shipped connected for the higher input voltage. To change this connection, proceed as follows:

Caution: Be sure the main power is turned off.

1. Remove the input side panel of the welder case.
2. Remove the insulated jumper plate by taking off the 4 nuts.
3. The jumper plate has two positions, an upper and a lower. Each position is for a different voltage.
4. Place jumper plate in position with your input voltage appearing in the opening in this plate. Tighten all 4 nuts.



If your input voltage is 220 volts, the contact panel should look like this.



If your input voltage is 440 volts, the contact panel should look like this.

RECOMMENDED CABLE SIZES

With the input power off, connect the output cables to the proper studs on the output panel. The cables should be led through the strain relief loop below the studs to prevent damage to the studs if the cables are pulled excessively. Cable size may be selected according to the following table.

CABLE SIZES FOR COMBINED LENGTHS OF ELECTRODE AND GROUND CABLE

Machine Size	Lengths up to 50 ft.	50 to 100 ft.	100 to 150 ft.	150 to 200 ft.	200 to 250 ft.
300	1/0	1/0	1/0	2/0	3/0

MOUNTING THE UNDERCARRIAGE

(Optional)

When the Idealarc TIG is equipped with an arc polarized kit (batteries), the undercarriage must be mounted with the handle to the front of the welder. Without the batteries, the handle is put to the rear so the two parallel wheels carry most of the weight.

CURRENT RANGE SELECTOR CONTROL

Start the welder. A pilot light on the front panel indicates when the output studs are energized. The Current Range Selector Control is a four step rough selector having overlapping current ranges. Set this switch for the current range you desire.

CURRENT FINE TUNING CONTROL

The Current Fine Tuning Control rheostat raises and lowers the output current within the range set on the Current Range Selector Control. This permits the operator to dial the exact current desired.

POLARITY SWITCH (ON AC/DC MODELS)

Turn the arc polarity switch located in the upper right corner to AC, DC negative, or DC positive as required for the particular application. DO

NOT CHANGE THE POLARITY SWITCH WHILE WELDING. Doing this will cause the current to arc across the contacts seriously damaging the switch.

DUTY CYCLE

This welder is rated for 60% duty cycle. Duty Cycle is based on a ten minute period. Therefore, this welder can be operated at the nameplate rated output for 6 minutes out of every ten minute period. When welding with AC current and high frequency, the duty cycle is lowered. See "Arc Polarizer" on page 5.

AUXILIARY POWER

115 volts AC current is available from the receptacle on the front of the welder mounted below the nameplate. This receptacle is fused for 15 amperes. If it should blow, replace with 15 ampere, 125 volt (ABC 15) fuse available locally.

OVERLOAD PROTECTION

All AC/DC Idealarcs and all straight AC's equipped with a line contactor have a built-in protective thermostat operated by both temperature and current. This device stops the machine if the transformer or rectifier reach the maximum safe operating temperature because of frequent overload, high room temperature plus overload or abnormally high input voltage. The thermostat automatically resets when the temperature reaches a safe operating level.

The thermostat is mounted on the reactor coil. In AC/DC Idealarcs, another thermostat is mounted on the rectifier.

CONDENSERS (Accessory C)

When the power factor correction condensers fail, it is not always apparent from the appearance of the condensers. To check the condensers, operate the welder at rated input voltage drawing rated output current. The input current should correspond to the nameplate amperes. If the input current is 10% or 20% higher, at least one condenser has failed.

LINE CONTACTOR (Accessory L)

The line contactor is standard on all combination AC/DC models. It is an accessory on AC models only. The overload protective thermostat and start-stop push button is included with the line contactor assembly.

HIGH FREQUENCY UNIT (Accessory H)

a. General

The high frequency unit is a complete factory installed package incorporating a high frequency spark generator, gas and water valves, and the necessary controls required for inert gas welding. The controls and the gas and water connections are mounted on a recessed panel on the upper part of the left side panel. The controls are the Gas Afterflow Timer, Spark Intensity Control, Spark Switch and the Weld Control Switch.

The Spark Switch enables you to choose the type of high frequency operation. This switch has no affect on the output contactor or the gas and water valves. With the Spark Switch in the On position, the high frequency operates continuously while welding. With the Spark Switch in the Off position, the high frequency is off at all times. With the Spark Switch in the Start Only position, the high frequency operates to start the arc, but turns off automatically when the arc is established.

The Weld Control Switch enables you to choose Inert Gas Welding or Other Types of Welding. With the Weld Control Switch in the Other Types of Welding position, the complete high frequency unit is disconnected. Therefore, the machine is a standard welder with no high frequency or gas and water flowing. To operate the welder with the high frequency unit operating, turn the Weld Control Switch to the Inert Gas Welding position.

The Spark Intensity Control is used to reduce the Spark Intensity when desired.

b. Connection

To weld with inert gas, connect the necessary gas and water lines. The gas tank should be equipped with a pressure regulator and flowmeter. The return water line from the torch should be permitted to flow freely into a drain. DO NOT operate the torch unless water is flowing.

Connect the welding torch to the Electrode output stud of the welder. Insert the plug of the separate Arc Start Switch into the receptacle located between the gas and water connections on the high frequency control panel. Tape the Arc Start Switch to the torch handle in a position which will enable it to be conveniently pressed by the thumb when the torch is held in the welding position.

c. Operation

The sequence of operation for both inert gas and high frequency is as follows: Turn the welder on. Turn the Spark Switch to the On position. Turn the Weld Control Switch to the Inert Gas Welding position. This opens the gas and water valves purging the lines of air. These valves shut off after a time determined by the setting on the Gas Afterflow Timer. The time is set according to the size tungsten being used. The gas and water valves can be turned off by turning the Gas Afterflow Timer to Off. The machine is now ready for welding.

When the Arc Start Switch taped to the torch is pushed, the gas and water valves open, the high frequency unit is energized, and the output contactor closes. The torch is now energized with gas and water flowing. Strike the arc. After the arc is started, the Arc Start Switch can be released.

To break the arc, withdraw the torch from the work. When the arc is broken, the output contactor automatically opens de-energizing the torch. When the time set on the Gas Afterflow Timer elapses, the gas and water valves close. To restart the arc push the Arc Start Switch and restrike the arc.

If desired the circuit can be changed to allow opening and closing the output contactor directly by operating the Arc Start Switch. With this connection, the torch can be left over the work to provide a shield of the afterflow gas. To disable this Arc Start Switch hold-in feature:

1. Turn the machine off.
2. Open the small door in the center of the control panel.
3. Loosen the bolted connection in the blue lead.
4. Tape both ends of the blue lead and tuck them back inside the machine away from the spark gaps.

If you wish to weld using inert gas but without high frequency or with high frequency starting only, turn the Spark Switch to Off or Start only. This affects the high frequency spark generator only. All other controls operate as previously described. To weld with normal coated electrodes, turn the Weld Control Switch to Other Types of Welding.

Be certain the tungsten electrode never touches the material being welded. This is particularly important in welding aluminum. Even a slight amount of aluminum causes contamination, which results in poor arc characteristics and formation of a black deposit on the bead.

Grounding the High Frequency Unit

The maximum radiated output of a high frequency unit is limited by regulations of the Federal Communications Commission. The following recommendations will help to minimize the amount of radiation:

1. Keep the electrode and work leads as short as possible.
2. Keep the electrode and work leads on the floor and as close together as possible.
3. Keep the covers on the unit.
4. Keep the spark gaps set at 0.008". The door in the center of the high frequency control panel provides access to the spark gaps.
5. The case and work stud must be grounded. The ground lead should be less than 8 feet in length. A water pipe within 8 feet of the welder going directly into the soil, make a good ground. Otherwise a direct earth ground should be installed. Grounding to the building frame or a long pipe system can make radiating aerials of these members.
6. Be sure there is a good electrical contact between the welder case and input lead conduit.

AMPTROL (Optional)

The Amptrol is a remote current control. It is available as either a hand or foot operated. Both models operate the same electrically except the latest models of the foot Amptrol incorporate the Arc Start Switch.

Insert the three prong plug from the Amptrol into the Remote Receptacle located at the left side of the machine nameplate. Switch on the Remote Switch located immediately above the Remote Receptacle. Operation of the Amptrol will now vary the welding current.

The range over which the Amptrol will vary the welding current depends upon the settings of the welder current controls. With the Current Fine Tuning Control set on maximum, the Amptrol can vary the current over the entire range for the particular setting of the Current Range Selector Control. If the Current Fine Tuning Control is set less than maximum, the Amptrol can vary the current from the minimum for the particular Current Range Selector Control setting up to the current set by the Current Fine Tuning Control.

When welding set the Current Fine Tuning Control for the maximum current you desire. You will get this maximum current with the foot Amptrol fully depressed. Raise your foot to reduce the current. Most welding should be done with the foot close to fully depressed. Models of the foot Amptrol made after January 1960 incorporate the Arc Start Switch. Insert the two prong plug from the Amptrol into the receptacle located on the high frequency control panel between the gas and water connections. With this connection the output contactor remote switch taped to the torch is not used.

The operation of the Arc Start Switch is the same whether incorporated in the foot Amptrol or taped to the torch. As normally used, the output contactor remote switch closes as the operator depresses the foot lever. It stays closed until the arc is broken by withdrawing the torch from the work. By disconnecting the blue lead from the receptacle as described previously, the arc can be broken by raising the foot lever to its topmost position.

