

# INSTRUCTIONS FOR PLASMA ARC CUTTER

## BASIC SAFETY PRECAUTIONS

### Fumes

During cutting operations harmful metal dust and fumes are produced.

It is therefore recommended to use safety masks and to work in areas adequately ventilated to guarantee sufficient operator's protection.

In indoor areas air aspirators are required located underneath the cutting area. Should halogen grease removers or solvents be present on the material to be cut, this is required to be cleaned prior to cutting operations in order to avoid the formation of toxic gases.

Some chlorinated solvents may decompose in the presence of radiations emitted by the arc and generate phosgene gas. Plated metals or metals containing lead, graphite, cadmium, zinc, mercury or beryllium may produce toxic fumes while cutting.

### Radiations

Both infrared and ultraviolet radiations created by the plasma arc have the same effect as those produced by arc welding. It is recommended to wear welding gloves and aprons to protect bare parts against rays, which are harmful to eyes and skin. Masks and grade 7 or 8 safety lenses are to be worn to protect face and eyes. Never use contact lenses! The intense heat coming from the arc may stick them on the cornea.

### Fire

Precautions should be taken against fire caused by spark or hot slag. All inflammable and combustible materials should be removed from the cutting and surrounding areas.

Cutting should not be carried out on: fuel or lubricant tanks, whether full or empty, or on parts with cavities filled with inflammable material.

Make sure that the fire-fighting equipment is installed near work stations.

### Electric shock

The plasma arc cutter requires dangerous voltages for spark starting and during cutting. The following safety rules should be therefore observed:

- Avoid touching or holding by hand the parts to be cut.
- Do not work in humid or wet areas.
- Do not use the unit if cables or torch parts are damaged. Replace them immediately!
- Always switch the unit off prior to any replacement of nozzle, insulating diffuser, electrode, spacer or nozzle holder.
- Always replace any damaged torch parts or cables with original material.
- Cut off the power feed line prior to any intervention on torch, cables or inside generator.
- Make sure that the power feed line is provided with an efficient earth plate.
- Make sure that the work bench is connected to an efficient earth plate.
- Any maintenance should be only carried out by skilled personnel, well aware of the risks due to dangerous voltages necessary for the equipment to operate.

### Burns

The operator should wear fire-proof shoes and clothing to protect against sparks and material slag; these are ordinary precautions while welding.

Do not direct the torch flame towards persons or foreign bodies.

### Publications

The following publications provide additional information on safety

precautions:

A) Bulletin No. C5. 2-83 "Recommended Safe Practices for Plasma Arc Cutting"

B) American National Standard ANSI Z49. 1-83 "Safety in Welding and Cutting"

Both are available from: American Welding Society Inc. -2501 Northwest 7th Street - Miami, Florida 33125 - Telephone (305) 443-9353

C) OSHA Safety and Health Standards, 29CFR 1910, available from the U.S. Department of Labor, Washington, D.C. 20210.

## SAFETY DEVICES

This equipment is provided with the following safety devices:

**Thermic:** located on the transformer windings to avoid overloads.

**Pneumatic:** located on the torch feed line to avoid insufficient air pressure and signalled by indicator light (11) (picture 2).

**Electric:** located on torch body 1) to avoid dangerous voltages while replacing nozzle, diffuser or electrode; 2) (90 A Version only) to stop the unit when the electrode is so worn that it is required to be replaced. This second function is signalled by indicator light (10) (picture 2).

