TM 9-3431-258-14&P

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT
AND GENERAL SUPPORT MAINTENANCE
MANUAL INCLUDING REPAIR PARTS LIST

FOR

TORCH OUTFIT, WELDING, GAS
MODEL 137
(NSN 3431-00-691-1415)

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

31 JULY 1981

TM 9-3431-258-14&P
C1

Change
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *20 March 1985*

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TM 9-3431-258-14&P, 31 July 1981, is changed as follows:

Page i. Under "REPORTING OF ERRORS", change mailing address to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, IL 61299-6000.

Page 3. The part number chart is rescinded. Add new part number charts as follows:

Wire Type	Wire Size (In.)	Front Guide Bushing Part No.	Front Guide Bushing NSN	Rear Guide Bushing Part No.	Rear Guide Bushing NSN
Aluminum	0.020	220A338H04	-	488A441H02	-
	0.030	220A338H04	-	488A441H02	-
	3/64	220A338H06	-	488A441H01	5365-00-166-8500
	1/16	220A338H05	3431-00-126-8947	488A441H01	5365-00-166-8500
Mild & Stainless Steel	0.020	220A338H04	-	488A441H02	-
	0.030	220A338H04	-	488A441H02	-
	0.035	220A338H04	-	488A441H02	-

Wire Type	Wire Size (In.)	Drive Roll Part No.	Drive Roll NSN	Guide Tube Part No.	Guide Tube NSN
Aluminum	0.020	419A009G3	3431-00-160-7879	306B172H01	-
	0.030	419A009G03	3431-00-160-7879	306B172H01	-
	3/64	419A009G01	3431-00-875-7633	306B172H09	3431-00-446-2644
	1/16	419A009G01	3431-00-875-7633	306B172H10	
Mild & Stainless Steel	0.020	419A009G03	3431-00-160-7879	306B172H01	-
	0.030	419A009G03	3431-00-160-7879	306B172H03	-
	0.035	419A009G01	3431-00-875-7633	306B172H04	-

Wire Type	Wire Size (In.)	Nozzle Part No.	Nozzle NSN
Aluminum	0.020	311B703H03	-
	0.030	311B703H03	-
	3/64	311B703H02	3431-00-446-2642
	1/16	311B703H02	3431-00-446-2642
Mild & Stainless Steel	0.020	311B703H03	-
	0.030	311B703H03	-
	0.035	311B703H02	3431-00-446-2642

Page 14. Add the following NSNs to the parts list:

Ref. No.	*Add NSN*
1	5355-00-246-3925
3	3431-00-164-2666
9	5905-00-161-3447
10	3431-00-446-2643

Ref. No.	*Add NSN*
14	3431-00-875-7638
15	3431-00-875-3977
19	3431-00-875-3977
20	5315-00-175-7467
22	5360-00-175-2907
23	3110-00-409-3279
27	5365-00-166-8500
29	3431-00-875-7646
34	3431-00-875-7635
35	3431-00-163-0180

Page 15. Add the following NSNs to the parts list:

Ref. No.	*Add NSN*
37	3431-00-446-2637
47	3431-00-875-7641
48	5365-00-173-0055
57	3431-00-446-2642
58	3431-00-446-2644
59	3431-00-875-7633
60	6105-00-169-6189

Page 29. Add the following NSNs to the parts list:

Ref. No.	*Add NSN*
1	5930-00-132-2672
10	6150-01-045-1260
22	5945-00-875-7889

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:

To be distributed in accordance with DA Form 12–21 requirements for FSC Group 3431-IL.

Technical Manual
No. 9-3431-258-14&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *31 July 1981*

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FOR

TORCH OUTFIT, WELDING, GAS
MODEL 137
(NSN 3431-00-691-1415)

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual direct to: Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock Island, IL 61299. A reply will be furnished directly to you.

NOTE

This manual is published for the purpose of identifying an authorized commercial manual for the use of the personnel to whom this welding set is issued.

Manufactured by: Westinghouse Electric Corp.
Industrial Electric Div.
P.O Box 300
Sykesville, MD 21784

Procured under Contract No. DAAA09-79-C-2019

This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

INSTRUCTIONS FOR REQUISITIONING PARTS

NOT IDENTIFIED BY NSN

Whe requisitionin part no identifie b Nationa Stoc Number i i mandator tha th follo in informatio b furnishe th suppl officer

1 Manufacturer' Federa Suppl Cod Numbe 0845

2 Manufacturer' Par Numbe exactl a liste herein

3 Nomenclatur exactl a liste herein includin dimensions i necessary

4 Manufacturer' Mode Numbe Mode 13

5 Manufacturer' Seria Numbe (En Item

6 An othe informatio suc a Type Fram Number an Electrica Characteristics i applicable

7 I D For 134 i used fil i al block excep 4 5 6 an Remark fiel i accordanc wit A 725 50

Complet For a Follows

(a I block 4 5 6 lis manufacturer' Federa Suppl Cod Numbe 0845 follow b dash an manufacturer' Par Numbe fo th repai part

(b Complet Remark fiel as follows
Noun (nomenclature o repai part
For NSN 3431 00 691 1415
Manufacturer Westinghous Electri Corp

Model 13
Serial (o en item

Any other pertinent information Number
Type Dimensions etc

TABLE OF CONTENTS

INTRODUCTION

The SP-9 and SP-10 Welding Gun is intended for use as part of a complete package for control of gas shielded consumable metal arc welding. The package includes the SP-9 or SP-10 Gun and the CV-2 Control when used with a constant potential welder. When arc spot welding is to be performed with a constant voltage welder, the CVS-2 Control and the CVAS-2 Timer is used. The guns may be used with a constant current DC Welder when the CC-2 Control is used. The WCP-1 Welder, a constant potential welder with a built-in gun control, may also be used with these guns.

DESCRIPTION

The SP Welding Gun

Type SP-9 Welding Gun is designed for use with 1/16-inch to 3/64-inch diameter aluminum welding wire on one-pound spools, 0.035-inch to 3/64-inch diameter Type MS 21 mild steel welding wire on 1-1/2 pound spools, and 0.035-inch to 3/64-inch diameter stainless steel welding wire on one-pound Spools. It can also be used with 10-pound spools of 3/64-inch diameter aluminum wire.

The SP-10 Welding Gun is designed for use with 0.020-inch and 0.030-inch diameter aluminum welding wire on one-pound spools, 0.020-inch to 0.030-inch diameter Type MS-21 mild steel welding wire on 1-1/2 pound spools, and 0.020-inch to 0.030-inch diameter stainless steel welding wire on one pound spools.

The Welding Gun SP-9 and SP-10 are compact, light-weight units designed to give dependable service over an extended period. All exposed parts of the gun are fully insulated from welding voltage for operator safety and prevention of accidental shorts. The distribution of weight and the cable and hose arrangement give excellent balance which make the welding guns easy to handle in all positions. The total weight of either welding gun (including a one-pound wire spool) is less than four pounds.

Each welding gun consists primarily of a gun barrel housing with a removable tapered nozzle, a mounting bracket with a shielding gas valve operated by the trigger, a handle of high impact plastic which contains the wire drive motor, a protective shield with electrode speed control, a plastic reel cover, a control cable, a welding current cable, and a gas hose.

The tapered nozzle (Part 1 on Drawing 483A756) is held by a nozzle holder (2) which is threaded to the gun barrel housing (3). A copper guide tube (4) passes thru the gun barrel and is secured by a thumbscrew (5). Mounted within the mounting bracket are a front guide bushing (6) and a rear guide bushing (7). The mounting bracket also includes a ball type shielding gas valve operated by the trigger (8) through a plunger. The trigger also actuates the weld switch (9). Pivoted on the side of the mounting bracket is a swing arm (10) on which is mounted an idler roll (11).

DESCRIPTION

The SP Welding Gun - Continued

The swing arm is secured in the closed position by a pressure screw (12) and a pressure spring (13). A, 50-foot control cable (14) extends from the base of the handle, and has a plug for connection to the control.

A protective shield (15) is secured to the mounting bracket and includes the electrode speed control (16). A four-inch diameter spool of welding electrode (17) is mounted on the spool shaft supported by the shield. A plastic cover (18) is secured to the spool shaft supported by the shield. A plastic cover" (18) Is secured to the spool shaft by a knurled thumbscrew. The combination of protective shield and plastic cover completely enclose the welding wire spool and provide protection against spatter or other foreign matter. The plastic cover also enables the operator to see the quantity of welding wire remaining the spool. An adjustable spool brake (19) is secured to the protective shield, and bears against the wire spool to prevent uncoiling of the weldlng wire.

In operation, the welding electrode from the spool passes thru the rear guide bushing, between the drive and idler roll, thru the front guide bushing, and thru the guide tube. The wfre then passes thru the nozzle to the arc. Welding current is transmitted thru the current cable to the gun barrel and to the guide bar, which in turn, transmits welding current to the welding wire. When the weld trigger is squeezed, the wlre drive motor is energized to feed the welding wire to the arc and the gas valve opens to supply shielding gas to the arc area.

NOTE : Inching circuit not included in CV-2 Control. Inch button will operate when this gun is used with CVS-2 or CC-2 Control.

INSTALLATION

Immediately after opening the carton, make a careful examination of the contents to ensure that no damage has occurred during shipment. Do not discard any packing without first accounting for all small parts such as guide tubes. If any shortage or damage is discovered or suspected, promptly file a claim with the carrier and notify the nearest Sales Office.

Gas Connections

Gas is supplied to the welding gun thru the gas hose which must be connected thru a regulator and flowmeter to the shielding gas supply.

Location

The ideal location for this welding equipment is a clean, dry place where the temperature does not exceed 40°C. (104°F.). Under these conditions, the system can be expected to give excellent performance with a minimum of maintenance.

INSTALLATION

Welding Current Connections

Welding current is supplied from the welder to the welding gun through the gun current cable (21 of Drawing 483A756). This cable should be connected to the Electrode (Positive) terminal on the welder. Also, connect a #2 or larger welding cable from the Work (Negative) terminal to the work ground.

Gun Control Connections

Plug the control cable (14 of Drawing 483A756) into the gun control receptacle on the control, making sure that the plug is fully engaged.

Optional Parts Required for Various Wire Sizes

Depending upon the size of the welding wire used, optional parts for the welding gun may be required. These parts are listed below with the corresponding welding wire sizes. Insure that the welding gun is equipped with the correct part.

Wires & Sizes	(Inches)	Front Guide Bushing	Rear Guide Bushing	Drive Roll	Guide Tube	Nozzle
Aluminum	0.020	220A338H04	488A441H02	419A009G03	306B172H01	311B703H03
	0.030	220A338H04	488A441H02	419A009G03	306B172H03	311B703H03
	3/64	220A338H06	488A441H01	419A009G01	306B172H09	311B703H02
	1/16	220A338H05	488A441H01	419A009G01	306B172H10	311B703H02
Mild & Stainless Steel	0.020	220A338H04	488A441H02	419A009G03	306B172H01	311B703H03
	0.030	220A338H04	488A441H02	419A009G03	306B172H03	311B703H03
	0.035	220A338H04	488A441H02	419A009G01	306B172H04	311B703H02

NOTES: The SP-9 Gun as shipped is equipped for 3/64-inch wire.
The SP-10 Gun as shipped is equipped for 0.030-inch wire.