ARC POLARIZER (Accessory B)

When welding aluminum and magnesium with the AC tungsten inert gas process, a circulating DC component appears in the welder secondary circuit. This circulating DC saturates the transformer iron, raising the input current of the welder. In this condition, the welder must be operated on not more than a 35% duty cycle or the primary winding will overheat. The Arc Polarizer supresses this DC component, thus raising the machine duty cycle from 35% to 50%. In addition, welding speed and penetration are increased with no DC in the circuit. Since this is less noticeable at lower currents, the Arc Polarizer is unnecessary if the machine is used for welding in the lower current ranges.

The Arc Polarizer consists of three paralleled six volt automotive batteries mounted in a case on the rear of the welder. The batteries are shipped dry. Fill with the electrolyte per instructions enclosed with the batteries.

Unless the welder is off or the batteries are disconnected for a two or three week period, the batteries should remain fully charged. The batteries are charged while they are in the machine by the welding current or by a trickle charger included with the Arc Polarizer. The trickle charger operates only when the welder is on.

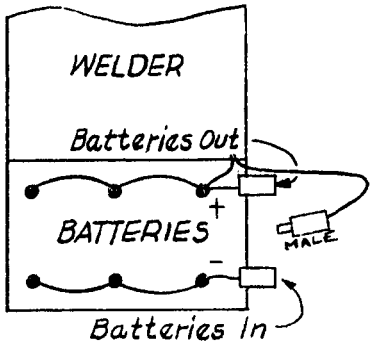
WELDING WITH A DEAD BATTERY RESULTS IN CHARGING AT AN EXCESSIVE RATE CAUSING SERIOUS HEAT DAMAGE TO THE BATTERY. If completely discharged, remove the battery and have it charged at a battery shop.

Partially discharged batteries can be brought up to welding charge through the trickle charger. To operate the trickle charger, turn the welder on but do not weld. If all three batteries are low, attempting to charge them with the trickle charger may blow the 10 amp (AGC-10) charger fuse located in the battery case. When the specific gravity of all three batteries is above 1.150, the machine can be used for welding. The batteries will quickly come up to full charge.

If the welder is used at currents above 150 amperes for several hours each day, the batteries will be kept fully charged by the welding current. The charger should be turned off to avoid overcharging the batteries. A charger on-off switch is located inside the battery case.

When welding with AC below 30 amperes with the high frequency on, you may sometimes find you get better arc characteristics with the batteries disconnected.

When welding with AC manual electrode (high frequency off), the batteries must be disconnected. If you fail to disconnect the batteries, the arc is unstable and the batteries may burn up. To disconnect the batteries see the sketch below.



To Disconnect the Batteries	To Connect the Batteries
Connect the male plug to the female plug at the positive terminal.	Connect the male plug to the female plug at the negative terminal.

The batteries are automatically disconnected when the polarity switch is turned for DC operation.

MAINTENANCE INSTRUCTIONS

1. The fan motor has sealed ball bearings which require no service.
2. In dusty locations, dirt may clog the air channels causing the welder to run hot. Under these conditions, blow out the welder at regular intervals.
3. Inspect the spark gaps monthly to maintain the .008" setting. The door in the center of the high frequency panel provides access to the spark gaps.
4. If the electrode is oxidized and the arc is hard to start, adjust the Afterflow Timer for a longer flow of gas after the arc is broken.
5. Wiring diagrams are pasted to the inside of the left side panel of the welder. If the diagram becomes illegible, write to The Lincoln Electric Co., Service Dept., for a replacement. Give the diagram number or the welder code number.
6. If the machine is not operating properly, refer to the Trouble Shooting Chart.

WARNING: USE EXTREME CAUTION WHEN WORKING WITH THE SECONDARY CIRCUIT OF THE HIGH FREQUENCY UNIT TRANSFORMER. THE OUTPUT VOLTAGE OF THIS TRANSFORMER IS DANGEROUSLY HIGH. TURN THE MACHINE OFF WHEN WORKING ON THIS PART OF THE CIRCUIT.

TROUBLE SHOOTING

TROUBLE	CAUSES	WHAT TO DO
Starter Chatters	Check-Low Line Volts.	Check with Power Company
	Faulty Starter	Repair or replace.
Welder will not start. (Starter not operating.)	Supply line fuse blown.	Replace. (Look for reason for blown fuse first.)
	Power circuit dead.	Check voltage.
	Broken power lead.	Repair.
	Wrong voltage.	Check voltage against instructions.
	Thermostat tripped. (Welder Overheated.)	Make sure that fan is operating and that there are no obstructions to free flow of air. Operate at normal current and duty cycle.
	Starter switch jammed.	Remove obstruction.
	NVR coil open.	Replace.
Welder will not weld. (Starter operating.)	Electrode or ground lead loose or broken.	Tighten and repair connections.
	Open transformer circuit.	Send to repair shop to have coils replaced.
	Polarity switches not centered on arrows. (AC-DC only.)	Center polarity switch on arrow.
Welder welds only on minimum - no control.	Open Control Circuit Lead.	Repair.
	Amptrol Remote Switch in wrong positions.	Throw Amptrol Remote Switch to OFF.
Welder welds but soon stops welding. (Thermostat tripped.)	Proper ventilation hindered.	Make sure all case openings are free for proper circulation of air.
	Either AC or DC unit loaded beyond rating.	Operate at normal current and duty cycle consistent with both AC and DC rating.
	Fan inoperative.	Check leads and motor bearings. Fan can be tested on 115 volt line; with welder on, voltage across fan should be 115 volts.
Variable or sluggish welding arc.	Poor ground or electrode connection or poor connection in control circuit.	Check and clean all connections.
	Current too low.	Check recommended currents for rod type and size.
	Low line voltage.	Check with Power Company.
	Welding leads too small.	Use 1/0 cable. If combined length of electrode and ground cable is over 150 feet, use 2/0 or larger cables.

TROUBLE SHOOTING

TROUBLE	CAUSES	WHAT TO DO
Polarity switch won't turn.	Arced by turning under load.	Replace Polarity Switch.
Amptrol Control does not control output.	Remote Switch in wrong position.	Throw Remote Switch to ON.
	Plug on Amptrol attachment not securely in remote receptacle.	Secure plug.
	Poor Contact or open lead in Amptrol itself.	Check connections and leads in control.
High Frequency weak or not present.	Spark Switch in "Off" Position.	Throw Spark Switch to ON.
	Weld control switch in Other Types of Welding position.	Turn the Weld Control switch to Inert Gas Welding position.
	Open or poor contact in H.F. Input Circuit.	Check connection and leads.
	H.F. being internally grounded in machine.	Check electrode circuit in machine for H.F. grounds. Check machine by-pass condenser and condenser leads.
Gas & Water valves apparently not turning on or off at proper time.	Timing off.	Adjust timer.
	No gas.	Check bottle for gas pressure.
	No water.	Check water line for pressure.
	Pilot Relay inoperative.	Check Pilot Relay Circuit for open leads.
Batteries having no effect on welding or reducing DC component in output.	Poor connections to batteries.	Check connections.
	Batteries discharged.	Charge batteries or replace with new.
High Frequency set for On at start only but remains on for entire weld. Or High Frequency set for On, but goes off when the Arc Start Switch on the torch is released.	Diode rectifier in High Frequency circuit may be burned out.	Replace. When soldering the diode, be sure the leads to the diode do not get too hot to hold in your bare hands.

INDEX OF PARTS LISTS

ACCESSORIES

Several accessories are available for addition to the basic TIG welder. Each accessory is designated by a single letter as listed below. To see which accessories were factory installed in your welder, check the code number stamped on the nameplate. Each letter after the basic four digit code number indicates one of the following accessories. Always give the full welder code number when ordering parts.