## INSTALLATION AND OPERATION

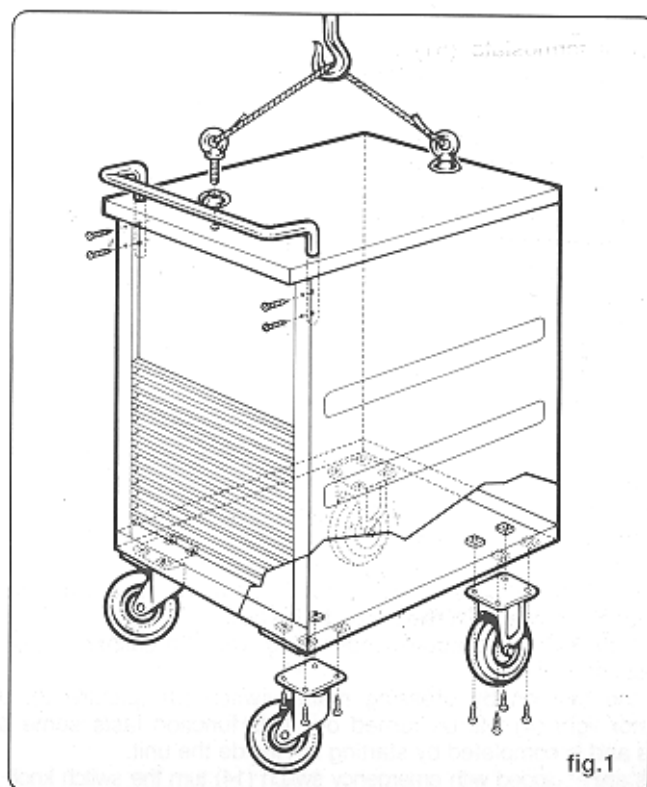
Have the wiring for the machine installed by a qualified electrician. All connections must be made according to the existing norms.

(Picture 1) Open the upper part of the packing. Extract the torch supplied detached from the unit. Extract both eyebolts located inside the accessory box and by means of two Belleville washers screw them to the unit.

By means of a lifter extract the unit from packing. Fit both pivoting wheels to the front side and fit both fixed wheels to the rear side. Insert handle into the cover holes and fix it by self-threading screws onto side uprights.

Install the unit in a room adequately ventilated making sure that the air inlet and outlet are not obstructed by cooling slots.

(Picture 2) Fit torch on the unit by tightening the adapter ring nut (12) to the fixed fitting (13) thus avoiding air leaks damaging torch working. Pay particular attention not to dent the power pin and not to bend the adapter pins (12); a dented pin cannot be disconnected,



once fit, from the fixed fitting (13); a bent pin prevents the adapter (12) from being correctly mounted on the fixed fitting (13) and the unit from working.

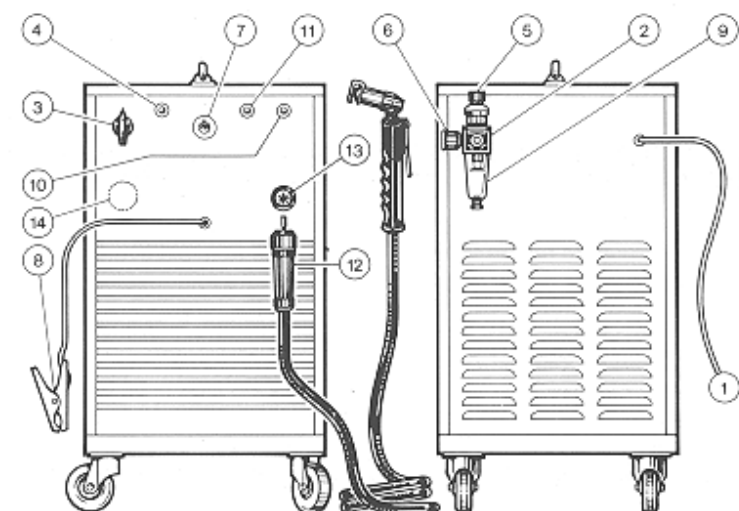


fig.2

The feed cable (1) is made up of four leads one of which is yellow-green and should be connected to the system earth lead; the remaining three leads should be connected to the feed line. Make sure that the feed voltage of the unit corresponds to the line one!

The minimum installation power for any operation of the unit should be 22 KW. Any extension leads should have suitable diameter. Connect the air feed to fitting (2) making sure that pressure is at least 88 PSI (6 bar or KPa x 100) with a minimum delivery of 530CFH (250 L/min).