OPERATION

Safety Precautions

Inert-gas, metal-arc welding processes Produce intense ultra-violet radiation which can be harmful to the eyes and skin. Therefore, certain precautions must be observed to protect the operator from injury.

Eye and face protection should be accomplished with a welding helmet which has a #10 or #12 shade welding plate. In addition, the operator should wear #2 shade flash goggles beneath the helmet. Skin must be completely covered. Leather gloves are recommended

Safety Precautions - Continued

for hand protection. Heavy, dark-colored clothing should be worn to prevent the radiation penetrating to the skin or reflecting onto the neck under the helmet. Light weight leather clothing Is recommended because of its durability and resistance to deterioration from radiation. Cotton clothing will deteriorate rapidly when subjected to ultra-violet radiation.

Adequate ventilation should be provided to remove fumes which are produced by this welding process. American Standard Z-49.1 on welding safety covers such ventilation procedures. Highly toxic gases are formed when the vapors from halogenated solvents are subjected to ultra-violet radiation. Therefore, It is recommended that degreasers and other sources of these vapors should be located so that the vapors cannot reach the welding operation.

Detailed safety precautions are given In the American Welding Society's publication A6.1-55T, "Recommended Safe Practices for Inert-Gas Metal-Arc Welding".

GuideTube Position

Loosen the thumbscrew (5), and adjust the position of the guide tube until the end of the guide tube is 1/8-inch behind the edge of the nozzle. When using 0.020 and 0.030-inch wires, the rear end of the guide tube must be back against the front guide tube bushing to prevent the wire from buckling. With the rear end of an .020 or .030 guide tube (in the SP-10 Gun) positioned against the guide bushing, the front end will be just even or slightly in front of the nozzle.

Wire Threading

Unscrew the knurled spool cover bolt, and remove the plastic cover. Pull back the adjustable brake (19), and place the desired spool of welding wire on the spool shaft so that the free end of the wire will pay off from the top of the spool into the rear guide bushing (7). Loosen the wire pressure screw (12) and open the swing arm (10). Thread the free end of the wire Into the rear guide bushing, thru the front guide bushing (6), and Into the wire guide tube (4). Close the swing arm (10) and adjust the pressure screw until there is just sufficient pressure to prevent the wire from slipping. Excessive pressure will overload the motor and cause erratic welding action. Too little pressure will allow slippage and cause burn backs . Switcn the welder on and pull the gun trigger (8). Since welding power still will be on when the trigger is pulled, make sure the electrode does not touch the work ground as an arc will result. If the wire has been threaded properly and the pressure screw is adjusted for the correct pressure, the wire will feed freely from the guide tube.

Brake Adjustment

Loosen the two screws which hold the brake support. Adjust the position of the brake support by moving the screw in the slotted hole. Just enough pressure is applied to the wire spool to prevent the wire from uncoiling.

OPERATION

Welding Setup

The following data is intended as a starting point in arriving at the proper adjustment of the system for welding an aluminum joint. It is important to understand that the final adjustment for a particular joint may vary considerably from this data depending on weld position, fit up material thickness, fillet size, etc.

1. Set the voltage control on the welder at the applicable voltage setting:

GUN	WIRE SIZE	VOLTAGE SETTING
SP-9	3/64 Inch	23 Volts
SP-9	1/16-Inch	28 Volts
SP-10	0.030-Inch	20 volts

NOTE : The open circuit voltage is usually about one to two volts higher per 100 amperes of welding current than the arc voltage.

2. Loosen the pressure screw (12) and release the swing arm (10) to move the idler roll out of position. Taking care not to touch the work piece with wire, squeeze and hold the weld trigger; at the same time, adjust the gas regulator to give the required gas flow. As a starting point, adjust the gas flow to 35 cubic feet/hr. An increase or decrease may be required after welding conditions have been established. Reclose the swing arm and readjust the pressure screw.

3. Adjust the position of wire so that the free end protrudes 1/2-inch to 3/4-inch beyond the end of the nozzle.

4. Turn the electrode feed speed control to the maximum setting.

5. With the electrode near the work, but not touching, lower the head shield, squeeze the trigger, and bring the electrode into contact.with the work piece to strike an arc.

6. Reduce the electrode feed speed control setting until the stubbing ceases and the crackling sound of the arc just disappears. When the setting of the electrode feed speed control is increased, the weld current is increased.

7. To stop the weld, release the trigger and draw the welding gun away from the work. Do NOT whip the gun away from the work without first releasing the trigger to TO BREAK the arc. Failure to observe this precaution may result in:

   a. Loss of the gas shield before the weld pool freezes, causing porosity.
   b. Too much wire will extend from the nozzle at the end of the weld requiring a clipping operation before the next weld.
   c. Extremely high transient voltages can develop which may damage the motor.

OPERATION

Welding Techniques

After the operator has found the desired current, voltage, and electrode feed speed settings for a particular application, it is still necessary to observe some elementary principles of technique.

1. Nozzle Spacing -

   In general, the gas nozzle should be held as close to the work as is practical. In most cases, a distance of 3/8-inch to 5/8-inch is satisfactory.

2. Gun Angle -

   The best cleaning action is obtained, and excellent porosity-free welds are made by using a forehand technique. For example, a horizontal fillet is best made by the welding gun at an angle of 40° to 50° to the horizontal and using a forehand angle of 20° to 25°. A right-handed operator would then weld from right to left on a horizontal weld.

3. Cleanness of Material -

   It is essential that aluminum be absolutely clean when it is welded. To ensure porosity-free welds, a cleaning operation should immediately precede the welding operation. Several organic solvents are now available for this purpose.

4. Wire Cleanness -

   Wire should be clean and free from oxide, grease, and other foreign material. Do not try to use wire that is not clean. Wire which is not in use should be kept in a container which will protect it from all forms of contamination.

MAINTENANCE

Operating Maintenance -

As the gun is used, a small amount of spatter will collect on the end of the guide tube and on the nozzle. This spatter can be removed easily with a knife or similar implement. Periodically, remove the nozzle by pulling it from the nozzle holder and inspect the nozzle and gun barrel for spatter which may have collected inside. Excessive spatter can cause a short between the nozzle and the guide tube. Such a short will create an arc between the nozzle and the workpiece if accidental contact is made.

If the guide tube becomes bent, replace it with a new guide tube. If a burn back occurs, do not inch the wire. Attempts to inch the wire under these circumstances will blow the fuses in the control circuit. When a burn back occurs, loosen the thumbscrew which secures the guide tube, and inch both the wire and the guide tube out of the gun. Cut the wire about 1/16" from the rear of the guide tube. Hold the guide tube perpendicular to a hard, flat surface, and strike the end of the wire against the flat surface. If this does not free the wire, cut or grind off the melted portion of the guide tube and remove the wire. The burr caused by cutting should be removed from the guide tube hole with a small drill. Failure to remove the burr can result in another burn back. Reinstall the guide tube in the gun, ensuring that the end of the guide tube is the correct

MAINTENANCE

Operating Maintenance - Continued

distance from the nozzle. The 1/16 to 0.035-inch tubes may be trimmed a maximum of 3/8-inch, and the 0.020 to 0.030-inch tubes may be trimmed a maximum of 1/8-inch before discarding.

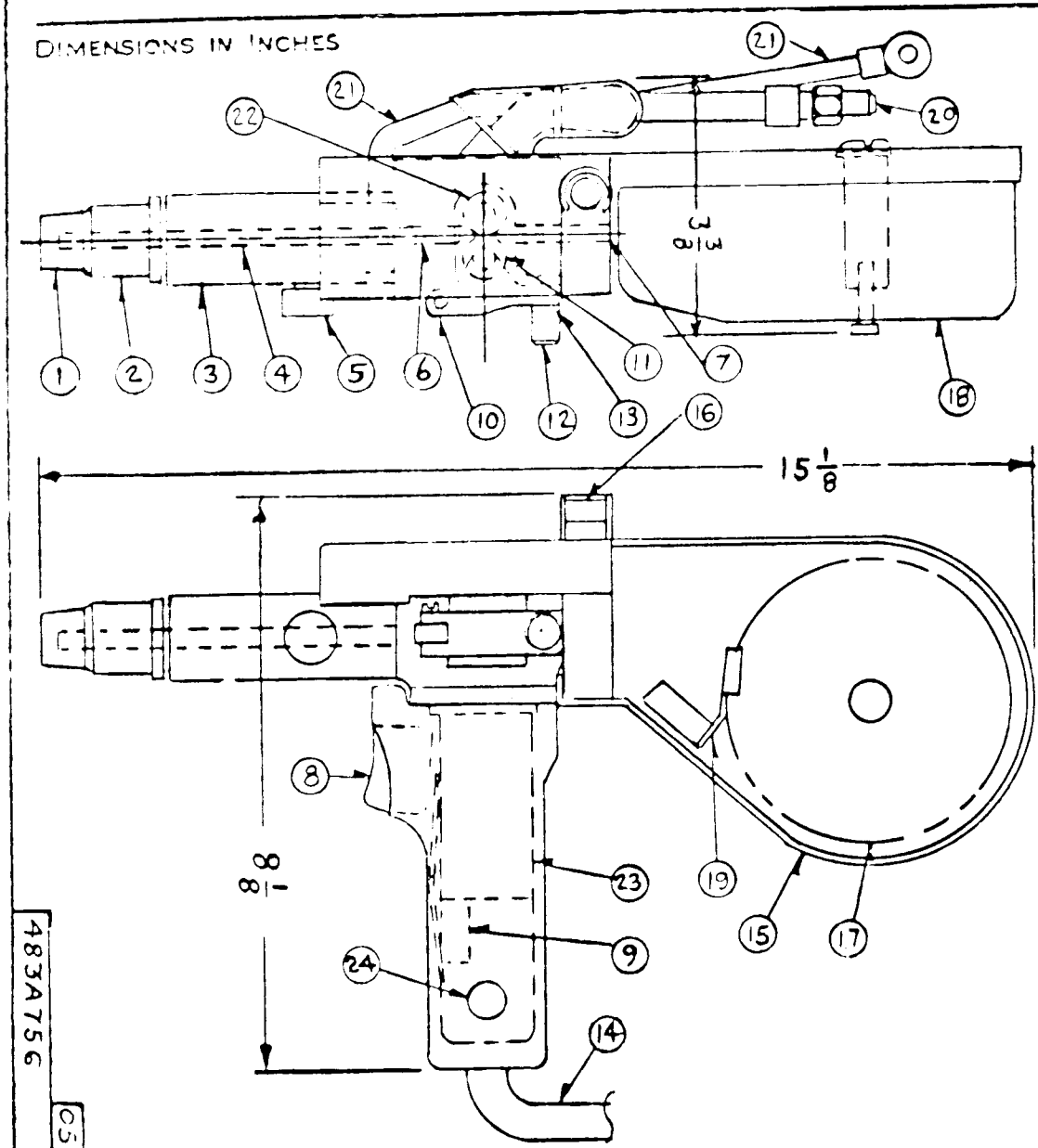
The gas holes in the gun barrel may become clogged with a residue of white powder which will obstruct the flow of gas. The gun should be dismantled every 100 hours, and the gas holes blown out with high pressure air.