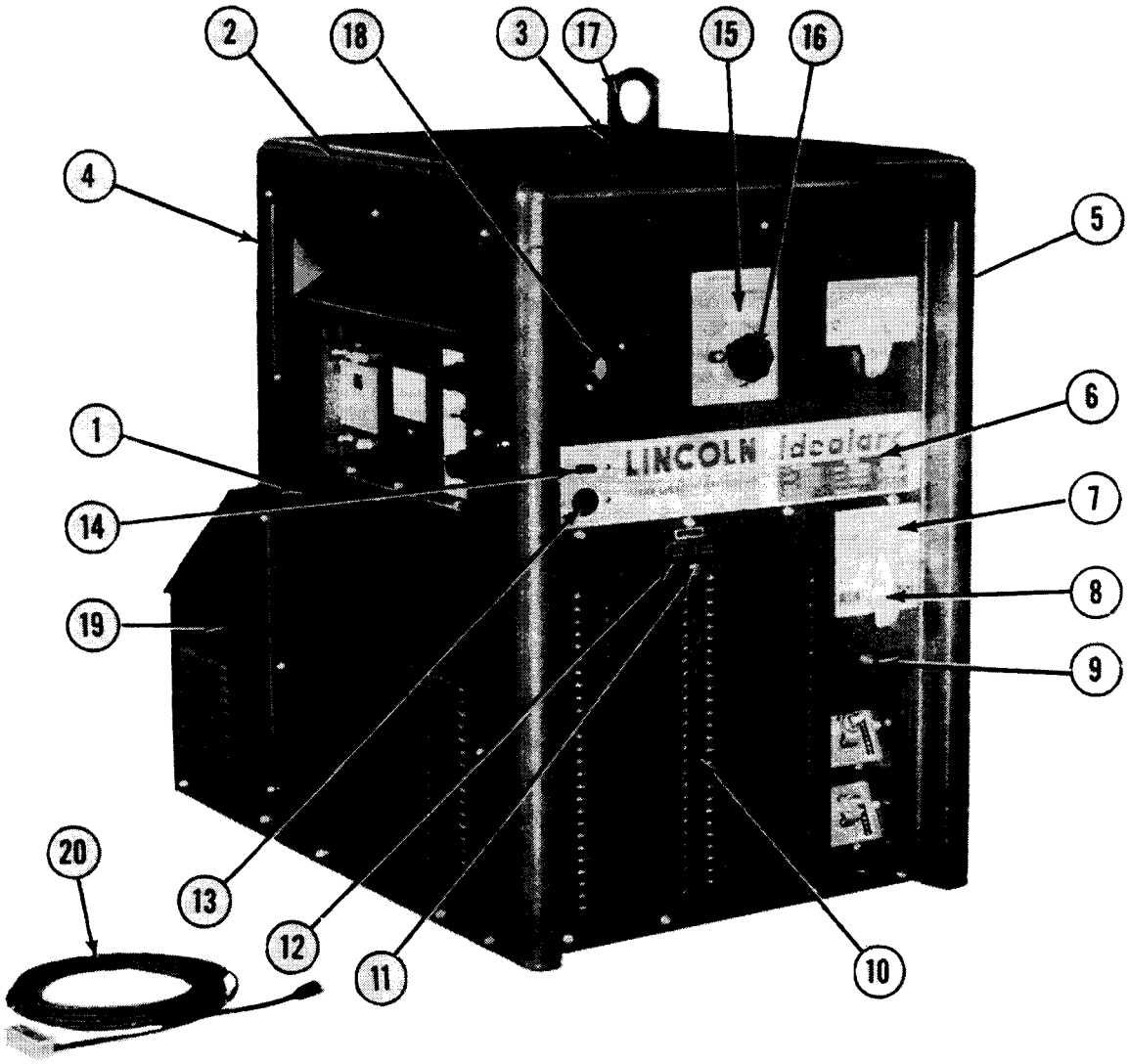
SEE THE BACK COVER FOR INSTRUCTIONS ON HOW TO ORDER PARTS

WIRING DIAGRAMS

The diagrams for each machine are now glued to the inside of the right side panel. If the diagram is illegible, write The Lincoln Electric Company, Service Department for a replacement. Give the diagram number or the welder code number.

CASE EXTERIOR GENERAL ASSEMBLY

Parts List P-62-C

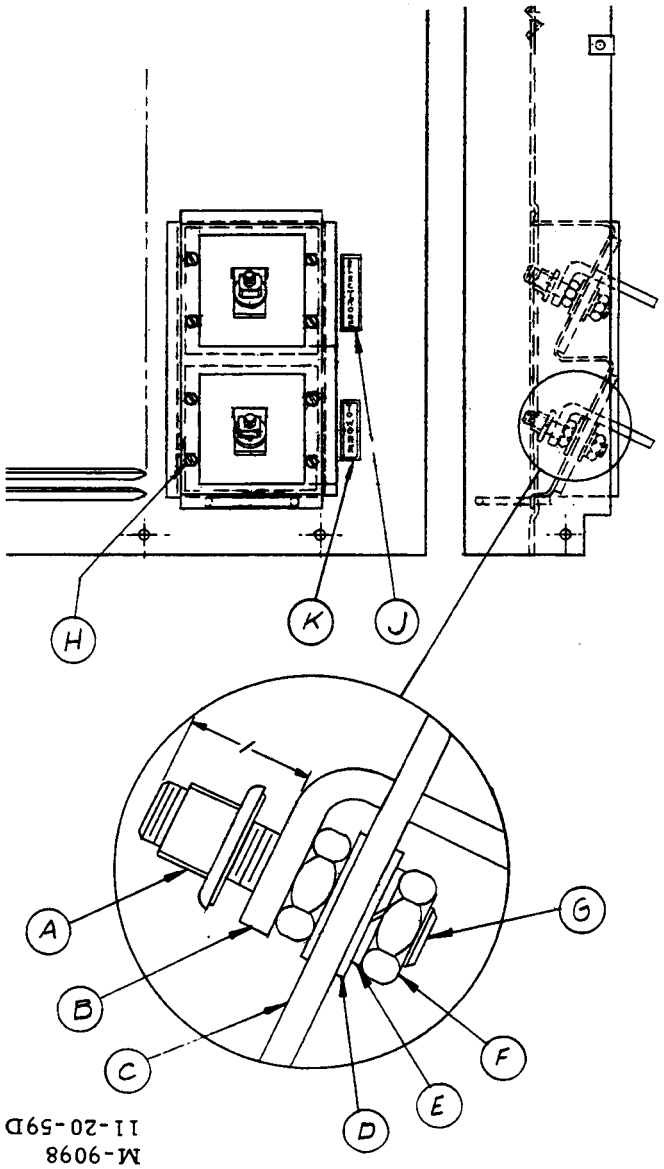


ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Case Left Side Panel (without hi-freq. unit)	1
1	Case Left Side Panel (with hi-freq. unit)	1
2	Case Cover	1
3	Cover Seal	1
4	Case Rear Panel (without arc polarizer)	1
4	Case Rear Panel (with arc polarizer)	1
5	Case Right Side Panel	1
6	Nameplate	1
	Self-Tapping Screws (Nameplate Mounting)	6
7	Nameplate, Current Range Selector Control	1
8	Handle, Current Range Selector Control	1
	Current Range Selector Control See P-62-F	
9	Pilot Light	1
10	Front Panel	1
11	Fuse Holder	1
	Fuse	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
12	Duplex Receptacle	1
13	Remote Receptacle	1
14	Remote Switch	1
15	Nameplate, Current Fine Tuning Control	1
	Self-Tapping Screw, Nameplate Mounting	4
16	Rheostat Knob	1
	Rheostat, Current Fine Tuning Control	1
17	Lift Bail, (AC only) Includes Horizontal Baffle:	1
18	Pushbutton	1
18	Cover Plate, Without Line Contactor	1
19	Arc Polarizer - Accessory B See P-62-L	
20	Arc Start Switch (With Hi-Freq. Unit Only)	1
	Tinnerman Nut, Mount On Front Panel	4
	Self-Tapping Screw, Fastens Top and Side Panels to Case Front, Back and Horizontal Baffle	17
	Round Head Screw, Mounts Top to Middle of Front Panel	1
	Spacer, Mounts Top to Middle of Front Panel	1
	Plug Button, Plug Polarity Switch Hole on AC Welders	1

OUTPUT STUDS

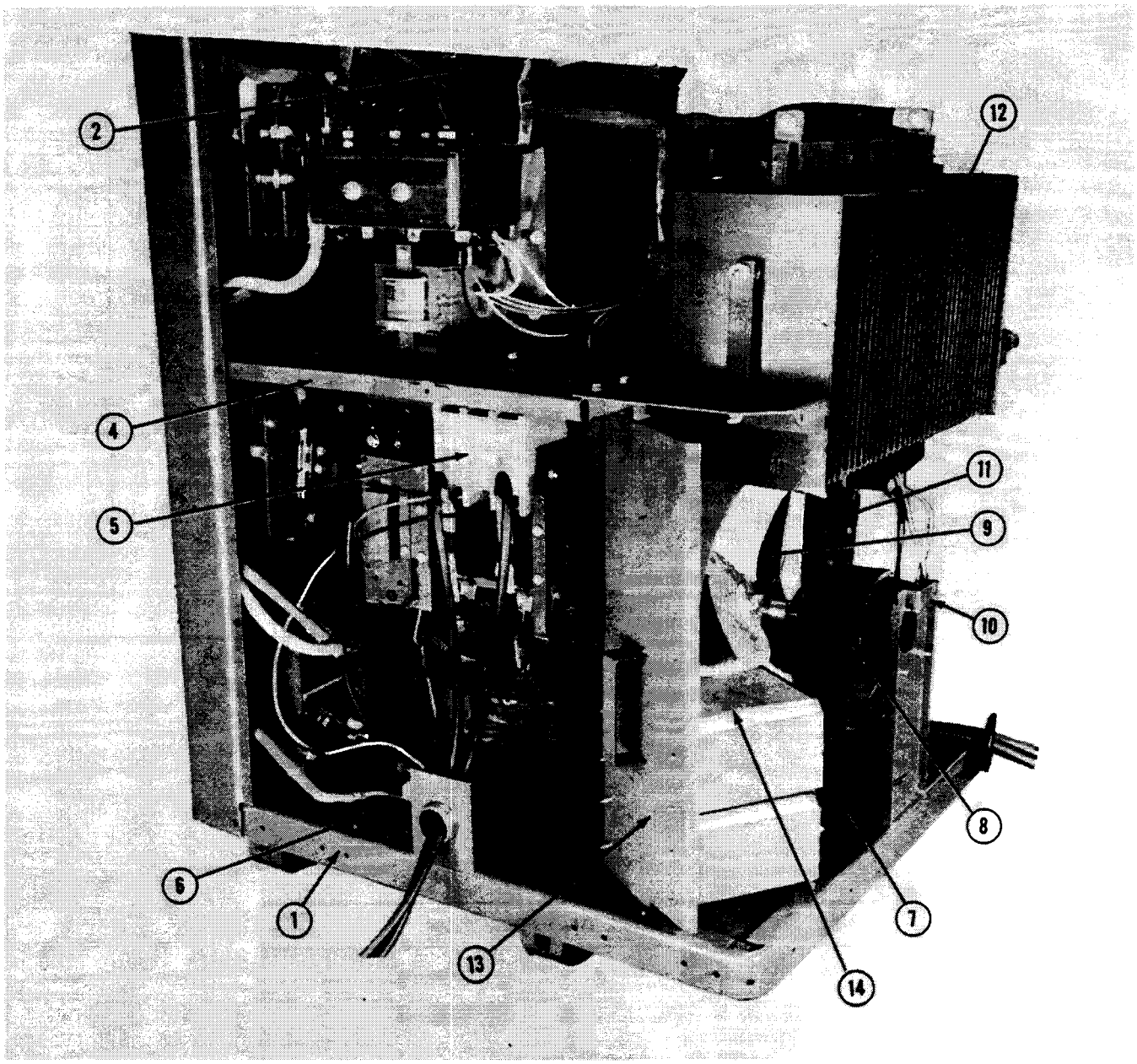
Parts List P-62-D



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
A	Flanged Weld Nut	2
B	Connection Strap	2
C	Stud Insulation	2
D	Washer	4
E	Lockwasher	2
F	Hex Jam Nut	4
G	Stud	2
H	Self-Tapping Screw	8
J	Decal (Electrode)	1
K	Decal (To Work)	1