Lift knob (5) of the reduction unit and adjust pressure, shown on gauge (6), at 80-88 PSI (5.5-6 Bar or KPa x 100).

Position the knob (7) according to the thickness to be cut following indications as below:

Aluminum:	up to 1/8" + 5/32"	(3-4 mm)	40- 50 A
	up to 5/16" + 3/8"	(8-10 mm)	80- 90 A
	up to 5/8" + 3/4"	(15-18 mm)	110-120 A
	up to 7/8" + 1"	(22-25 mm)	150 A
Stainless steel: and Mild steel:	up to 3/16"	(5 mm)	40- 50 A
	up to 1/2"	(12 mm)	80- 90 A
	up to 1"	(25 mm)	110-120 A
	up to 1 3/8"	(35 mm)	150 A

Cutting power is steadily adjusted therefore operator may find the correct value according to cutting conditions.

Higher power values than those mentioned do not prevent the unit or torch from working correctly and sometimes they may even improve the cutting quality because they reduce slag on the piece edges.

The nozzle hole diameter is depending on the cutting power and it should be, as shown on the front panel of the unit, the following:

At	20/ 50 A	nozzle diam. 1.1 mm	standard or long
	40/ 90 A	nozzle diam. 1.3 mm	
	80/130 A	nozzle diam. 1.6 mm	
	120/150 A	nozzle diam. 1.8 mm	

With cutting current of 20 ÷ 50 A and a 1,1 mm. nozzle, standart or long, it is possible to do contact work, more precisely, with the nozzle directly on the material to be cut.

Concerning other conditions it is necessary to use a spacer (spacer with two extensions B or spring A fig. 6) keep about 5/32" (4 mm) far away (automatically-controlled torch) **so as to avoid any direct contact of nozzle with the piece to be cut.**

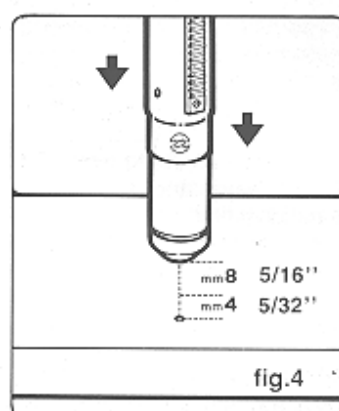
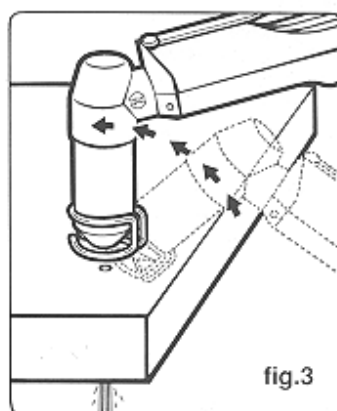
Follow the same procedure when using wheeled caliper (supplied on request).

Turn the unit on by pressing mains switch (3) (picture 2); the indicator light (4) will be turned on. This function lasts some seconds and is completed by starting fan inside the unit.

If units are equipped with emergency switch (14) turn the switch knob to

ON; the indicator light will be turned on. This function permits the unit to be "ready". By turning knob to START this function is completed and the fan inside the unit starts working. START position is removed by releasing knob which will be positioned again on ON.

By pressing emergency button (14) when working, the unit immediately stops and returns to position "ready".



Once the unit is turned on, the compressed air flow opening is controlled by pressing the torch button for a little while.

When using automatically-controlled torches the torch button is meant to be the button or switch located on the pantograph to be connected to the wire supplied in connection with the torch.

Make sure that in this case pressure shown by gauge (6) is 73PSI (5 Bar or KPa x 100); otherwise adjust it by turning knob (5) of the reduction unit, then lock it by pressing. Connect terminal (8) to the piece to be cut, ensuring good contact, especially with painted, oxidated or insulated sheets. The pilot arc is turned on by pressing the torch button. If cutting does not start after 1 or 2 seconds, the pilot arc turns off and the button should be pressed again to repeat the operation. After cutting has been performed and button has been depressed, air still flows out from torch for about one minute so that torch cools down. Do not turn the unit off before that time.