REPLACEMENT PARTS

Reference should be made to the Renewal Parts List for identification of replacement parts.

DIMENSIONS IN INCHES

DWG 483A756



1. NOZZLE
2. NOZZLE HOLDER
3. GUN BARREL HOUSING
4. GUIDE TUBE
5. GUIDE TUBE THUMB SCREW
6. FRONT GUIDE BUSHING
7. REAR GUIDE BUSHING
8. TRIGGER
9. WELD SWITCH
10. SWING ARM
11. IDLER ROLL
12. PRESSURE SCREW
13. PRESSURE SPRING
14. CONTROL CABLE
15. SHIELD
16. ELECTRODE SPEED CONTROL
17. ELECTRODE SPOOL
18. PLASTIC COVER
19. SPOOL BRAKE
20. GAS HOSE
21. WELDING CURRENT CABLE
22. DRIVE ROLL
23. DRIVE MOTOR
24. INCH SWITCH

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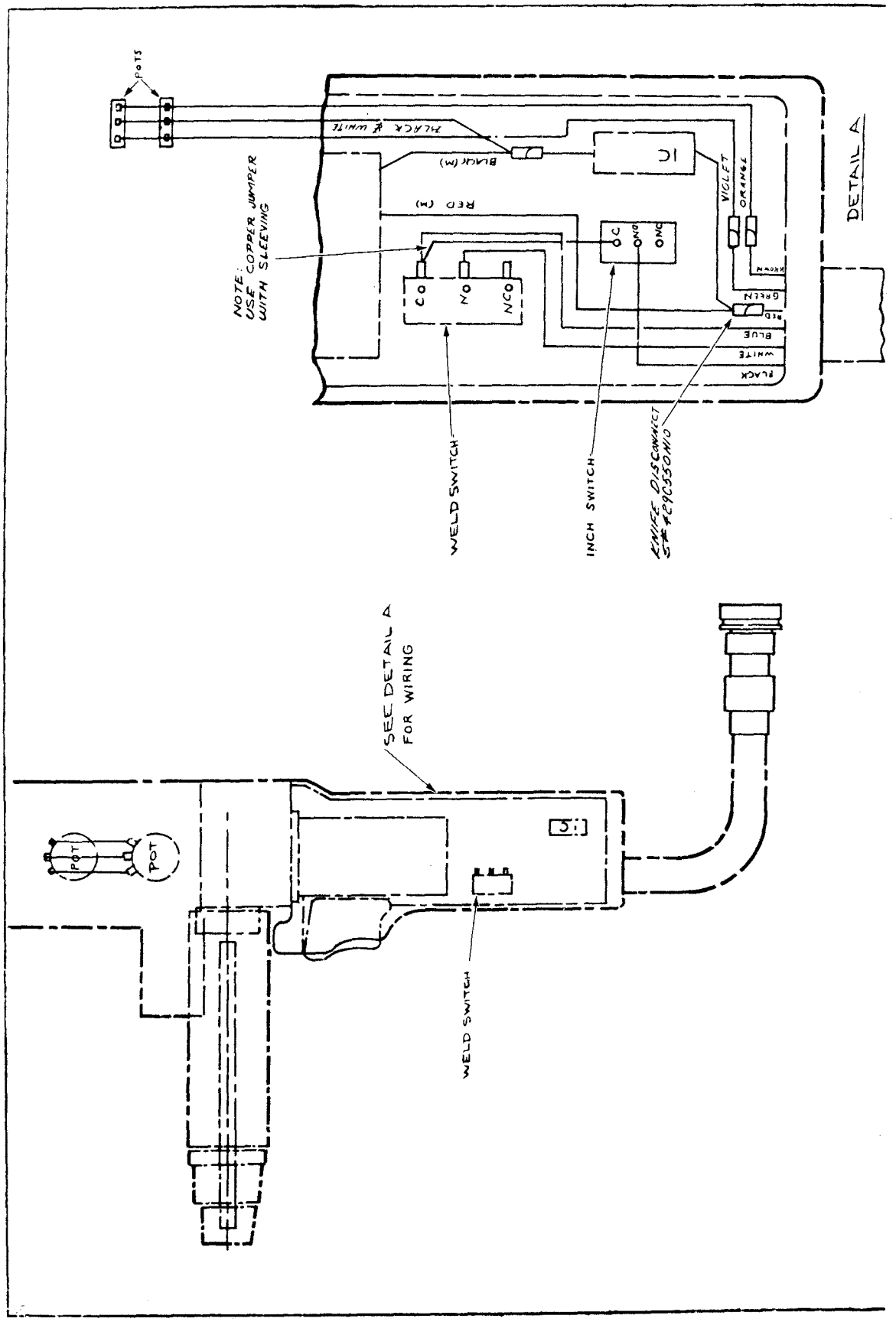
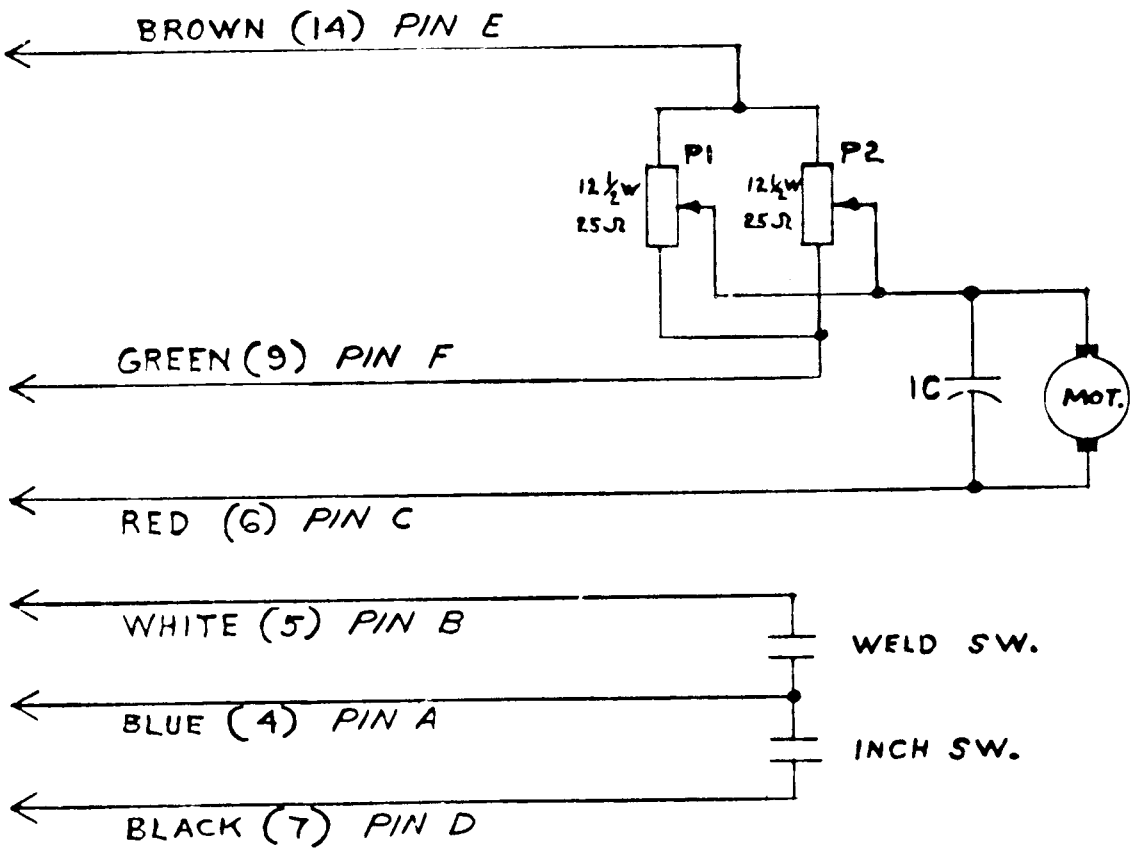