INTERIOR GENERAL ASSEMBLY

Parts List P-62-E

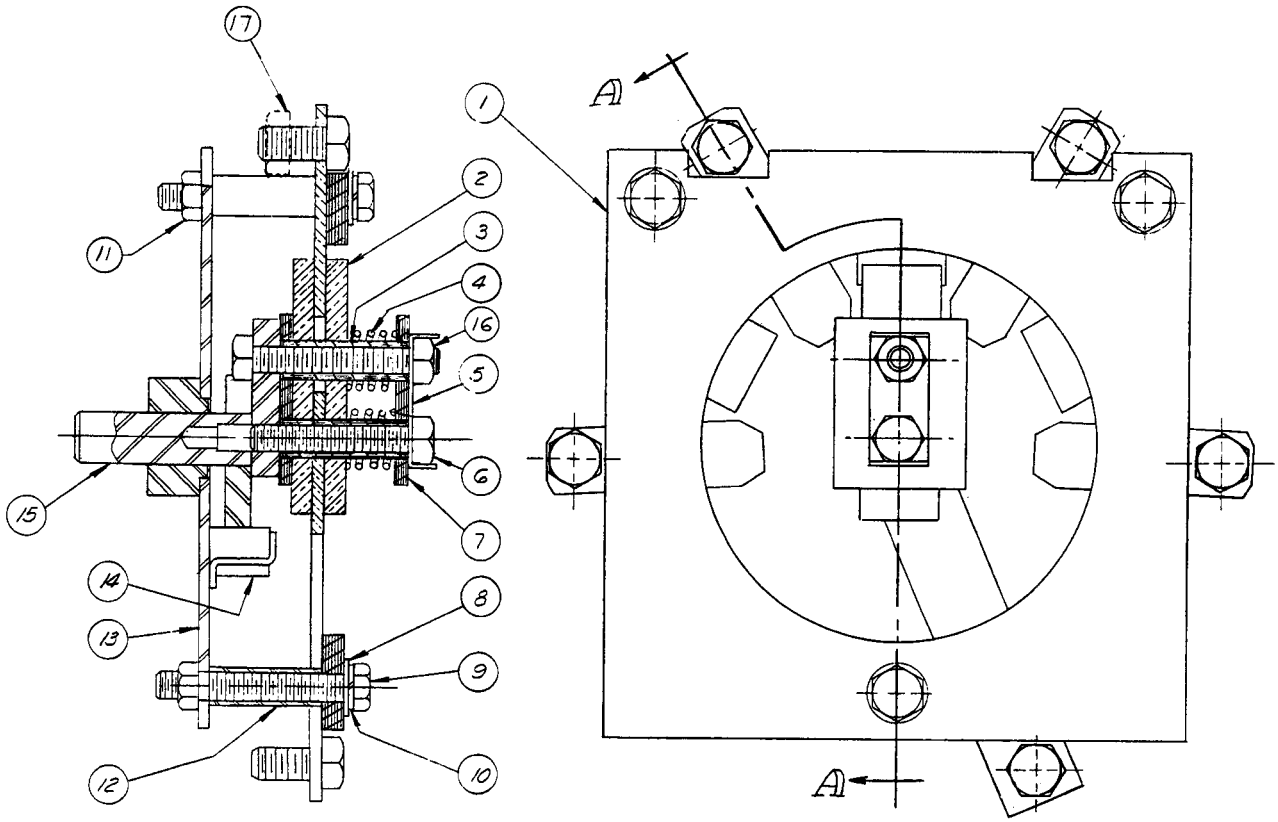


ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Base	1
	Reactor Lamination Assembly (60 cycle)	1
	Reactor Lamination Assembly (50 cycle)	1
	Reactor Coil	
	Transformer Lower Lamination Assembly	1
	Transformer Upper Lamination Assembly	1
	Transformer Coil	
	Hex Head Bolt, Clamps Transformer Halves	4
	Lockwasher, Clamps Transformer Halves	8
	Spacer, Clamps Transformer Halves	4
	Square Nut, Clamps Transformer Halves	8
2	Control Rectifier	1
	Control Rectifier Mounting Bracket	1
4	Horizontal Baffle, 300/300	1
4	Horizontal Baffle, AC Only, Includes Lift Bail	1
5	Line Contactor Assembly See	P-61-L
6	Large Base Baffle	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
7	Small Base Baffle	1
	Drive Screw, Mount Base Baffles	9
8	Fan Motor	1
		4
9	Fan Blade	1
10	Fan Support Bracket	1
11	Vertical Baffle	1
12	DC Unit See	P-62-G
13	Condenser Mounting Panel	1
14	Condenser	

CURRENT RANGE SELECTOR CONTROL

Parts List P-62-F



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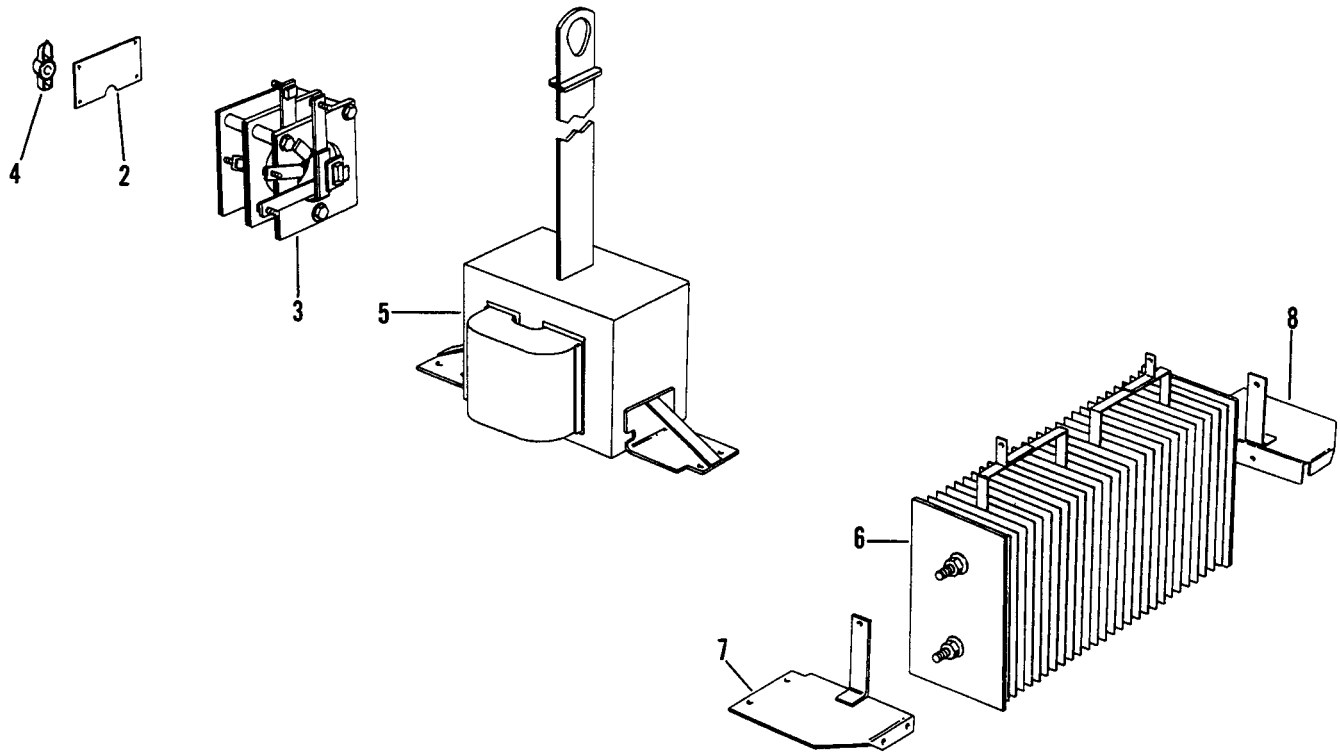
SECTION A A

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Current Range Selector Control, (3 ranges) Includes:	1
	Current Range Selector Control, (4 ranges) Includes:	1
1	Switch Plate Assembly	1
2	Moving Contact	2
3	Insulating Tube	2
4	Spring	2
5	Locking Clip	1
6	Hex Head Bolt	1
7	Insulation	2
8	Flat Washer	3
9	Hex Head Bolt	3
10	Lockwasher	3
11	Hex Nut	3
12	Spacer	3
13	Bracket Assembly	1
14	Spring (Cam) (4 range switch only)	1
15	Rotor Arm Assembly	1
16	Hex Nut	1
17	Hex Nut	5
18	Insulating Washer	1