Should holes be drilled some precautions should be followed:

- **manual operation** (see picture 3) tilt the torch and then slowly straighten it to prevent molten metal from being spread on nozzle
- **automatic operation** (see picture 4) keep nozzle at least 5/16" (8 mm) far from the piece and if possible bring it to about 5/32" distance after having drilled the hole. Do not drill materials thicker than 3/8"/1/2" (10/12 mm). Thicker materials should be pre-drilled before cutting operation can be made.

## GOUGING

This operation permits to remove faulty weldings, to devide welded pieces, to prepare edges, etc. and is almost exclusively used with manually-controlled torch.

Nozzle (E) (picture 6) dia.3 mm should be used and spacer (C) should be fit onto the nozzle holding bush (D). Spacer (C) prevents molten metal from burning the insulating material covering the nozzle holding bush (D), while gouging. The power value to be used varies from 70 to 150 A according to the thickness and quantity of the material to be removed. This operation is carried out by keeping torch tilted (see picture 5) and advancing towards the molten material thus moving it away by means of the outflowing compressed air.

Torch is tilted depending on the penetration to be obtained. As molten slag tend to stick on spacer (C) and nozzle (E) it is recommended to clean them often to prevent effects (double arc) destroying nozzle in few seconds.

Because of intense radiation emission (both infrared and ultraviolet) the operator as well as persons nearby are recommended to use proper protection.

## DUTY CICLE

(Refer to the technical specification plate on the unit)

Duty cycle X sets the cutting time as a percentage of a 10-minute

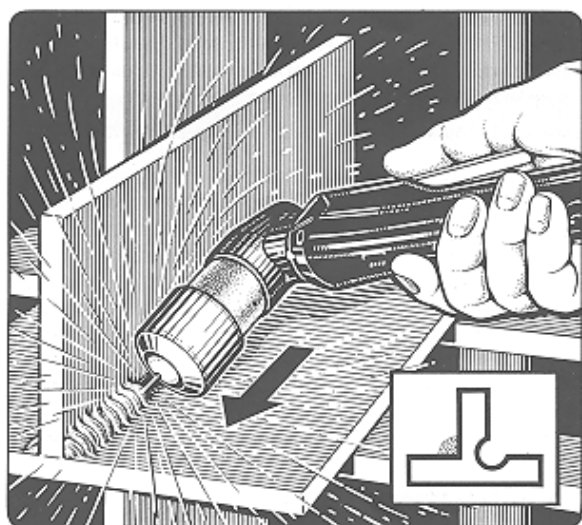


fig.5

period of time at a preset cutting current  $I_2$ .

Ex. Should generator duty cycle be:

X = 60% at  $I_2 = 120$  A  
X = 100% at  $I_2 = 95$  A

This means that at 120 A position it is capable to cut for 60% of 10 minutes, i.e. 6 minutes every 10 minutes; at 95 A position it is capable to cut for 100% of 10 minutes, i.e. continuous service.

Should generator duty cycle be:

X = 40% at  $I_2 = 90$  A  
X = 90% at  $I_2 = 60$  A

This means that at 90 A position it is capable to cut 4 minutes every 10 minutes; at 60 A it is capable to cut for 9 minutes every 10 minutes.