Drawing 655C951

DIMENSIONS IN INCHES

TYPE SP-7, 8, 9, & 10 WELDING GUN SCHEMATIC DIAGRAM

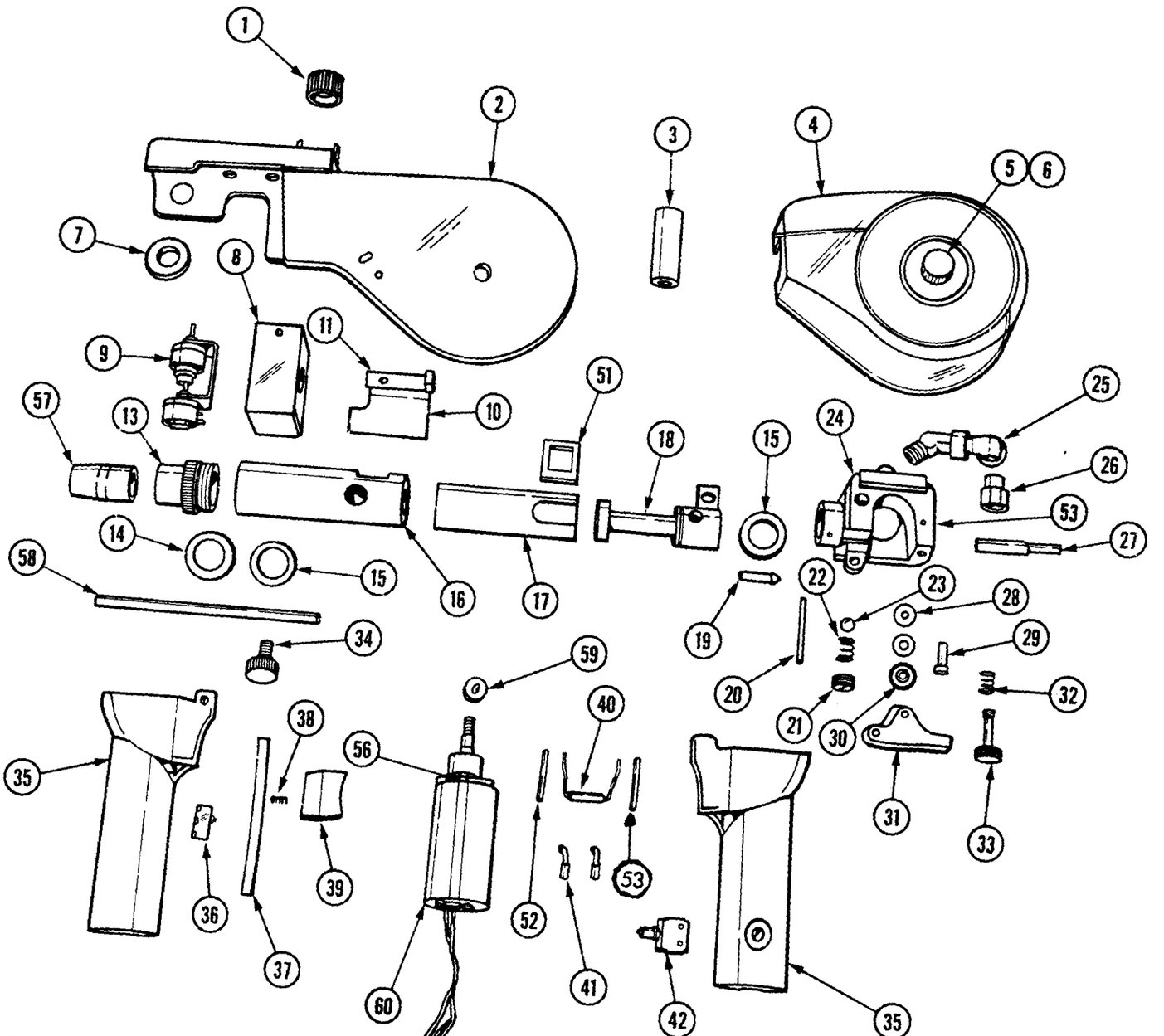
DWG. 483A767



Renewal Parts Data

TYPE SP-10 GUN

STYLE #483B128G02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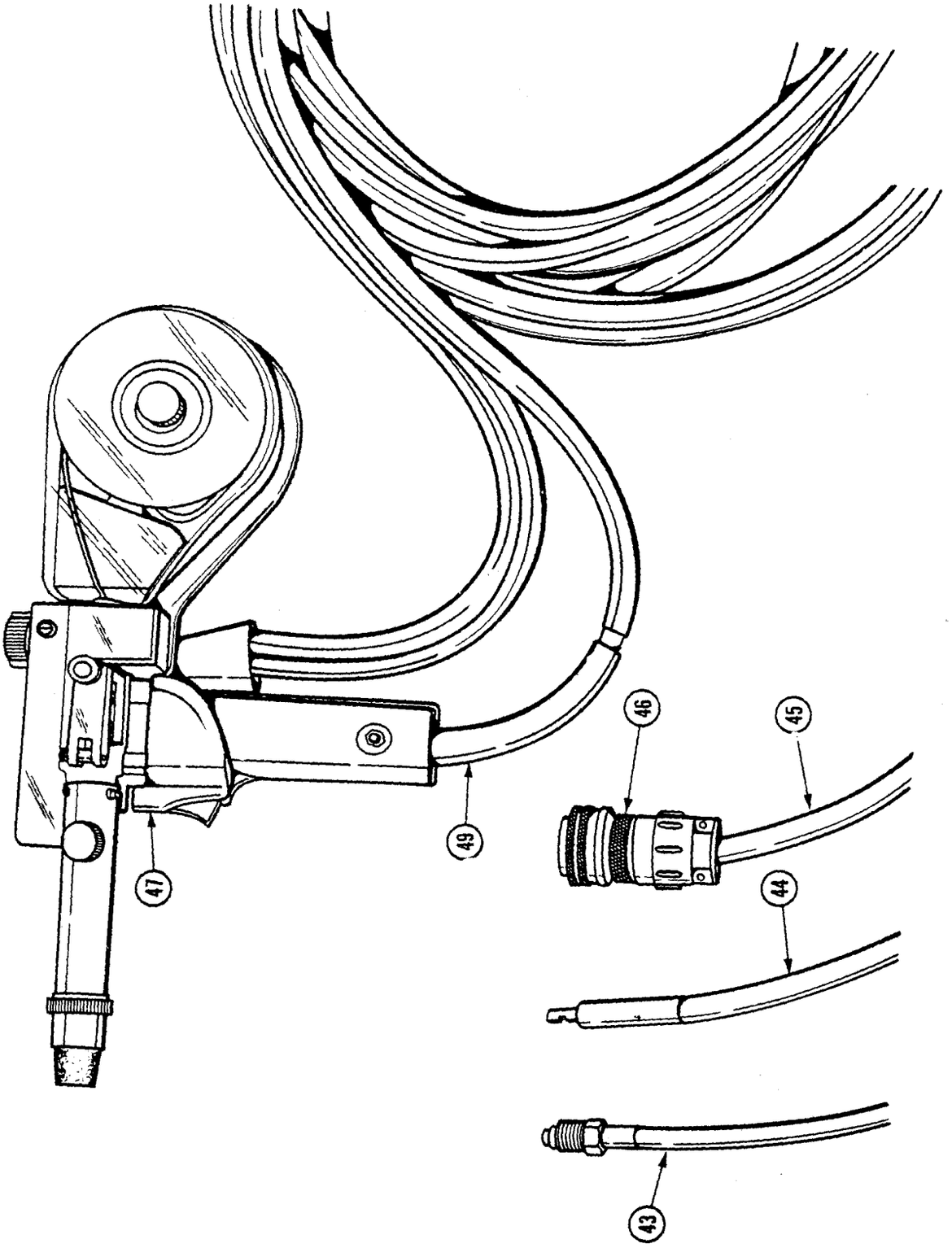
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RENEWAL PARTS DATA

THE FOLLOWING PARTS ARE MOST SUBJECT TO WEAR IN ORDINARY OPERATION:

COMMON PARTS

REF. NO.	DESCRIPTION OR NAME OF PART	IDENTIFICATION NUMBER	NUMBER PER UNIT
1	KNOB FOR RHEOSTAT	451A240H01	1
2	SHIELD	867D652G01	1
3	REEL SHAFT	448A024H01	1
4	REEL COVER	637C247H01	1
5	REEL COVER BOLT	419A029H01	1
6	O RING	576D964H07	3
7	RUBBER BUSHING	363A421H90	1
8	POT. SHIELD	483A753H01	1
9	DUAL POT. ASSY	483A752H01	1
10	BRAKE	419A011H01	1
11	BRAKE SUPPORT	419A008H01	1
12	INSULATOR *	222A550H01	1
13	ADAPTER	419A003H01	1
14	INSULATING WASHER	419A006H02	1
15	INSULATING WASHER	419A006H01	2
16	GUN BARREL HOUSING	453A483H01	1
17	GUN BARREL INSULATION	419A005H02	1
18	GUN BARREL ASSEMBLY	419A002G02	1
19	FRONT GUIDE BUSHING 1/16 & 3/64	2209A70H01	1
20	PIN	452A107H01	1
21	PIPE PLUG	2209A69H01	1
22	SPRING	452A106H01	1
23	BALL BEARING	452A108H01	1
24	MTG. BRACKET	427C605G08	1
25	FITTING ASSEMBLY	427C605G04	1
26	FITTING	419A043H01	1
27	REAR GUIDE (.035 TO 1/16)	488A441H01	1
28	INSULATING WASHER	310B141H04	2
29	NYLON SCREW	442A169H01	1
30	INSULATED IDLER ROLL	557D415H39	1
31	BEARING ARM	419A026H02	1
32	SPRING	419A027H01	1
33	BEARING ARM BOLT	419A025H01	1
34	INSULATED GUIDE TUBE LOCK SCREW	422A505G01	1
35	HANDLE ASSEMBLY (INCLUDES BOTH LEFT AND RIGHT HANDLE HALVES)	827D099G03	1

RENEWAL PARTS DATA

THE FOLLOWING PARTS ARE MOST SUBJECT TO WEAR IN ORDINARY OPERATION.

COMMON PARTS

REF. NO.	DESCRIPTION OR NAME OF PART	IDENTIFICATION NUMBER	NUMBER PER UNIT
36	SWITCH TRIGGER	301B663H05	1
37	SPRING FLAT	205A091H01	1
38	SPRING	453A464H01	1
39	TRIGGER ASSEMBLY	451A241G01	1
40	CAPACITOR	422A518H04	1
41	KNIFE DISCONNECT	429C550H10	2
42	SWITCH	301B663H09	1
43	GAS HOSE ASSEMBLY	1474B90G01	1
44	CURRENT CABLE ASSEMBLY	1474B91G01	1
45	POWER SUPPLY CABLE ASSEMBLY	1112C77G07	1
46	PLUG	483A890H01	1
47	BOOT	419A046H01	1
48	RETAINING RING *	52D9290H01	1
49	BUSHING, CORD PROTECTOR	2214A61H01	1
50	COPPER STRAP *	576D964H64	1
51	INSULATION	419A010H02	1
52	TUBING	422A484H01	2
53	TUBING	422A484H02	2
54	PLUG BUTTON *	451A237H02	1
55	PLUG BUTTON *	451A237H03	1
56	INSULATION	453A434H01	1
57	NOZZLE	311B703H02	1
58	GUIDE TUBE	306B172H09	1
59	DRIVE ROLL	419A009G01	1
60	MOTOR	429C550G05	1
			1
	WIRING DIAGRAM	655C951	

* NOT SHOWN

DESCRIPTION - INSTALLATION - OPERATION - MAINTENANCE

Instruction Book

TYPE CCD-4 CONTROL

INTRODUCTION

The CCD-4 Control is designed for consumable electrode inert-gas shielding welding with the SP-9 or SP-10 gun. It incorporates a well-balanced hand-gun and a control with a built in contactor. The system is designed for semi-automatic welding of aluminum with aluminum wire sizes from .030 to 1/16 inch diameters, and for steel wire sizes of .030 to 3/64 inch diameters.

DESCRIPTION

The Control as shown on Outline Drawing 2214A57 is lightweight, properly insulated, and compact. (Numbers in parentheses indicate item numbers on referenced drawings.)

The Control operates from a 115 volt A.C. or D.C. power supply required for the operation of the control and inching circuits. The power for the gear-head drive motor during the welding operation is supplied by the welding machine. The motor armature is said to be across the arc . This is accomplished by attaching the terminal of the ground cord (4) to the negative lug of the welder and the terminal of the current cable (12) to the positive lug of the welder. The control cable for the welding gun is connected to the Gun Control Receptacle (1) and the welding current cable of the gun inserts into the Receptacle (5).

A rheostat in the welding gun is adjusted to control the wire feed speed and the arc length. The rheostat setting will vary with the type of shielding gas used and with different welding machines, and is primarily dependent on the current setting of the welder. The fact that the wire feed drive operates from the arc voltage is important, because it insures good steady feeding consistent with constant arc length. It is based on the following principle of operation: If the arc length increases, the voltage across the arc becomes higher and increases the motor speed, thereby feeding more wire and shortening the arc length. If the arc length shortens, the voltage across it is lower and the motor speed decreases, thereby increasing the arc length. The rheostat type control works through approximately a 6 to 1 speed range.

An On-Off switch (2) energizes the control monitor while replaceable fuzes (6) protect the line. The power supply cord (3) is a 16 foot cable terminated in a three-prong plug with a three to two wire plug adapter. A replaceable fuze (7) in series with the wire drive motor protects the armature from damage due to high current. This is a one ampere fuze and should not be replaced with a larger fuze.

The line fuzes (6) should be 2 ampere fuzes.

The Control Monitor has a current relay which permits touch starts. The normal minimum current required to operate the relay is approximately 45 amperes. A 200 amp D.C. contactor (9) is mounted in the control enclosure and is controlled from the control panel (8).

INSTALLATION

Receiving

Immediately upon receipt of the equipment, make a careful examination for evidence of damage encountered in transit. If any damage is found or suspected, file a claim promptly with the transportation company and notify the nearest sales office. Do not discard any packing materiel without first checking it for small accessory items.

Location

The control should be installed so that all parts of the workpiece to be welded can be reached with a minimum of effort. Approximately 50 feet of cable and hose. are normally supplied with the gun. The control unit should be located so no sharp kinks or bends are made in the gas hose. Care should be taken to avoid dragging the cable or hose over hot work or sharp projections.