DC UNIT - AC/DC MODELS

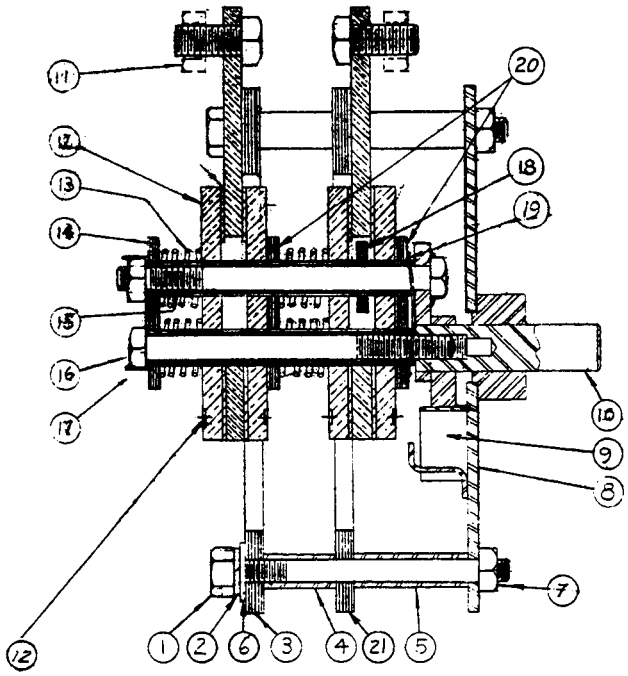
Parts List P-62-G



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
2	Nameplate, Arc Polarity Switch	1
3	Arc Polarity Switch (2 Gang)	1
	Switch Parts See	P-61-H
3	Arc Polarity Switch (3 Gang)	1
	Switch Parts See	P-62-H
4	Handle, Arc Polarity Switch	1
5	Choke Assembly, Includes	1
	Thermostat Assembly	1
6	Rectifier	1
7	Rectifier Support Bracket, Right Hand	1
8	Rectifier Support Bracket, Left Hand	1
	Thread Cutting Screw, Case Rear Panel to Mounting Bracket	2

ARC POLARITY SWITCH - 2 GANG

Parts List P-61-H



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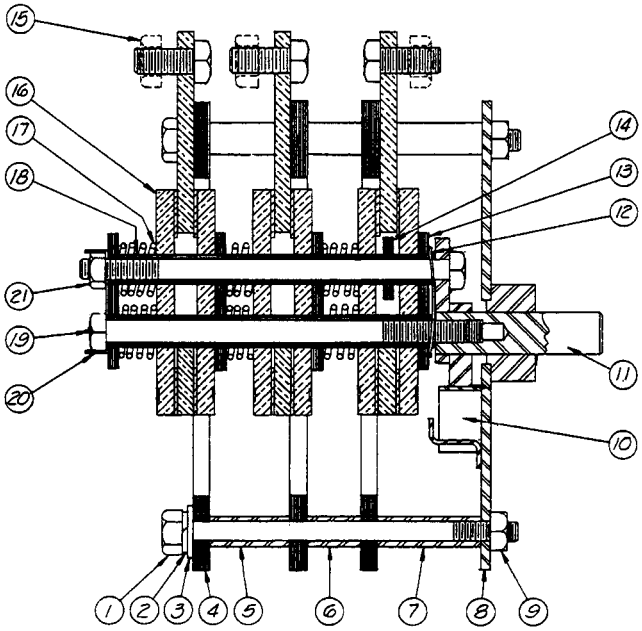
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Arc Polarity Switch Assembly, Includes:	1
1	Hex Head Bolt	3
2	Lockwasher	3
3	Contact Panel Assembly	2
4	Spacer	3
5	Spacer	3
6	Plain Washer	3
7	Hex Nut	4
8	Mounting Bracket Assembly	1
9	Spring	1
10	Shaft Assembly	1
11	Hex Nut	8
12	Moving Contact	4
13	Spring	4
14	Insulating Washer	1
15	Insulating Tube	2
16	Square Head Bolt	1
17	Locking Clip	1
18	Insulating Washer - 300 Amp Only	1
19	Spring	1
20	Rotor Insulation	2

ARC POLARITY SWITCH - 3 GANG

Parts List P-62-H

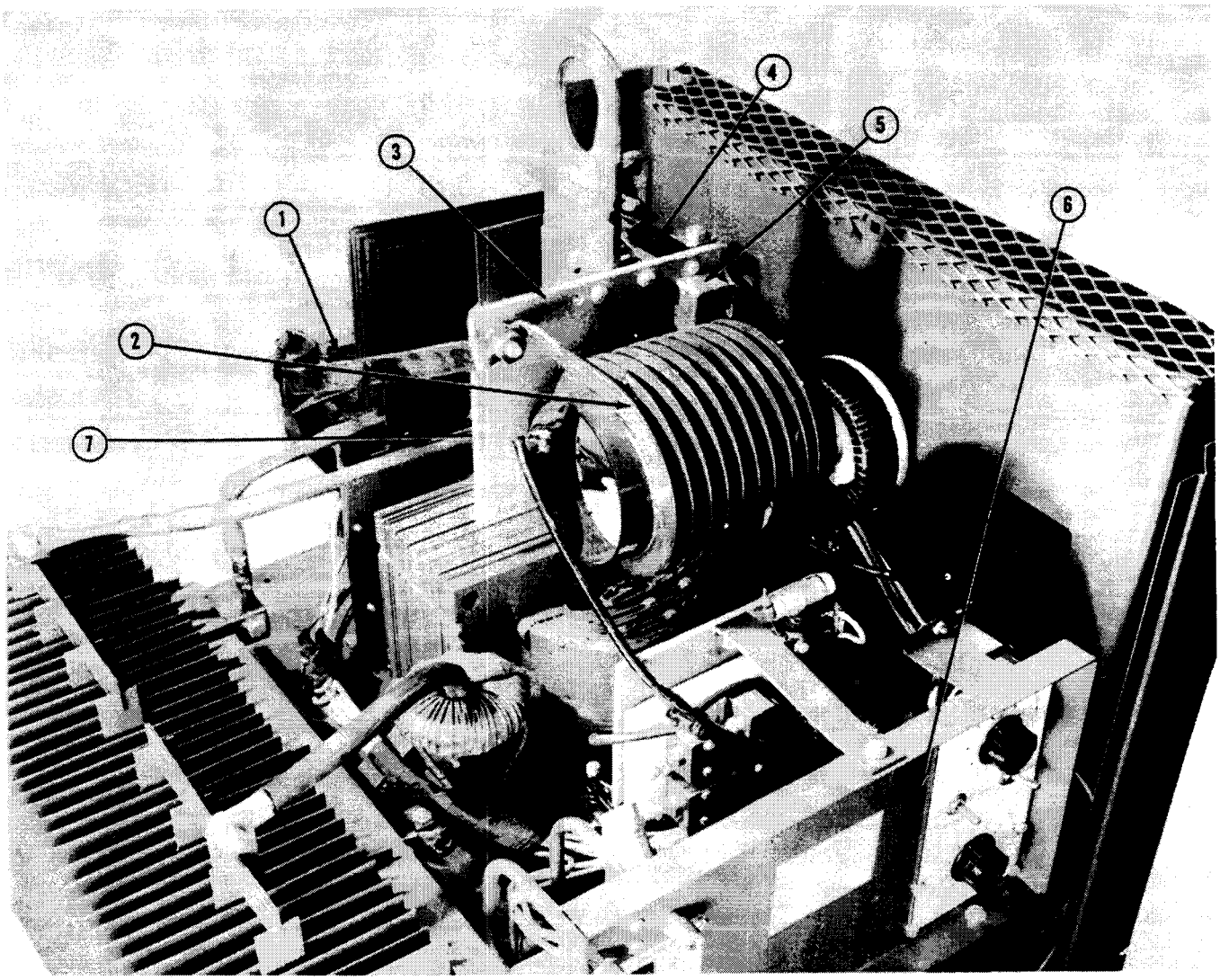


L-3792
3-18-60C

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Arc Polarity Switch, Includes:	1
1	Hex Head Bolt	3
2	Lockwasher	3
3	Flat Washer	3
4	Contact Panel	3
5	Spacer	3
6	Spacer	3
7	Spacer	3
8	Mounting Bracket	1
9	Hex Nut	3
10	Switch Spring	1
11	Rotor Arm	1
12	Spring	1
13	Insulating Washer	4
14	Insulating Washer	1
15	Hex Nut	12
16	Moving Contact	6
17	Spring	6
18	Insulating Tube	2
19	Hex Head Bolt	1
20	Locking Clip	1
21	Hex Nut	1