## TORCH MAINTENANCE

Power to the unit should be cut off prior to any intervention on the torch:

### 1) Substitution of wearing-out materials

Parts subject to wear (picture 6) are electrode (G), diffuser (F) and nozzle (E). These can only be replaced after unscrewing nozzle holder (D). The electrode should be replaced when it shows an approx 5/64" deep crater (see picture 7). Unless this is not replaced the unit

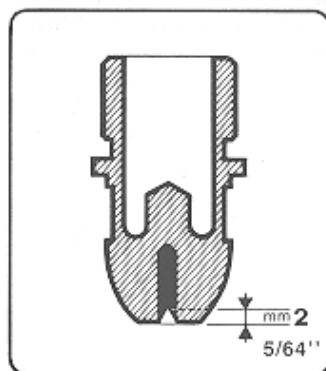


fig.7

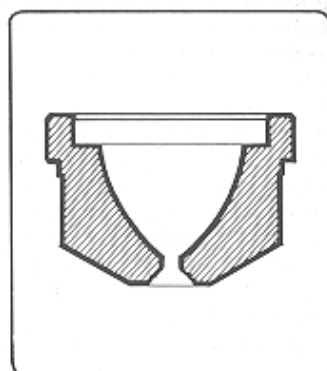


fig.8

stops (pilot light 10 picture 2 lighting) once it is worn out.

Turn the unit off, replace nozzle and then turn the unit on again by turning knob (3) (picture 2).

**ATTENTION!** Do not make sudden stresses when unscrewing the electrode, but gradually force so as to have the thread unlocked. Lubricate the thread of the new electrode with silicone lubricant (on supply with the unit). This new electrode is required to be screwed in its housing and locked without tightening.

Nozzle should be replaced when its central hole is damaged or too large with respect to the new part (see picture 8).

Diffuser (F) (picture 6) should be replaced when one of its ends tends to char. This part often tends to stick on electrode (G) or on nozzle (E), because of the thermal shocks and mechanical stress it is subjected to. To detach it it is recommended to use extractor (O) supplied with the unit, thus avoiding any damage to the diffuser.

After replacing the above parts tighten nozzle holder (O). Check locking at regular times.

### 2) Substitution of torch body (Q) (see picture 6)

Open the handgrip by loosening screws. Loosen screws which secure the safety lead terminals (S-S1). Loosen the screw locking the pilot arc lead (U). Cut the insulating sheath (K1). Loosen connector (V) after cutting the insulating sheath (K). Fit the new torch body carrying out all previous operations in reverse order. Warm up the shrinking sheaths (K) and (K1) through a small source of heat (e.g. lighter) so that they adhere to connectors. Make sure that connections are well tightened before fitting the handgrip.