The distance from the welding machine to the control is not critical and is limited only if the voltage drop due to the length and size of the cable prevents stable welding conditions. The 115 volt suppuly cable maybe extended as required, within reasonable limits.

It is usually best if the control is placed as close to the workpiece as is practical, therefore making it easy for the operator to make adjustments or reenergize the equipment as required.

Connections

1. Attach the Regulator and Flowmeter to a cylinder of pure argon by threading nut on regulator-flowmeter to matching threads on cylinder. Tighten the nut to prevent gas leaks. The gas cylinder is not part of. welding set.

2. Attach nut on gas hose from welding gun to the matching threads on the outlet side of regulator-flowmeter and tighten to prevent gas leakage.

3. As shipped, the SP-9 or SP-10 welding gun has a terminal on the end of the welding cable. Remove this terminal and add the camlock plug ineluded with the CCD-4 Control. Insert the plug into the matching receptacle on the control. ‘this plug is keyed and must be rotated to the proper position before inserting. After inserting plug, turn plug 1/4 turn clockwise to lock in place.

4. Insert plug on end of control cable from welding gun in matching receptacle on the control monitor. This plug is also keyed and must be rotated to the proper position before inserting. After the plug is lined up properly with receptacle, gently work plug into socket and tighten retaining ring.

Connections (cont)

5. Attach current cable from control monitor to the positive (+) output terminal of the welding power supply. This cable includes a large terminal for connection to the positive (+) output terminal. Since this welding set may be used with various types of welding power supplies, some adaptation to make this connection may be required. However, a tight connection is required. On welding power supplies which include a polarity switch, this cable should be attached to the terminal marked electrode and the polarity switch should be placed in the Reverse Polarity position. Be certain that any high voltage or high frequency arc starters are kept deactivated.

6. Attach one end of a ground cable and the ground cord from the control monitor to the negative terminal of the welding power supply. This must be a tight connection. On welding power supplies with a polarity switch, these leads are connected to the Work terminal. Connections should be tight and electrically conducting.

7. Connect the other end of the ground cable to the workpiece or material to be welded. This must be a tight connection with good electrical conductivity.

8. Connect the line cord to a 110 to 125 volt AC or DC supply. This cord is equipped with a standard 3-prong plug. For connection to a 2-prong supply, an adapter is provided. Where used, the screw on the side of the adapter should be connected to the frame of the welding machine with a short piece of wire.

OPERATION

Welding

1. Adjust the current control on the welder to the required output current.

2. To adjust the gas flow, first turn on the gas supply by turning on the main valve at the top of the gas cylinder. Being careful not to touch the wire to the workpiece, pull the weld trigger and hold; at the same time adjust the gas regulator by turning the flow adjustment to the required gas flow. As a starting point adjust the flow to 35 cubic feet/hour. This is indicated when the top of the ball in the flow reaches the calibration marked 35. An increase or decrease may be required after welding conditions are established.

3. Adjust the position of the wire to protrude 1/2 to 3/4 of an inch beyond the end of the nozzle by pressing the inch button.

4. Turn the rheostat knob (16) on the welding gun to maximum.

Welding (cont)

5. With the wire near the work, but not touching, lower the head shield, pull the weld trigger and bring the wire into contact with the work-piece. An arc will form and the wire will begin to feed.

6. With the wire feed speed knob on the control monitor adjusted near maximum as described in paragraph 4, the arc will probably be too short and the wire will stub, causing considerable spatter. Decrease the setting of the wire feed control until the proper arc length is accomplished. This is usually the point where the crackling sound of the arc just disappears. With this welding control system, the dial setting affects arc length by changing electrode wire feed speed at a given welding power supply current setting. Increasing the setting of the dial will shorten the arc.

7. To stop the weld, release the trigger. Do not whip the gun away from the work before releasing the trigger to break the arc as this will cause excessive wire stick-out.

High Frequency Precautions

The control monitor should never be connected to a welder at the same time the welder is being used on high frequency as the motor will burn-out instantly. Neither the ground clamp nor the electrode lead should ever connect to a welder which is supplying welding current and high frequency to a tungsten arc torch or any other process requiring high frequency.

SAFETY PRECAUTIONS

Inert-gas metal-arc welding processes produce intense visible and ultra-violet radiation and require certain precautions to protect the operator from injury.

For eye protection, welding helmets should have a #10 or #12 shade welding plate. In addition, the operator should wear #2 shade flash goggles with wide side shields under the helmet.

The skin should be completely covered. Leather gloves are recommended for hand protection. Heavy, dark-colored clothing should be worn to prevent radiation from penetrating to the skin or from reflecting onto the neck under the hood. Lightweight leather protective clothing is also recommended because of its durability and resistance to deterioration from the radiation and sparks. It should be noted that cotton clothing is subject to rather rapid deterioration.

Adequate ventilation should be provided to remove fumes produced by the process, as set forth in American Standard Z-49.1 on safety in welding. Inasmuch as vapors from halogenated solvents such as trichloroethylene are decomposed by ultra-violet light to form highly toxic gases, it is recommended that degreasers or other sources of such vapors be so located that the vapors will not reach the welding operation.

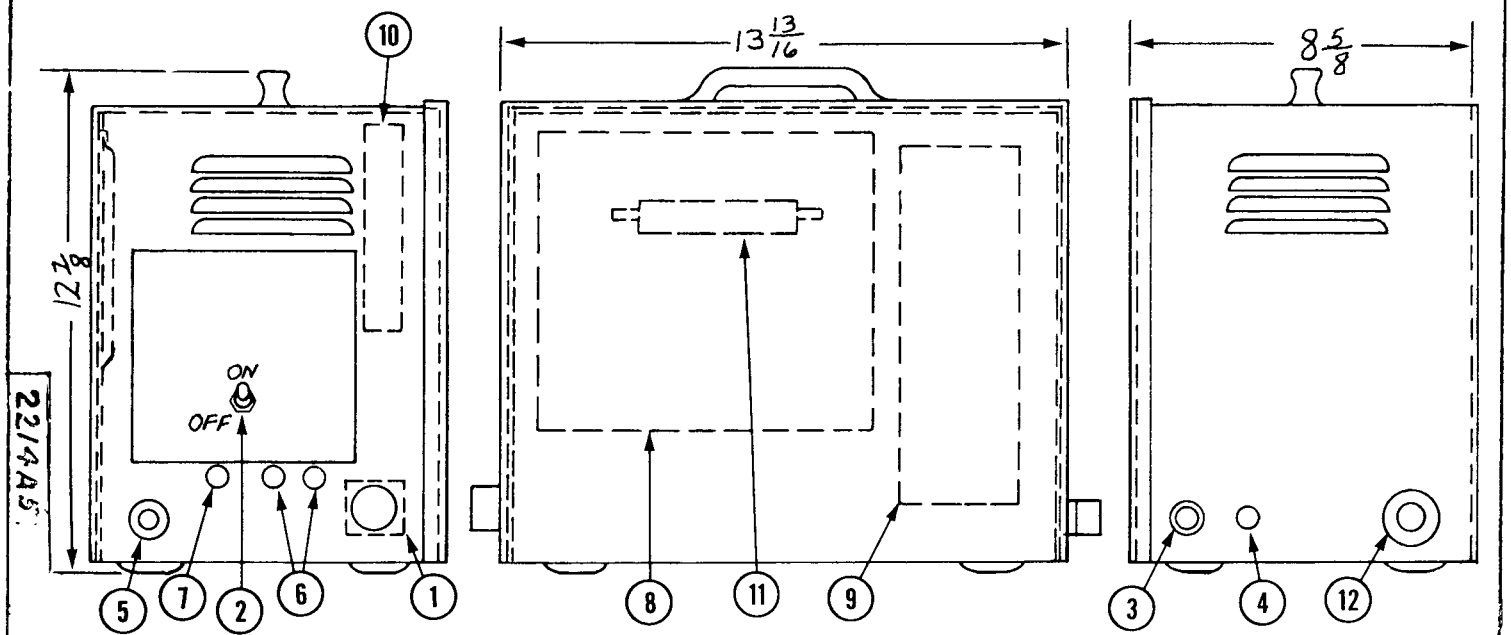
Safety Precations (cont)

Detailed safety practices are given in the publication A6.1-55T on "Recommended Safe Practices for Inert-Gas Metal-Arc Welding", published by the American Welding Society.

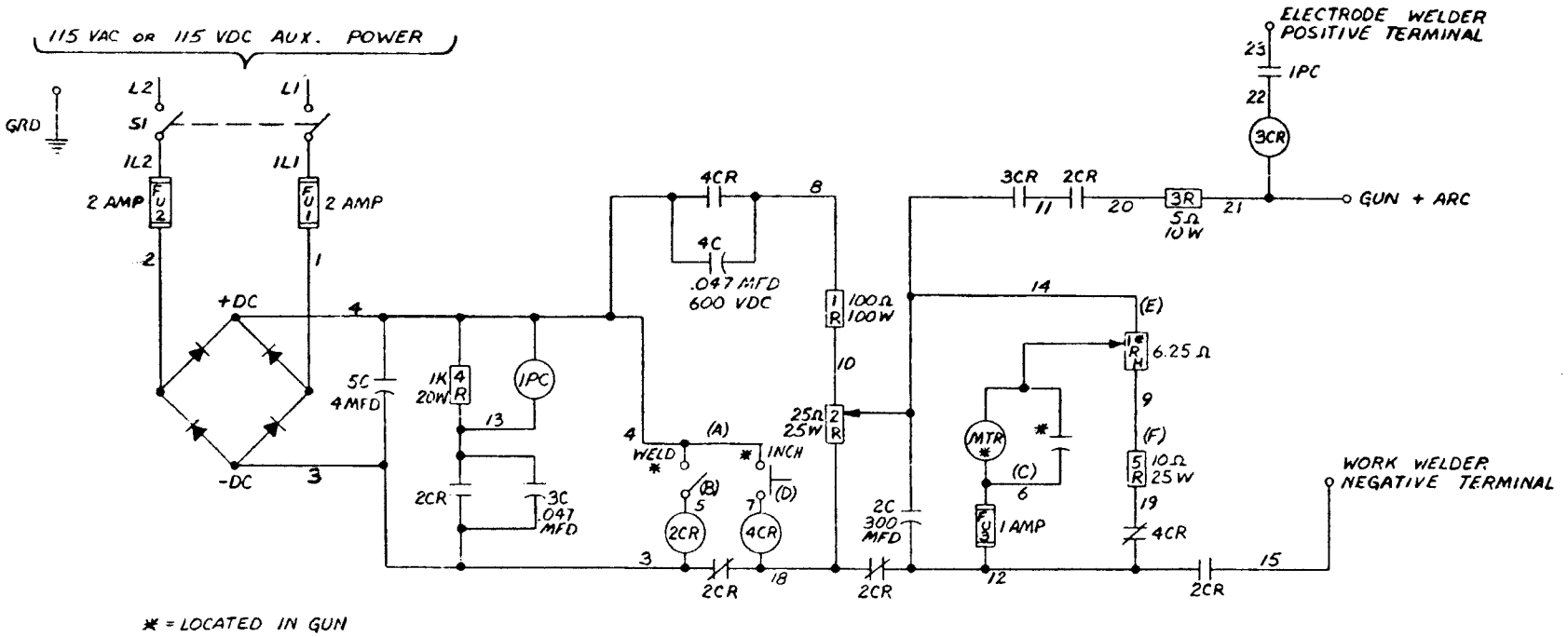
DIMENSIONS IN INCHES

CCD-3 & CCD-4 CONTROL OUTLINE

① GUN CONTROL RECEPTACLE
② ON-OFF SWITCH
③ POWER SUPPLY CABLE TO CUSTOMER'S 115 V A.C. or D.C. POWER SUPPLY
④ GROUND CORD
⑤ RECEPTACLE
⑥ LINE fuzes
⑦ MOTOR fuze
⑧ CONTROL PANEL
⑨ CONTACTOR
⑩ TERMINAL STRIP
⑪ RESISTOR (2 RES)
⑫ CURRENT CABLE