H - HIGH FREQUENCY UNIT

Parts List P-62-J

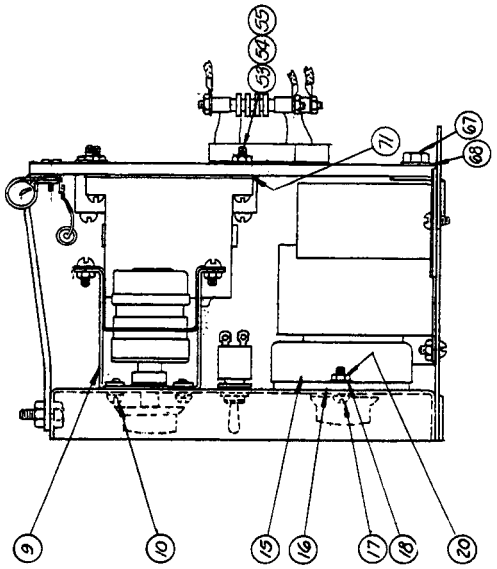


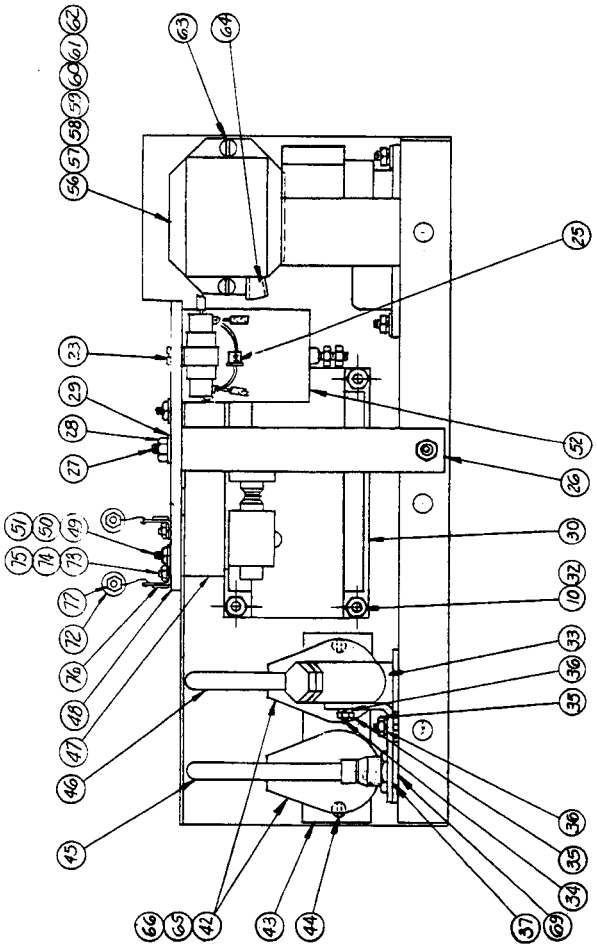
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	S-45 Output Contactor	1
	S-45 Output Contactor Parts See	P-28-E
	Contactor Mounting Panel	1
	Thread Cutting Screw, Contactor to Panel	4
2	Air Core Transformer	1
3	Air Core Transformer Mounting Panel	1
	Straps, Mounts Panel to Lift Bail	2
4	Resistor	1
5	Condenser	1
6	High Frequency Control Panel See	P-62-K
	Additional Timer Parts	
7	Condenser, Timer Delay Circuit, Note 1	1
	Relay, Timer Delay Circuit,	1
	Relay Box and cover	1
	Relay Gasket	1
	Self-Tapping Screw, Mount Relay Box	2
	Note 1: Timer Delay Circuit was not installed on machines with the 3 range 'Current Range	
	Selector Control'. It can be added to increase timer life. Order the Timer Delay Circuit Kit. Give the welder code number.	

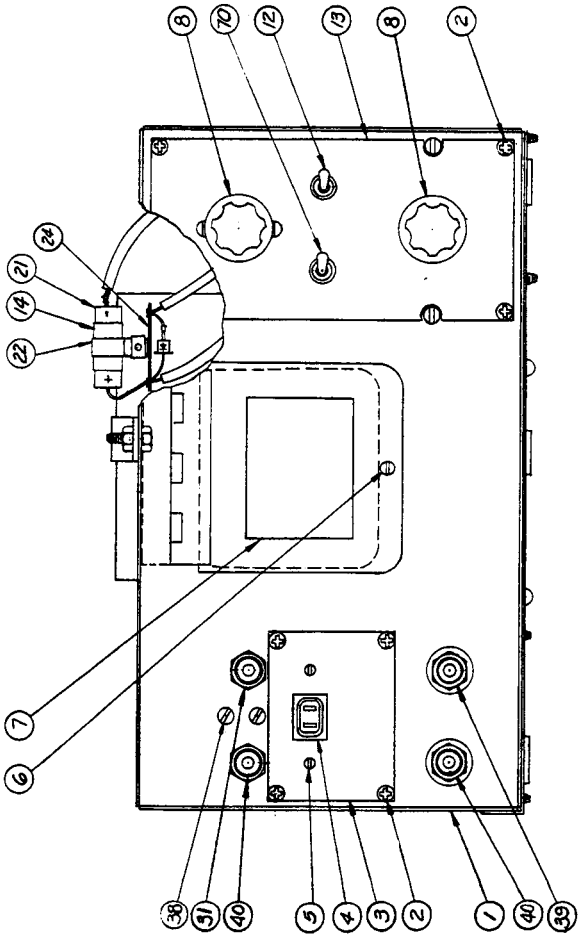
HIGH FREQUENCY CONTROL PANEL

Parts List P-62-K

L-3814
7-8-60







ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Control Panel Assembly, Includes: Specify Cycles	1
1	Panel	1
2	Self-Tapping Screw	8
3	Valve Plate	1
4	Receptacle	1
5	Round Head Screw	2
6	Self-Tapping Screw	1
7	Caution Decal	1
8	Knob	1
9	Timer Assembly	1
10	Round Head Sems Screw	6
12	On-Off Switch	1
13	Control Plate	1
14	Insulation	1
15	Rheostat	1
16	Rheostat Mounting Panel	1
17	Round Head Sems Screw	2
18	Flatwasher	2
20	Hex Nut	2
21	Condenser (Filter)	1
22	Clamp	1
23	Self-Tapping Screw	1
24	Terminal Strip	1
25	Diode	1
25	Germanium Rectifier	1
26	Panel Support Bracket	1
27	Hex Head Screw	2
28	Hex Nut	2
29	Flat Washer	2
30	Transformer (60 cycle)	1
30	Transformer (50 cycle)	1
31	Connector, Hex Nipple	1
32	Hex Nut	4
33	Strainer	1
34	Round Head Screw	1
35	Hex Nut	3
36	Lockwasher	3
37	Pipe Mounting Bracket	1
38	Round Head Screw	2
39	Connector	1
40	Connector	2
42	Solenoid Valve (60 cycle)	1
42	Solenoid Valve (50 cycle)	1
43	Solenoid Mounting Bracket	1
44	Self-Tapping Screw	2
45	Gas Line Assembly	1
46	Water Line Assembly	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
47	Spark Gap Assembly Includes:	1
	Ceramic Base	1
	Asbestos Pad (Large)	1
	Asbestos Pad (Small)	2
	Spark Gap Support	1
	Spark Gap Support	2
	Electrode	4
	Set Screw	4
	Round Head Screw	6
	Washer	6
	Hex Nut	6
48	Rear Panel	1
49	Round Head Screw	2
50	Hex Nut	2
51	Washer	2
52	Condenser	1
53	Round Head Screw	2
54	Hex Nut	2
55	Flat Washer	2
56	Pilot Relay	1
57	Relay Box	1
58	Relay Gasket	1
59	Round Head Screw	2
60	Spacer Tube	2
61	Washer	2
62	Lockwasher	2
63	Self-Tapping Screw	2
64	Tubing	1
65	Round Head Screw	4
66	Lockwasher	4
67	Hex Head Screw	2
68	Washer	2
69	Washer	2
70	Toggle Switch	1
71	Insulating Washer	2
72	Radio Frequency Choke	2
73	Lockwasher	2
74	Round Head Screw	2
75	Hex Nut	2
76	Terminal Strip	2
77	Hex Nut	4
	Resistor (Not Illustrated)	1

B - ARC POLARIZER

Parts List P-62-L

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Base	1
	Case	1
	Thread Cutting Screw, Case To Base	4
	Thread Cutting Screw, Battery Case To Welder Base	6
	Self-Tapping Screw, Battery Case To Welder Case	7
	Battery	3
	Battery Cable, Battery To Work Stud	1
	Battery Cable, Battery Jumper	1
	Battery Cable, Battery To Reactor Tap	1
	Switch, Trickle Charger	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Fuse Holder	1
	Fuse	1
	Rectifier	1
	Insulating Bushing, Rectifier Mounting	1
	Insulating Washer, Rectifier Mounting	1
	Resistor	1
	Insulating Washer, Resistor Mounting	2

L - LINE CONTACTOR

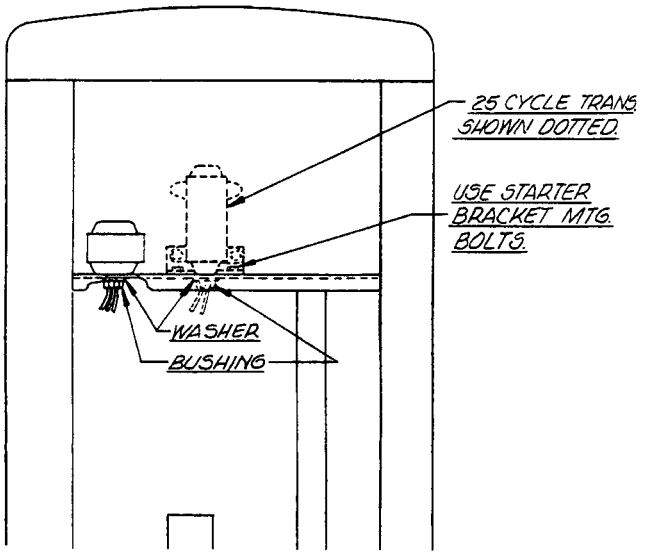
Parts List P-61-L

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	GXL Starter, Less NVR Coil	1
	GXL Starter Parts	P-28-F
	Two Volt Input Panel, Stationary, Specify Voltages	1
	Two Volt Input Panel, Movable	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Starter Mounting Panel	1
	Thermostat Assembly, Includes:	1
	Push Button	1
	Klixon Thermostat	1