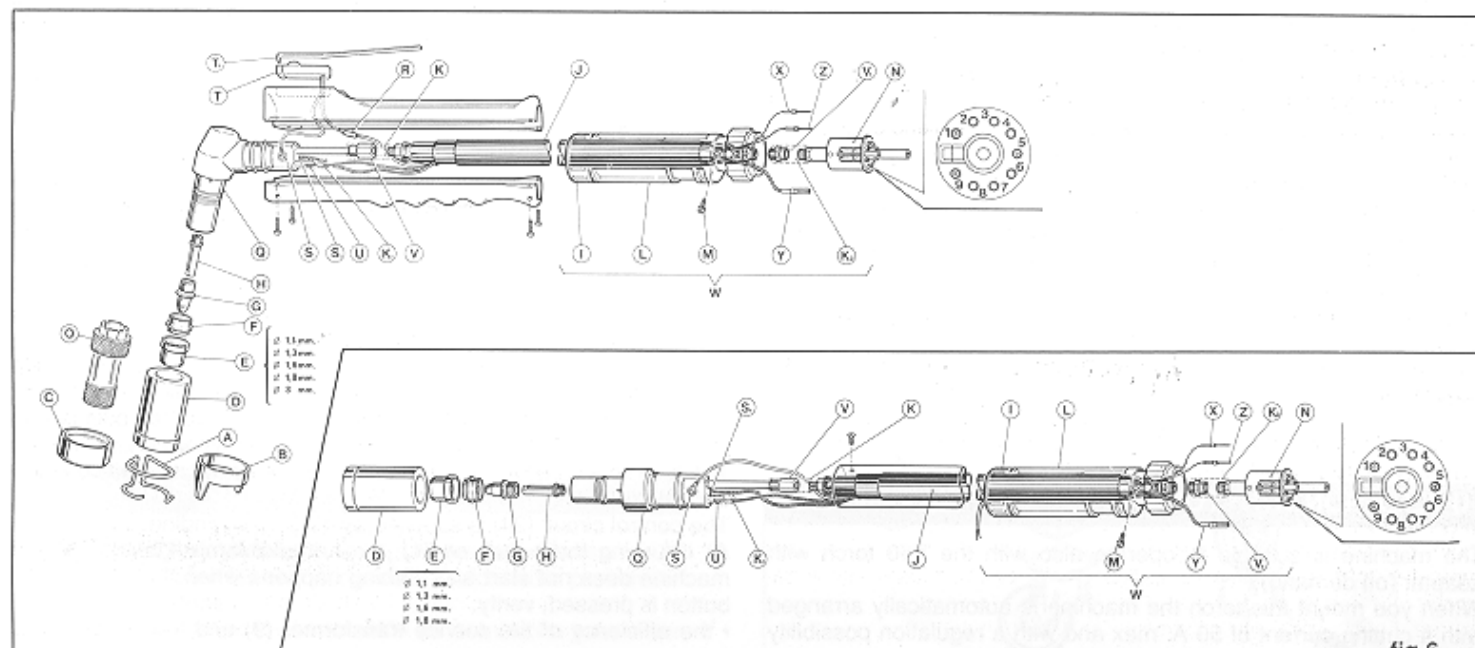


fig.6

### 3) Substitution of adapter (W) (see picture 6)

Remove ring nut (I) and cut the clamps locking cable (J). Loosen screw (M) and extract cover (L). Extract the control cable pins (X) and (Z) and the red cable pin for pilot arc (Y). Cut the insulating sheath (K2) and loosen the adapter body (N) from connector (V1). Fit the new adapter body carrying out all previous operations in reverse order. Use sealing adhesive for threads in order to lock the adapter body thread (N) on connector (V1). Pins (X) and (Z) of the control cable should be connected to contacts (1) and (9) of adapter body (N). Pin (Y) of the red cable for pilot arc should be connected to contact (5) of adapter body (N). Sheath (K2) acts as insulating material and adheres to connector (V1) after warming it up.

### 4) Substitution of cable (J) (see picture 6)

This cable is replaced by carrying out the operations as shown at points (2) and (3). When using a manually-controlled torch connection (R) should be reached.

**N.B.** Connection (R) should be accurately insulated.

### 5) Substitution of button (T) (manually-controlled torch - see picture 6)

After removing lever (T1), loosen screws and once the handgrip is open, loosen screw (S) locking the lead with button cable, cut connection (R), extract the old button, insert the new one and carry out all previous operations in reverse order, accurately insulating connection (R).

### 6) Substitution of handgrip (manually-controlled torch-see picture 6)

Handgrip is replaced by carrying out all operations as described at point 5.

### 7) Substitution of handgrip (automatically-controlled torch-see picture 6)

Handgrip is replaced by carrying out all disassembly operations as shown at point (2); extract the old handgrip and fit the new one performing all previous operations in reverse order.

### 8) Substitution of diffuser sheath (H) (see picture 6)

Loosen nozzle holder (D) remove nozzle (E) and diffuser (F); unscrew electrode (G) and then sheath (H). Fit the new one and screw it with a 6 mm wrench performing all previous operations in reverse order.

### 1) Insufficient penetration

This may be caused by:

## CUTTING PROBLEMS

- high speed. Always make sure that arc fully penetrates the piece to be cut and that its tilting never exceeds 10-15 degrees (see picture 9).
- excessive thickness of the piece.
- knob (7) (picture 2) not correctly positioned.
- bad electric contact between earth terminal (8) (picture 2) and piece.
- too large nozzle hole (E) (picture 6) with respect to the power value preset by knob (7) (picture 2).

### 2) Cutting arc is extinguished

This may be caused by:

- too low advancing speed
- too high cutting speed with respect to the thickness of the piece to be cut.