DWG 7208096 SUB 1

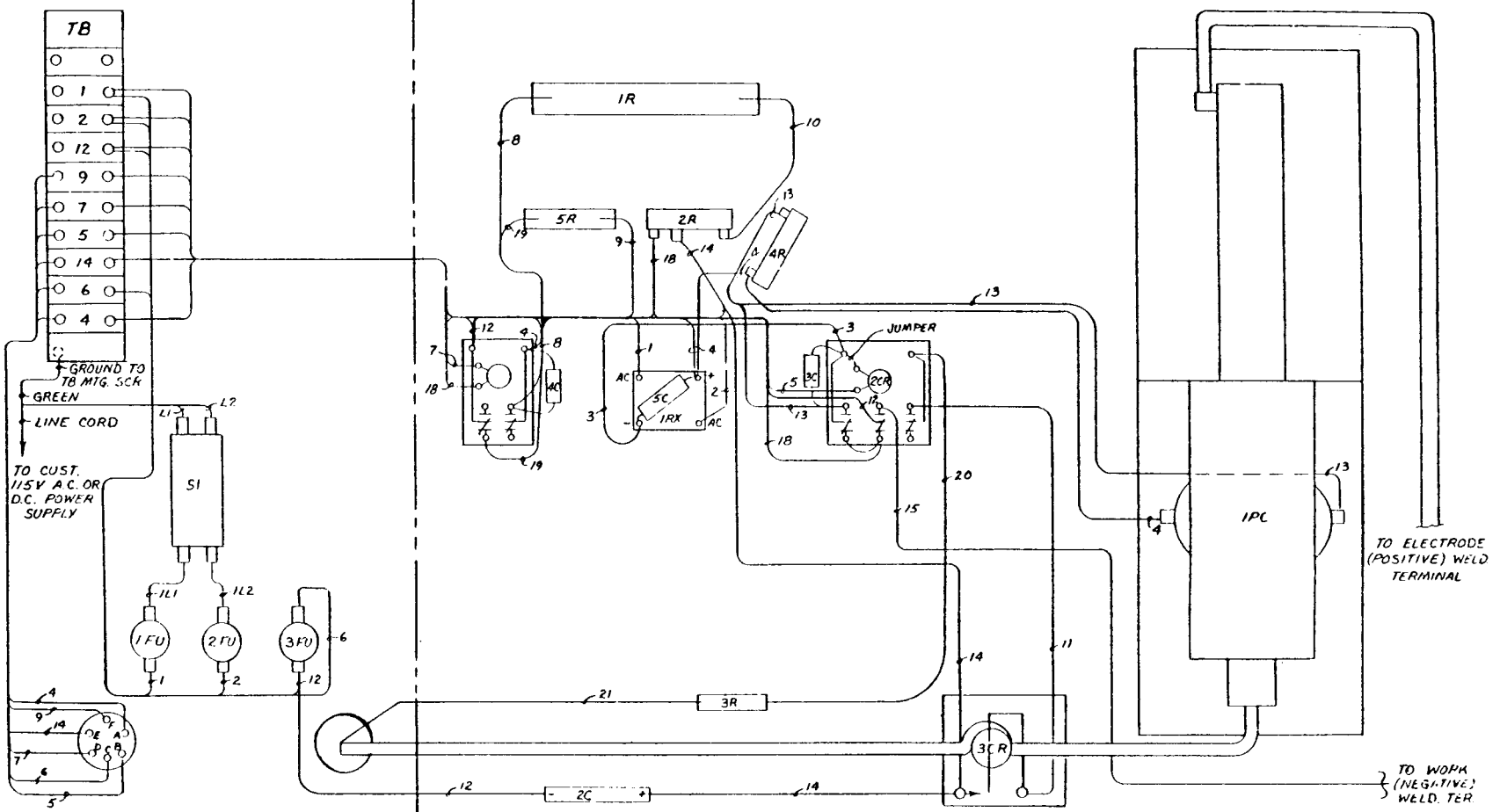


TITLE SCHEMATIC
CCD-4 CONTROL

86

720B096

DWG 221C688 SUB +2



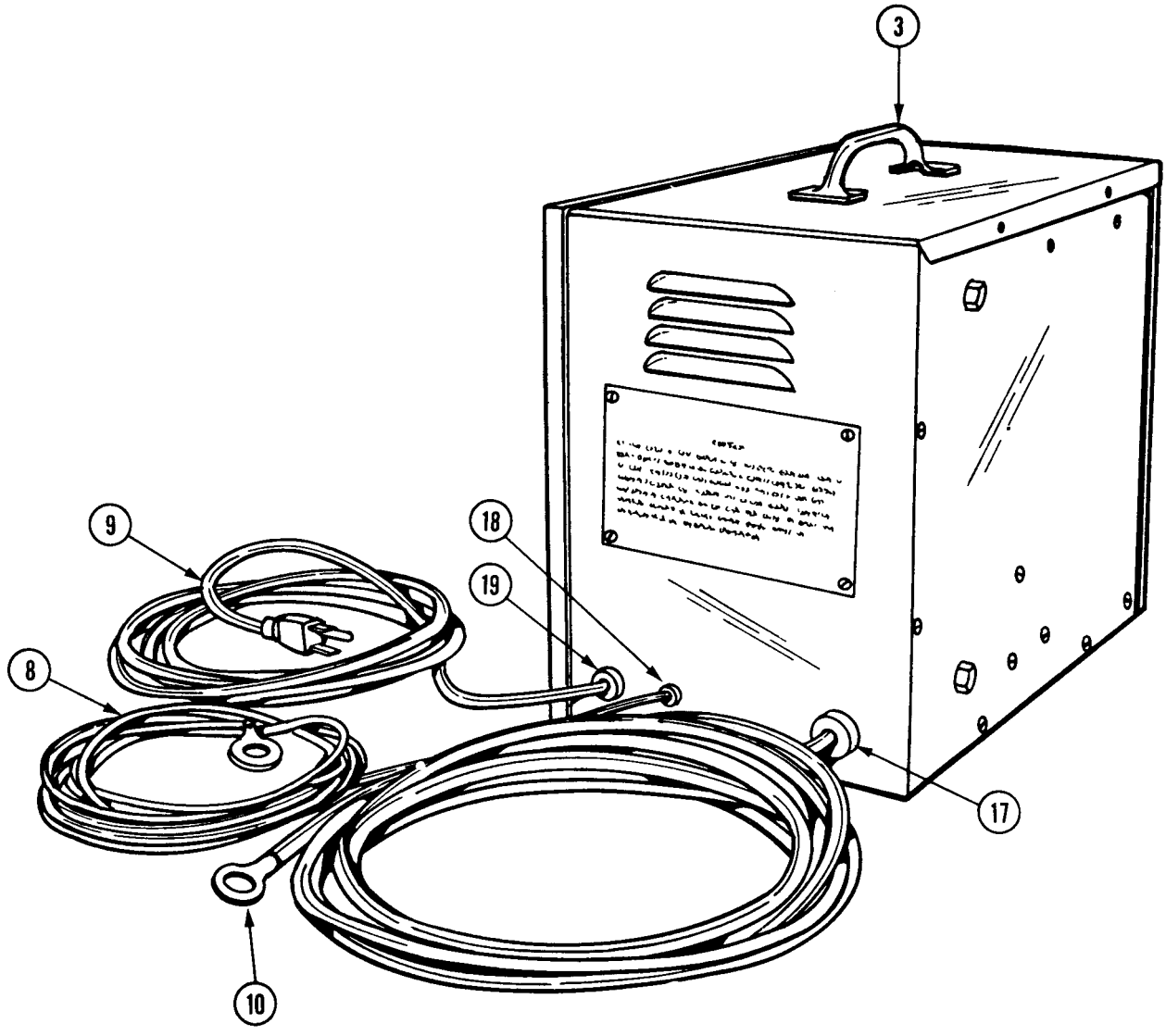
TITLE WIRING DIAGRAM CCD-4 CONTROL

221C688

Renewal Parts Data

Type CCD-4 Control

Style 483B126G05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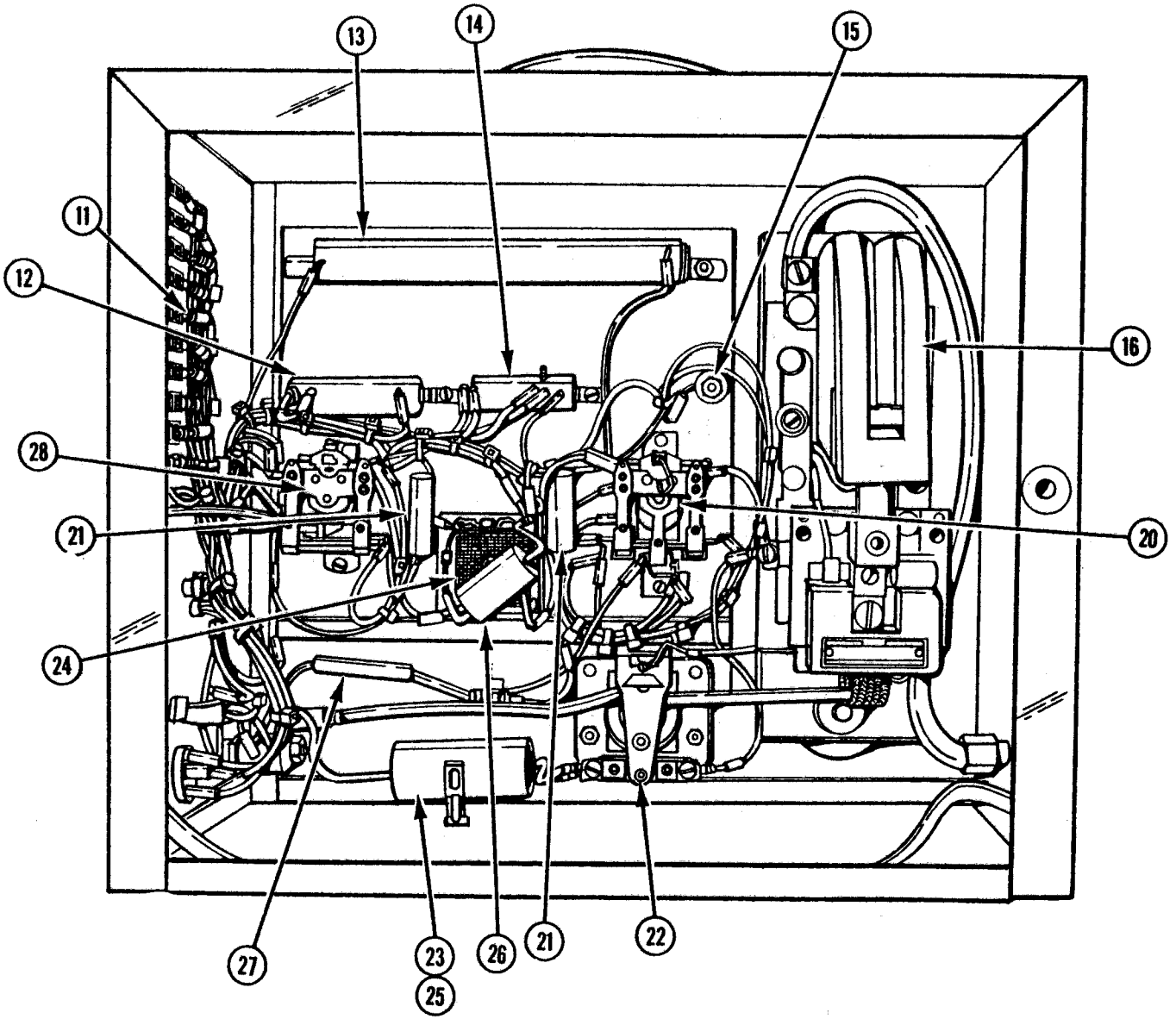
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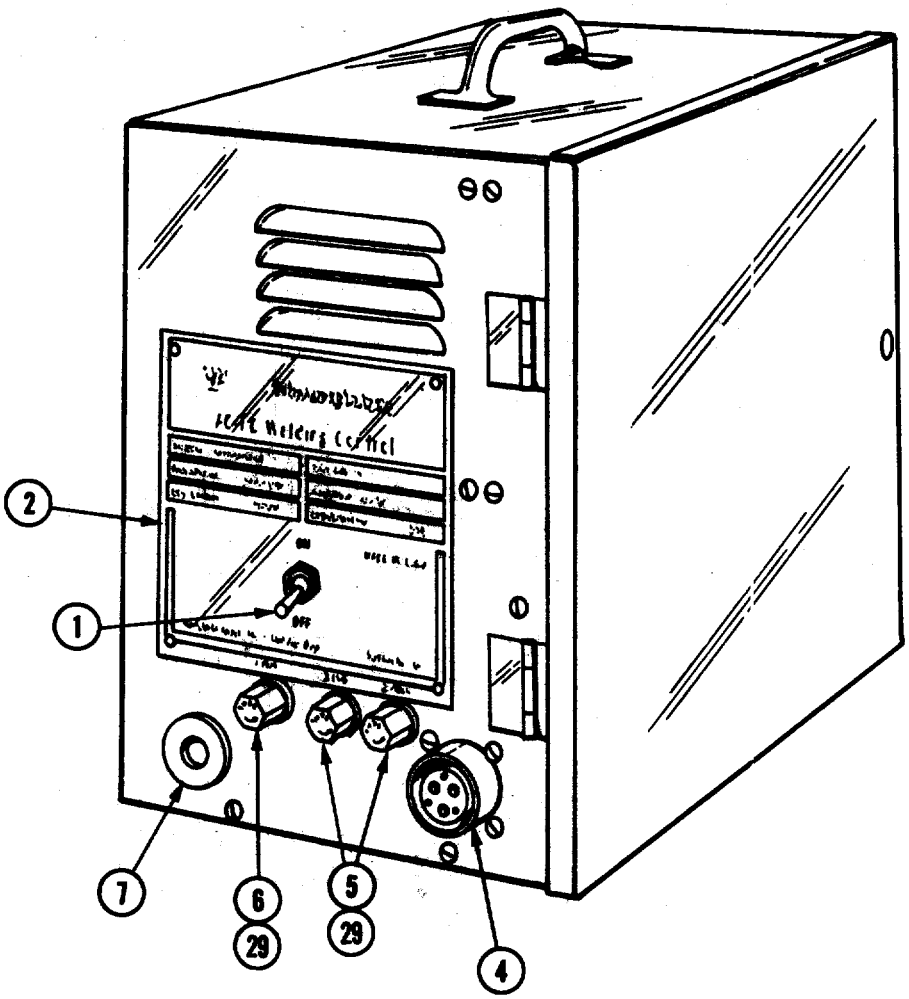
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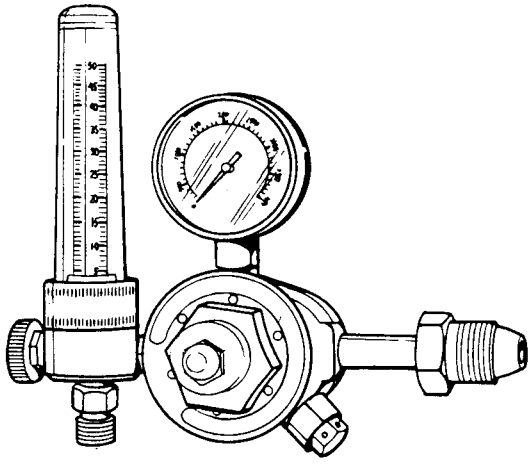
4

RENEWAL PARTS

COMMON PARTS

REF. NO.	DESCRIPTION OR NAME OF PART	IDENTIFICATION NUMBER	NUMBER PER UNIT
1	ON-OFF SWITCH	429A051H02	1
2	NAMEPLATE	228P758H01	1
3	HANDLE	1129648	1
4	GUN CONTROL RECEPTACLE	483A891H01	1
5	FUSES (2 AMP)	363A018H16	2
6	FUSE (1 AMP)	363A018H15	1
7	RECEPTACLE	419A012H01	1
8	CABLE ASSY (GROUND)	432C524G12	1
9	CABLE ASSY	2222A01G01	1
10	CABLE ASSY (CURRENT)	1474B91G02	1
11	TERMINAL BOARD	32B1029H15	1
12	RESISTOR (5R) 10 OHM, 25W	363A014H46	1
13	RESISTOR (1R) 100 OHM, 100W	422A473H02	1
14	RESISTOR (2R) 25 OHM, 25W	422A473H06	1
15	RESISTOR (4R) 1K, 20W	363A114H88	1
16	CONTACTOR	2224A77H01	1
17	STRAIN RELIEF	582D430H06	1
18	STRAIN RELIEF	576D916H73	1
19	STRAIN RELIEF	427C613H04	1
20	RELAY (2CR) 3PDT	480B096H27	1
21	CAPACITOR (3C, 4C) .047 MFD	363A104H86	2
22	RELAY (3CR)	320B224G01	1
23	CAPACITOR (2C)	2224A78H01	1
24	RECTIFIER ASSY (1RX)	2224A79H01	1