P - 115 VOLT PUSH BUTTON CONTROL CIRCUIT

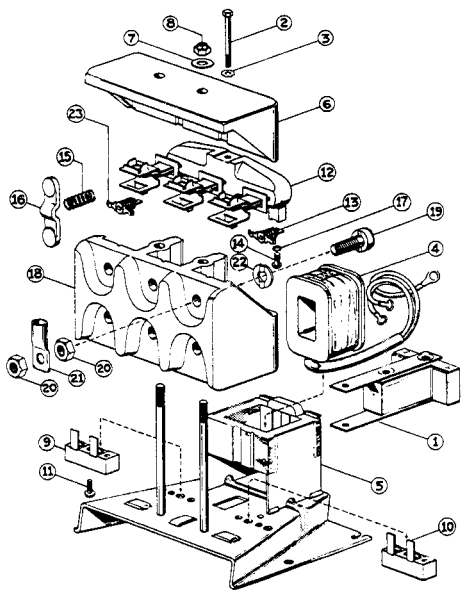
Parts List P-61-M



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Transformer	1
	Transformer Mounting Bracket	1
	Sems Screw, Bracket Mounting	2
	NVR Coil	1
	Conduit Bushing	1
	Washer	1
	Round Head Screw	2
	Hex Nut	2

S-45 OUTPUT CONTACTOR

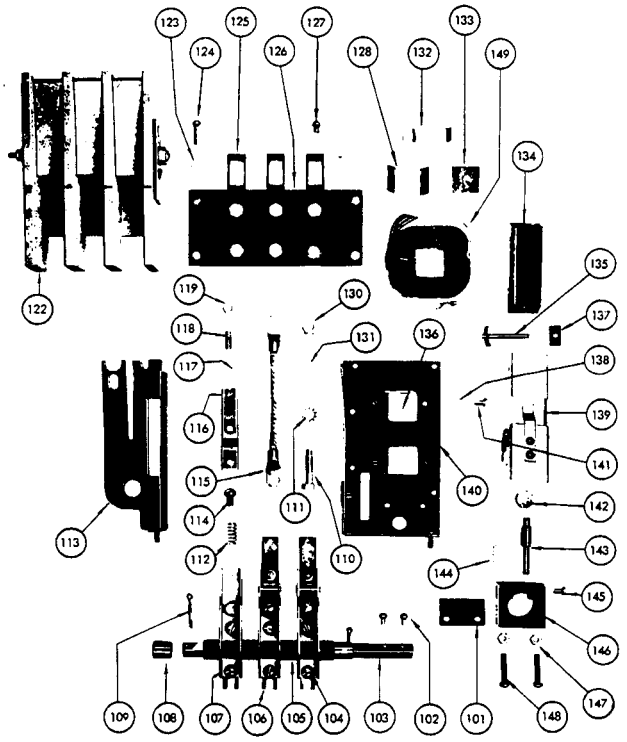
Parts List P-28-E



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	S-45 Starter Assembly, Includes: (Less NVR Coil)	1
1	Moving Lamination Assembly	1
2	Screw - Lamination Mounting	1
3	Lockwasher	1
4	*	1
5	Lamination and Panel Assembly (Specify Input Cycles)	1
	Plastic Guide	1
6	Contact Block Cover	1
7	Plain Washer	2
8	Hugnut	2
9	Stationary Interlock Contact Assembly	1
10	Stationary Interlock Contact Assembly	1
	Screw - Lead Connections	4
11	Screw - Interlock Block Mounting	2
	Contactor Assembly, Includes	1
12	Moving Contactor Block	1
13	Moving Interlock Contact Assembly	1
14	Round Head Screw	1
15	Spring - Main Contact	3
16	Moving Contact	3
17	Lockwasher	1
23	Moving Interlock Contact Assembly	1
	Main Contact Block Assembly, Includes	1
18	Main Contact Block	1
19	Main Stationary Contact	6
20	Hex Jam Nut - Brass	As Needed
21	Terminals	3
22	Spacer Washer	6
*	NVR Coil (Specify Input Voltage)	

GXL STARTER

Parts List P-28-F



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	GXL Starter, Includes: (Less NVR Coil)	1
101	Interlock Insulation	1
	Interlock Support Plate	1
102	Sems Round Head Screw	2
	Shakeproof Lockwasher	2
103	Square Shaft	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
104	Sems Round Head Screw	6
105	Shaft Insulation	1
106	Contact Arm Clamp	2
107	Contact Arm	2
108	Bearing, Nylon	2
109	Cotter Pin	2
110	Hex Head Cap Screw - Contact Mounting (Lower)	3
110	Hex Head Cap Screw - Contact Mounting (Upper)	3
111	Shakeproof Washer	6
112	Contact Spring	2
113	Side Panel, Left Side	1
114	Sems Round Head Screw	3
115	Lead With Lugs	2
116	Moving Contact	2
117	Rivet, Contact Assembly	2
118	Headless Slotted Set Screw	2
119	Hex Nut	2
122	Barrier	1
123	Hex Nut, Side Panel Mounting	4
124	Sems Round Head Cap Screw-Contact Block Mounting (Lower)	2
124	Sems Round Head Cap Screw-Contact Block Mounting (Upper)	2
	Shakeproof Washer	4
	Contact Block Assembly, Includes:	1
125	Stationary Contact	2
126	Contact Block	1
127	Sems Round Head Screw - Lead Connection	2
128	NVR Coil Clamp Insulation	1
129	Copper Lead	2
130	Hex Nut	4
131	Square Nut	3
132	Clamp, NVR Coil	1
133	Fiber Retainer, NVR Coil	1
134	Moving Lamination Note 1	1
135	NVR Arm Pin	1
136	Stationary Lamination	1
137	Tinnerman Nut	2
138	Hex Nut	4
	Shakeproof Washer	4
139	Movable NVR Crossing Arm	1
140	Side Panel - Right Hand	1
141	Sems Round Head Screw, Lamination Mounting	4
	Interlock Assembly, Includes:	1
142	Plain Washer	1
143	Plunger	1
144	Coil Spring	1
145	Sems Phillips Head Screw	2
146	Interlock Block	1
147	Hex Nut	2
148	Sems Round Head Screw - Interlock Mounting	2
	Lug	3
	Round Head Screw - Lug Mounting	3
149	NVR Coil (Specify Input Voltage)	1
	Note 1: To obtain proper moving lamination (Item 134) specify input line cycles.	

HOW TO ORDER REPLACEMENT PARTS

All parts should be ordered from Authorized Field Service Shops or branch offices. The "Field Service Directory" listing all Authorized Field Service Shops geographically is supplied with each machine or is available upon request. These shops stock GENUINE replacement parts and have factory trained men to service your machine.

In ordering replacement parts give the following information:

(a) From the machine nameplate - Machine model, code number and serial number.

(b) From the Instruction Manual - Part name, item number, quantity required, and the number of the parts list used to get this information. To obtain this information refer to the pictures of the machine shown in this manual and find the required part and its item number. Get the part name and quantity required from the accompanying parts list.

All items in the parts lists which are indented in the parts name column are integral parts of the assembly which they are listed immediately under. If the entire assembly is required, do not order the indented items as they will be supplied as part of the assembly. The indented parts may be ordered separately if only parts of the assembly are required.

SAFETY PRECAUTIONS

When using a welder, as with all machinery, certain safety precautions should be observed:

(1) Protect the arms and hands from rayburns and hot slag by wearing good leather gloves whenever welding.

(2) Wear a good shield fitted with the proper safety lenses to protect your eyes from sparks and arc flash.

(3) Use extreme care whenever chipping slag that chips do not fly and hit your eyes or those of your helper.

(4) Although, with rated input, this welder will have a maximum output voltage well within prescribed safety limits, carelessness can result in a serious accident. Be Careful.

(a) Ground the welder frame.

(b) Use a well constructed, properly insulated electrode holder connected to the welder by insulated welding cable.

(c) Make certain the work is well connected to the ground cable, as close to the point of welding as possible. This is particularly important when standing on wet ground or a metal framework. Under such conditions be sure you are well insulated from the ground by dry gloves and rubber soled shoes.

(d) The electrode holder should be used for welding and not for lighting cigarettes.

(5) Provide adequate ventilation for weldor.

GUARANTEE

The Lincoln Electric Company, Cleveland, Ohio, the Seller, warrants all new equipment except engines and accessories thereof, against defects in workmanship and material for a period of one year from date of shipment, provided the equipment has been properly cared for and operated under normal conditions. Engines and engine accessories are warranted free from defects for a period of ninety days from the date of shipment.

If the Buyer gives the Seller written notice of any defects in equipment or electrode within any period of warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or electrode or its use by the Buyer whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment or replacing defective electrode in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and there are no other guarantees or warranties either expressed or implied.

SPECIAL GUARANTEE ON RECTIFIER STACKS

Subject to all conditions of the standard guarantee of The Lincoln Electric Company, Cleveland, Ohio, an adjustment will be made on rectifier stacks which fail because of defective material or workmanship on the following basis: Up to the end of the first year after shipment, a credit to the customer of 100% of list price will be allowed; 2nd year, 60%; 3rd year, 50%; 4th year, 35%; 5th year, 25%.

THE LINCOLN ELECTRIC COMPANY

The World's Largest Manufacturer of Arc Welding Equipment and Electrodes

CLEVELAND 17, OHIO

LINCOLN ...USA

Branch Offices, Field Service Shops, and Distributing Agencies in All Principal Cities

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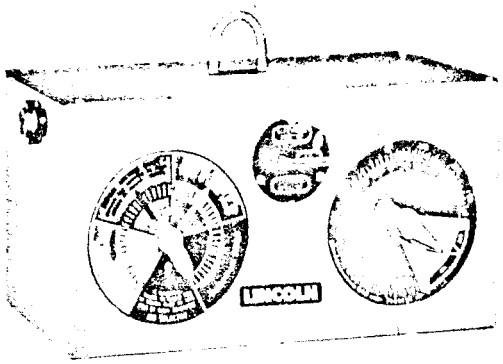
THE ARMCO INTERNATIONAL CORPORATION, Middletown, Ohio, U.S.A.