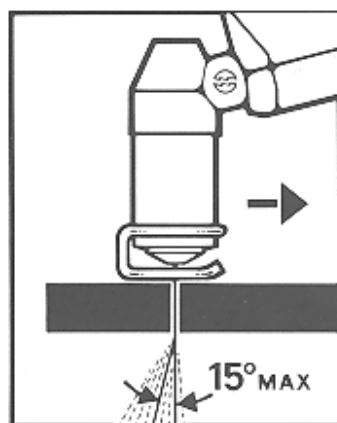


fig.9

## UTILIZATION WITH TORCH P 50

(on demand)

The machine is suitable to operate also with the P50 torch with adapter (on demand).

When you mount this torch the machine is automatically arranged with a cutting current of 50 A. max and with a regulation possibility

which starts from 20 A.

You will be able to cut, in contact with the piece, both using our standard nozzle and electrode and our longer nozzle and electrode. **Please note: it may happen that when you use the torch P50 the block device for exhausted electrode couldn't operate.**

## PRACTICAL RECOMMENDATIONS

- If the air in the system contains a large amount of humidity and oil it is recommended to use a drier filter so as to avoid excessive oxidation and wear of the parts and damage to the torch.
- The impure matter of the air easily leads to the electrode and nozzle oxidation and may make the pilot arc operation more difficult.
- Should this occur, clean the end part of the electrode and inside the nozzle with fine abrasive paper.
- Make sure that the new electrode and nozzle to be assembled are thoroughly clean and degreased.
- Always use original spare parts in such a way as to avoid torch damage.

## MAINTENANCE AND CHECKS

Nozzle should be periodically cleaned of metal slag by means of a steel brush.

Sharpened bodies should not be used as they may damage the nozzle hole. If the electrode is not easily removed, act as follows:

lubricate the electrode thread with penetrating lubricating fluid; then unscrew the electrode. If the thread of the electrode holder support is damaged when removing the electrode, rebore it by means of tap (M11) after removing diffuser sheath (H) (picture 6).

To prevent metal residuals from remaining inside the torch body in the course of this operation it is recommended to remove the cover of the machine, to extract the air tube from one of the automatic fittings and to blow in compressed air, while tapping.

Although the unit is provided with an automatic condensate discharge device, operating whenever air feed is shut off, it is recommended that periodical checks of the container (9) (picture 2) of the reduction unit are carried out to ensure the absence of any trace of condensate. The unit should be periodically cleaned of any metal dust by means of compressed air.

Disconnect power cable from socket prior to any operation inside the unit.

## GUIDE TO PROBABLE FAILURES

Failures most likely to occur during machine operation are listed below, this list being by no means exhaustive.

Repair, if any, should only be carried out by qualified personnel.

Primary and secondary windings of the service transformer (9) are protected by fuses. In case of failure, first action to be taken will be checking if any fuse is burnt.

### 1) STARTING

With the machine functioning and air pressure set as indicated on the instruction manual, section "Installation and operation", starting sequence will be as follows:

Turning on the switch (1), the service transformer (9) is activated.

This, together with the secondary winding 0 - 180V, supplies all condensers (13) on complete power unit (17) with a precharging voltage of approx. 195V d.c. through the control circuit (24).

When precharging voltage reaches this value, the control circuit (24) activates the contactor (19) that starts the machine.

Utilities such as contactors, solenoid valves, relays, red pilot lamps are fed by the 0 - 25V winding of the service transformer.

The torch push-button and the board (85) selecting the setting scale of cutting current are fed by 0 - 18V winding.

The control circuit (24) is supplied by 12-0-12V winding.

**A)** If turning the switch on (1), the net pilot lamp lightens but the machine does not start and nothing happens when the torch push-button is pressed, verify:

- the efficiency of the service transformer (9) and the continuity of



the electric circuits.

- the efficiency of control circuits (24).