25	CAPACITOR MOUNTING CLAMP	474A830H01	1
26	CAPACITOR (5C) 4 MFD	2224A78H02	1
27	RESISTOR (3R)	474A023H01	1
28	RELAY (4CR) DPDT	480B096H26	1
29	FUSE HOLDERS	2218A11H01	3
	SCHEMATIC DIAGRAM	720B096	
	WIRING DIAGRAM	221C688	

HVTS 2000 Series
REGULATOR/FLOWMETER
Parts Bulletin



MODEL INFORMATION

MODELS WITH ONE CALIBRATION ON FLOW TUBE

GAS	FLOWMETER RANGE – S.C.F.H.	REGULATOR/FLOWMETER MODEL NO.	CGA INLET CONNECTIONS AVAILABLE	TUBE WITH FLOAT PART NO.
OXYGEN & INDUSTRIAL AIR	3-19	HVTS 2020	540 & 590	1015-0005
	5-40	HVTS 2021		1015-0006
	15-75	HVTS 2022		1015-0007
NITROGEN & INDUSTRIAL AIR	3-20	HVTS 2329	580 & 590	1015-0017
	5-45	HVTS 2330		1015-0018
	15-80	HVTS 2331		1015-0019
HYDROGEN	2-25	HVTS 2470	350 & Victor No. 982	1015-0034
	10-75	HVTS 2432		1015-0023
	20-160	HVTS 2433		1015-0024
	50-280	HVTS 2434		1015-0025

OLD MODELS WITH TWO CALIBRATIONS ON FLOW TUBE

ARGON HELIUM	2-16 10-50	HVTS 2335	580 350	1015-0026
ARGON HELIUM	5-35 20-110	HVTS 2336	580 350	1015-0027
ARGON HELIUM	10-65 30-200	HVTS 2337	580 350	1015-0028

OLD MODEL WITH THREE CALIBRATIONS ON FLOW TUBE

ARGON HELIUM CARBON DIOXIDE	4-50 20-155 4-50	HVTS 2370	580 350 320	1015-0037

NEW MODELS WITH TWO CALIBRATIONS ON FLOW TUBE

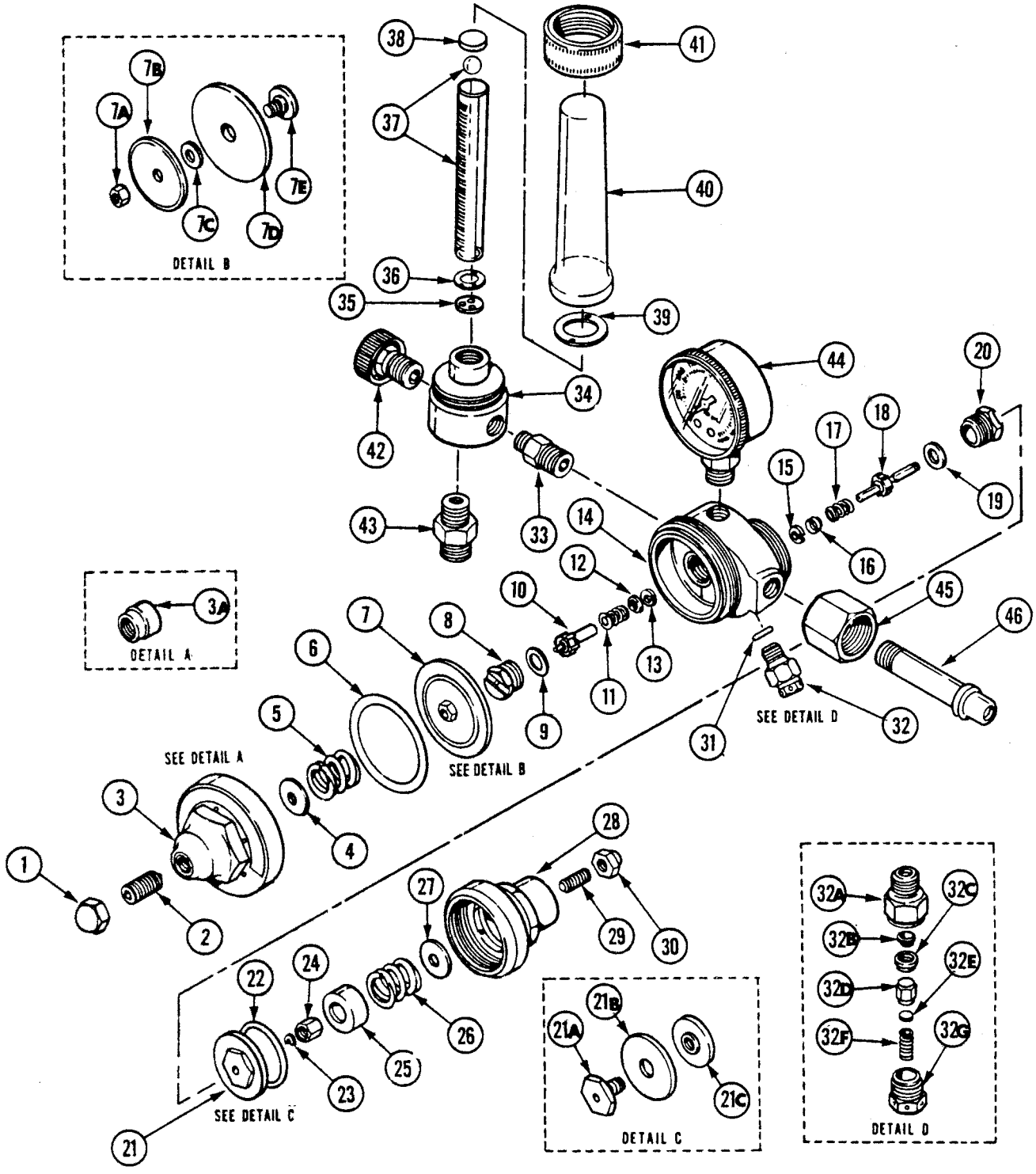
ARGON HELIUM	2-16 10-50	HVTS 2335A	580	1015-0046
ARGON HELIUM	5-35 20-110	HVTS 2336A	580	1015-0047
ARGON HELIUM	10-65 30-200	HVTS 2337A	580	1015-0048