IM-228 7-60

Litho in U.S.A.

THE PRINCIPLE OF DUAL CONTINUOUS CONTROL FOR DC WELDERS



Set the TYPE *of work with the Self-Indicating Continuous* "JOB SELECTOR".

Set the AMPERES *with the Self-Indicating Continuous* "CURRENT CONTROL".

IT IS human nature to want to explore into the "engine room" of modern inventions—"to see what makes the wheels go around." Here are the facts behind Dual Continuous Control of the "Shield-Arc" Welder—how it produces the practical results which it does:

First of all, it must be realized that there are two types of welding voltage to which we commonly refer. These are the *open circuit* voltage and the arc voltage.

The open circuit voltage is the voltage generated by the welding machine when no welding is being done. The arc voltage is the voltage between the electrode and the work during welding. See Figs. 1 and 2.

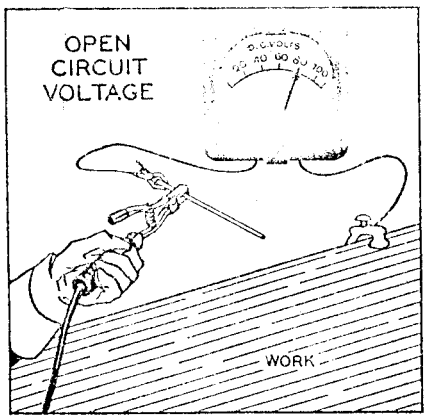


Fig. 1

The open circuit voltages are between 50 and 100; arc voltages are between 18 and 36. The open circuit voltage drops to the arc voltage when the arc is struck and the welding load comes on the machine.

Value of the arc voltage is determined largely by the length of the arc and, to some degree, by the type of electrode that is being used.

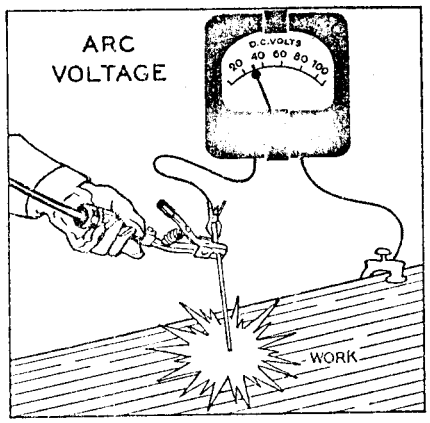


Fig. 2

If the arc is *shortened,* the arc voltage *decreases.* If the arc is *lengthened,* the arc voltage *increases.* See Fig 3. The value of open circuit voltage of the welding machine has little effect on the arc voltage.

The reason for providing an adjustment of open circuit voltage is to make possible a choice of different arc characteristics to match different types of jobs and welding conditions.

A welder with any degree of experience realizes that the arc characteristics required for flat welding

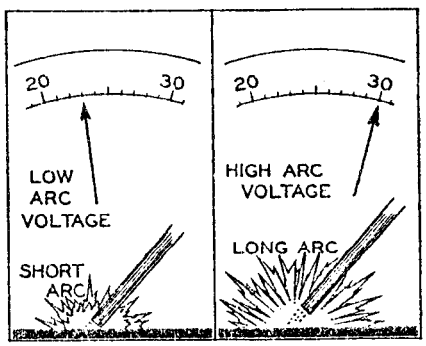


Fig. 3

are different than those needed for vertical and overhead welding. Two welding applications can require the same welding current, but because of the difference in metals or welding positions will require different arc characteristics. The most satisfactory welding machine is one which, by a mere change in the setting of the machine, can obtain the various arc characteristics necessary for the three positions of welding, flat, overhead and vertical. In the Lincoln "Shield-Arc" machines, these different types of arc are obtained by different open circuit voltage settings.

What effect does Dual Continuous Control have on the performance of the welding arc? Consider what happens to the welding current when this control is operated. By varying only the left-hand control —the "Job Selector"--the open circuit voltage is changed, producing any desired volt-ampere curve, such as those shown in Fig. 4.

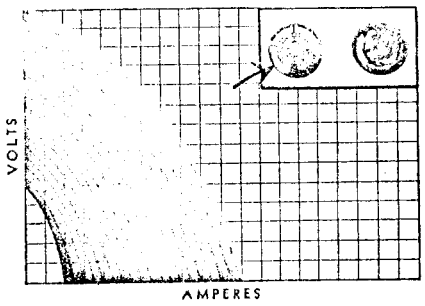


Fig. 4

By varying only the right-hand control—the "Current Control"—the welding current is changed, producing any desired volt-ampere curve, such as shown in Fig. 5.

An indeterminate number of volt-ampere curves can be produced for

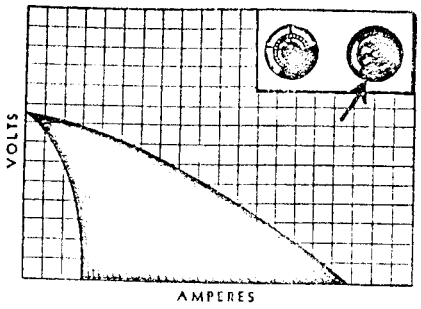


Fig. 5

each open circuit voltage adjustment.

In other words, the combination of the two controls allows the operator to blanket the entire range of the welder—to choose a volt-ampere setting which can be anywhere or of any slope between the curve of the lowest open-circuit voltage (Curve 1) and the minimum current, and that of the highest open-circuit voltage and maximum current (Curve 2). See Fig. 6.

For downhand welding in the flat position (relatively easy with any welder), the increase and decrease of current moving in and out of the crater is not necessary or desirable. Then the "Job Selector" is set in the range marked "normal" which is a fairly high open circuit voltage setting. For this setting there is little change in the current at the arc when the arc is lengthened or shortened.

Select any welding current and its corresponding arc voltage, such as point A in Fig. 7. This is a current of 140 amperes and 25 volts. Through that point, any number of volt-ampere curves can be produced, varying in slope as shown, from the gradually sloping Curve 3, to the steep Curve 4.

For example, when set for Curve 4, a shortening of the arc, so that the voltage drops to B, or 20 volts, causes little change in the welding current; the current increases only to 150 amperes. Hence, this type of setting is more suitable for application such as downhand flat welding with large sized electrodes.

When welding in the vertical or overhead positions, the operator generally moves his electrode up and down, or back and forth, in and out of the molten puddle. As the electrode is moved out of the puddle, the operator would like it to cease depositing, so the puddle will freeze and no metal will be deposited on the plates outside the crater. Since this is not completely possible, he is satisfied for its deposition to slow down until it is out of the crater.

When the operator brings the electrode back into the molten puddle, he immediately wants the metal deposited. He would also like an increase in current to obtain more "arc force," so that the stream of electrode metal will penetrate deep into the parent plates. Then the cycle is repeated as he withdraws the electrode from the crater. The needs of the operator are made possible with Lincoln "Shield-Arc" machines equipped with Dual Continuous Control.

If he desires to weld overhead, setting the "Job Selector" or voltage control in the range marked "Overhead and Vertical" the machine will respond exactly as the operator wishes. Setting the "Job Selector" in this range gives low open circuit voltage setting. With this setting, the current decreases rapidly and less metal is burned off the electrode when the arc is lengthened and the electrode is moved out of the puddle. The current will increase rapidly as the arc is shortened and the electrode is moved back into the puddle.

Now to see technically why the operator, when welding vertical or overhead, can get this arc characteristic at any welding current with Dual Continuous Control, glance at Fig. 7.

Now, suppose the arc were shortened, decreasing the arc voltage to B, or 20 volts. It is clearly evident that this shortening of the arc gives a material increase in the welding amperes when set for Curve 3. It makes the current 180 amperes. Hence, this setting gives a digging arc—one that is more suitable for overhead or vertical welding.

Now it can be understood why the Lincoln "Shield-Arc" SAE has two controls. One is to vary the open circuit voltage, or the arc characteristics of the welder, and the other is to vary the current for different sizes of electrodes for different sizes of plates. By continuous ranges on both the "Job Selector" and "Current Control" it is possible to completely eliminate any blind spots. This means that *no compromise need be made* for the exact type of arc and the exact currents can be obtained for every single welding job to suit every operator's individual style or technique of welding.

If the operator is working on the flat position exclusively on one type of metal, with one type of job (as is sometimes the case in production work) he may need to use only the current control to get different currents. He may feel that the "Job Selector" is not necessary. If he locked the "Job Selector" and threw the handle away and had only a single control of the welder, he would still have a welder similar to many conventional model welders now available. Yet with the Lincoln "Shield-Arc" SAE, he always has the "Job Selector" at his finger tips IF he needs it, and at no additional cost.*

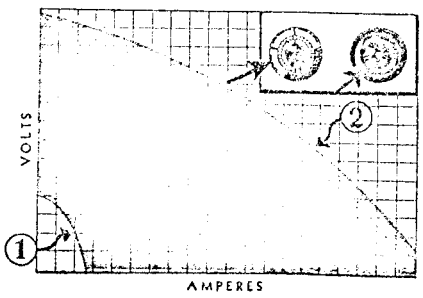


Fig. 6

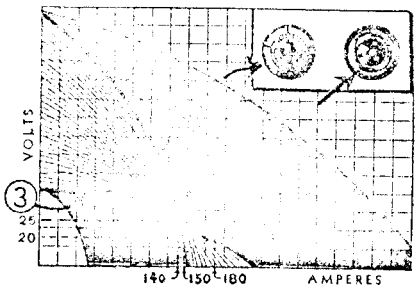


Fig. 7

**Lincoln Welders are as low, or lower in price than other makes of welding machines now available.*