**B)** If turning the switch on the net pilot lamp lightens, the machine does not start but air flows out of the torch when the push-button is pressed, ensure:

- that plant pressure is sufficient. The lamp signalling insufficient pressure may be faulty.
- that the microswitch of the air pressure switch (30) or the rectifier (79) or the power unit (17) or control circuits (24) are efficient.
- that the electrical circuit is not interrupted.

## 2) PILOT ARC

The duration of the pilot arc in air is approx. 2-3 sec, even holding the torch push-button.

- air keeps flowing out as long as the push-button is held and until approx. one minute after releasing it.

The voltage measurements prescribed below for component inspection must be taken within 2 or 3 sec after pressing the torch push-button otherwise measurements may be incorrect

**C)** If the machine is functioning and pressing the push-button no air flows out of the torch, verify:

- that nozzle holder (70) is appropriately fastened and fitted with electrode, diffuser and nozzle.
- that thermostat (51) is not temporarily off due to transformer overload or discontinued.
- that push-button, safety contacts, and control cables on the torch are not discontinued.
- that solenoid valve (31/1) is efficient.
- that solenoid valve (31/1) feeding is correct; if not, replace control circuit (24) after checking the continuity of the electrical connections.

**D)** If the machine is functioning and pressing the push-button air flows out of the torch but the arc is not activated, ensure:

- that the torch has not short-circuited.
- that pilot arc contactor (23) is efficient.
- that the contactor (23) is supplied; if not, replace the control circuit after checking the electrical circuit.
- that control circuit (24) feeds the driver (16) of the complete power unit (17). This is signalled by led 1 lighting up on the control circuit (24) simultaneously with contactor (23) operation time for pilot arc when torch push-button is depressed.
- that complete power unit (17) is efficient. This is done by pressing the torch push-button and verifying that there is voltage on the fixed adapter (54) between central current pin (air connection) and the red cable connected to the pilot arc contactor (27) after disconnecting the high-tension circuit (6) connector (7). Voltage should measure approximately 250V d.c.
- that the high-tension circuit (6) is efficient. After verifying the presence of 250V on the fixed adapter (54), reconnect the connector (7); if pressing the torch push-button no sparks or very weak sparks are generated on the high-tension circuit (6) platinum points, the high-tension circuit must be replaced.
- that impedance (46) has not short-circuited. If pressing the torch push-button the high-tension circuit (6) generates sparkles on the platinum points but the pilot arc is not activated, impedance (46) must be replaced.

**WARNING:** if impedance (46) has short-circuited, repeatedly trying to turn on the pilot arc might damage the high-tension circuit (6).

## 3) CUTTING

**E)** If pilot arc turns on but as it approaches to the workpiece to be cut the machine stops and the pilot lamp signalling "electrode exhausted" lights up even with a new electrode, ensure:

- that connection (8) is firmly fastened and not discontinued in terms of electricity.
- that the solenoid valve (31/2) is efficient and appropriately supplied. For verifications see point H.
- that the high-tension circuit (6) and the control circuit (24) are efficient.

**F)** If the torch arc turns on but then turns off again when the torch is approached to the workpiece, verify:

- that the workpiece is efficiently grounded.
- that the control circuit (24) is efficient.

**G)** If the machine equipped with torch P 50 does not set full-scale setting at 50 A, verify:

- that contacts 2 and 3 of torch part adapter are short-circuited.
- that governing board (85) or its connections are efficient.

**H)** If the electrode and the nozzle wear too quickly or cut quality is poor, ensure:

- that the solenoid valve (31/2) is efficient and appropriately supplied.

Correct supply only occurs during cutting as the above mentioned solenoid valve is only supplied under those conditions.

If this is not the case, replace the control circuit (24) after verifying the continuity of the connections.

The efficiency of the solenoid valve is usually tested observing the gauge (37) pointer that has a slight movement towards lower pressure values when the solenoid valve (31/2) is triggered, or also feeding it separately with outside voltage.

## CUTTING SPEED GRAPH