NEW MODEL WITH THREE CALIBRATIONS ON FLOW TUBE

ARGON HELIUM CARBON DIOXIDE	4-50 20-155 4-50	HVTS 2370A	580 320	1015-0049

OLD MODELS ARE PRESET FOR 50 PSIG

NEW MODELS ARE PRESET FOR 25 PSIG


DETAIL B
DETAIL A
SEE DETAIL A
SEE DETAIL B
SEE DETAIL C
SEE DETAIL D
DETAIL C
DETAIL D

PARTS LIST

REF. NO.	DESCRIPTION	HVTS 2020 HVTS 2021 HVTS 2022 HVTS 2329 HVTS 2330 HVTS 2331 HVTS 2335 HVTS 2336 HVTS 2337 HVTS 2370	HVTS 2470 HVTS 2432 HVTS 2433 HVTS 2434	HVTS 2335A HVTS 2336A HVTS 2337A HVTS 2370A - 580	HVTS 2370A - 320
1	Cap Nut	1403-0005			
2	Adjusting Screw	0750-0026			
3	Housing Cap w/Bushing	0720-0023			
† 3A	Bushing	0722-0002			
4	Spring Button	0706-0015			
5	Adjusting Spring	0761-0054	0761-0054	0761-0055	0761-0055
6	Diaphragm Slip Ring	0705-0004			
7	Diaphragm Assembly	0730-0024			
7A	Diaphragm Nut	1409-0002			
7B	Diaphragm Plate	0735-0004			
7C	Washer	1406-0049			
7D	Diaphragm	0731-0015			
7E	Centralizer	0733-0023			
8	Nozzle (L.P.)	0702-0038	0702-0038	0702-0038	0702-0003
† 9	Nozzle Gasket	1408-0086			
† 10	Seat Assembly (L.P.)	See Chart II			
11	Valve Spring (L.P.)	0762-0004			
12	Gland (L.P.)	0708-0003			
† 13	Friction Washer	1408-0033			
14	Body	0701-0104			
† 15	Friction Washer	1408-0033			
16	Gland (H.P.)	0708-0003			
17	Valve Spring (H.P.)	0762-0004			
† 18	Seat Assembly (H.P.)	See Chart II			
† 19	Nozzle Gasket	1408-0086			
20	Nozzle	0702-0038			
21	Diaphragm Assembly (H.P.)	0730-0003			
21A	Centralizer	0733-0003			
† 21B	Diaphragm	0731-0003			
21C	Diaphragm Plate	0735-0003			
22	Diaphragm Slip Ring	0705-0005			
† 23	Valve Stem Clockwasher	1406-0066			
24	Diaphragm Plate Nut	0743-0035			
25	Spring Guide	0760-0003			
26	Adjusting Spring (H.P.)	0761-0054			
27	Spring Button	0706-0015			
28	Housing Cap (H.P.)	0720-0103			
29	Adjusting Screw (H.P.)	1401-0034			
30	Diaphragm Plate Nut	1403-0039			
† 31	Screen	0717-0007			
32	Safety Valve	See Chart I			
33	Flowmeter Inlet	0910-0069			
34	Flowmeter Body	1001-0003		1001-0007	
† 35	Float Bumper	1408-0002			
† 36	Thorpe Tube O Ring	1407-0014			
37	Thorpe Tube and Float	See Model Information			
† 38	Float Bumper	1408-0002			
† 39	O Ring	1407-0018			
40	Thorpe Tube Cup	1002-0003			
41	Body Nut	1003-0003			
42	Control Valve	0662-0026			
43	Outlet Connection	0950-0068	0960-0029		
Not Shown	Adapter			0911-0050	
44	H. P. Gauge	1424-0019			
45	Inlet Nut	See Chart II			
46	Inlet Swivel	See Chart II			

†Items most commonly required for regulator repair and recommended for stock.

SPECIAL NOTE: In order to insure the proper installation of the seat material by type of regulator service, only the entire seat assembly is available. To aid the proper identification of seat assemblies, they are color-coded in the following manner:

	Nut	Seat Material
Acetylene	Nickel	Black
Other Fuel Gas	Nickel	Brown
O_2 and Inert Gas	Brass	Black
CO_2 and N_2O	Copper	Brown

The use of the incorrect type of seat material may result in malfunction of the regulator. DO NOT INTERCHANGE SEAT ASSEMBLY.

CHART I

SAFETY RELIEF VALVE INFORMATION

REF. NO.	DESCRIPTION	ALL MODELS EXCEPT AS SHOWN	HVTS 2470 HVTS 2232 HVTS 2233 HVTS 2234
32	Safety Valve	0600-0016	0600-0070
32A	Body	0601-0004	0601-0006
32B	Seat	0608-0009	0608-0009
32C	Seat Retainer	0609-0003	0609-0006
32D	Upper Seat	0608-0018	0608-0023
32E	Disc	1406-0016	1406-0017
32F	Spring	0610-0009	0610-0014
32G	Cap	0614-0004	0614-0016
Not Shown	Spring Button	None	0606-0005
Not Shown	Adj. Screw	None	1401-0008
Not Shown	Cap Nut	None	1403-0024

CHART II

INLET NUT & SWIVEL AND SEAT ASSEMBLY INFORMATION

GAS	CGA INLET NO.	INLET NUT PART NO.	INLET SWIVEL PART NO.	H. P. SEAT ASSEMBLY PART NO.	L. P. SEAT ASSEMBLY PART NO.
Air	540	0967-0044	0967-0034	0740-0003	0740-0004
Argon/Helium/Nitrogen	580	0973-0003	0970-0005	0740-0003	0740-0004
Hydrogen, Air, Nitrogen	982	0982-0003	0967-0034	0740-0003	0740-0004
Hydrogen	350	0983-0003	0983-0008	0740-0110	0740-0111
Carbon Dioxide	320*	0968-0003	0985-0004	0740-0018	0740-0019

***Inlet Washer P/N 1408-0065 required for use with CGA 320 Inlet Connection.**

REPAIR INSTRUCTIONS

1. Use Locktite 59-31 sealant on low pressure gauge, outlet connection, and safety valve.
2. Use Teflon tape to seal inlet connection and high pressure gauge.
3. Use Fluorolube to lubricate O rings.
4. Use 50 foot pounds of torque to tighten front housing cap and 50 for pounds of torque to tighten rear housing cap.
5. To clean inlet filter, blow-out filter in reverse direction to normal gas flow.
6. Use Trichlorethylene to clean all metal parts before assembling. **Do Not** allow seat or O rings to come into contact contact with Trichlorethylene as it will cause material to swell.
7. First stage setting – Remove safety valve or pupe plug and install 500 psig gauge. The adjusting screw for presetting the first stage is located under the acorn nut on the first stage housing.

CAUTION

Welding apparatus improperly maintained or repaired can be dangerous. Some parts

Service or repair of apparatus should be performed only by an authorized repair technician. Improper service or repair, or modification of the product could result in damage to the product or injury to the operator.

By Order of the Secretary of the Army:

E. C. MEYER
General. United* States *Army
Chief of Staff

Official:

B. G. JOYCE
Brigadier General, United States Army
The Adjutant General

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TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

Your mailing address

DATE SENT

Date you filled out form.

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 9-XXXX-XXX-XX	Date of TM	Title of TM

BE EXACT . . PIN-POINT WHERE IT IS

PAGE NO	PARAGRAPH	FIGURE NO	TABLE NO
400		183	
512		191	

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Change illustration. Reason: Tube end shown assembled on wrong side of lever cam.

Figure 191, item 3 has the wrong NSN. Supply rejects orders for this item. The NSN shown here is not listed in the AMDF or the MCRL.

Please give us the correct NSN and P/N.

SAMPLE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

John Smith, S. SGT. 793/XXXX

SIGN HERE

John Smith

DA FORM 1 JUL 79 2028-2 PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

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SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 9-3431-258-14&P	31 Jul 81	Welding Set Model 137

BE EXACT . . . PIN-POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

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REVERSE OF DA FORM 2028-2 AMSMC OP 103-85

FILL IN YOUR
UNITS ADDRESS

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

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Director
Armament and Chemical Acquisition
and Logistics Activity
ATTN: AMSTA-AC-NML
Rock Island, IL 61201-9948

TEAR ALONG PERFORATED LINE

THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'VEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

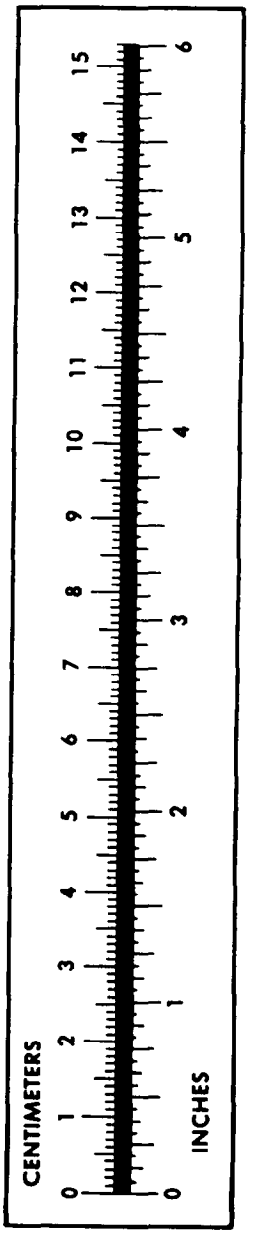
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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