

INSTRUCTION MANUAL FOR MIG WELDING MACHINE

IMPORTANT SAFETY INFORMATION!!!

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE INSTALLATION, USE, OR SERVICING OF THIS UNIT. PAY CLOSE ATTENTION TO THE SAFETY RULES AND CONTACT YOUR DISTRIBUTOR IF YOU DO NOT UNDERSTAND SOME OR ALL OF THE POINTS COVERED IN THESE INSTRUCTIONS.

1 SAFETY RULES CONCERNING THE USE OF THIS WELDING MACHINE

1.1 INTRODUCTION

All people authorized to use this machine should read the following instructions manual before using or servicing this unit.

A REMINDER: YOUR SAFETY DEPENDS ON YOU!!!

Always follow all safety regulations and instructions when using this machine. It is your responsibility to protect yourself and others against the risks related to the operation of this welding machine. The operator must be familiar with and observe all the safety rules regarding the safe operation and maintenance of this welding machine.

NOTHING REPLACES GOOD COMMON SENSE !!!

1.2 GENERAL PRECAUTIONS

1.2.1 Fire



- Avoid causing fires due to sparks, slag, hot metal and spatter which are produced during normal welding operations.

- Make sure that a suitable fire-extinguisher is located near the welding sight.
- Remove all flammable material within 30 feet of the welding area.
- Do not weld containers (tanks or drums) containing flammable material, even when empty.
- Allow the welded metal to cool down before touching it or putting it into contact with flammable material.
- Do not weld structures with hollow spaces containing flammable substances.
- Do not work in conditions where there are high concentrations of combustible vapours, gases, or flammable dust.
- Always check the work area half an hour after welding so as to make sure that no fire has started.
- Do not keep any flammable material such as lighters or matches in your pockets while using this equipment.

1.2.2 Burns

- Protect your entire body by wearing fire-proof clothing. This will protect your skin against burns caused by: ultra-violet radiation given off by the arc, sparks and molten slag.
- The protective clothing should include: gloves, a hat, and high shoes. Your shirt collar and pocket flaps should be buttoned, and cuff-less trousers should be worn to prevent contact with sparks and molten slag.
- Wear a helmet equipped with the appropriate lens shade and a clear glass cover plate. This is imperative when welding, cutting, and chipping to protect your eyes from ultra-violet arc rays and molten spatter. Replace the glass cover plate when cracked or covered with spatter etc.

- Do not wear clothing spotted with oil or grease as a spark may set them on fire.
- Hot metal, electrode stubs and workpieces, should never be handled without gloves.
- First-aid equipment and a qualified first-aid person should always be available when welding, unless medical facilities are in the immediate vicinity, to treat flash burns of the eyes and skin burns.
- Ear plugs should be worn when working in the overhead position or in confined spaces. A hard hat should be worn when others are working overhead.
- Flammable hair sprays and gels should not be used by those persons intending to weld.

1.2.3 Fumes



Welding operations produce harmful fumes and metal dusts which may be hazardous to your health, therefore:

- Work in well-ventilated areas.
 - Keep your head out of the fumes.
 - In closed areas, use a fume exhaust system, preferably placed under the welding area if possible.
 - If ventilation is inadequate, use an approved respirator set.
 - Clean the metal to be welded of any solvents or halogen degreasers which give rise to toxic gases. During some welding operations chlorine solvents may be decomposed by arc radiation thus creating phosgene gas.
 - Do not weld coated metals or those containing lead, graphite, cadmium, zinc, chrome, quicksilver, or mercury unless you have an approved respirator set.
 - The electric arc creates ozone. Long exposures to high ozone concentrations may cause headaches; nasal, throat and eye irritation; as well as congestion and chest pains.
- WARNING: NEVER USE OXYGEN FOR VENTILATION.**
- Gas leaks in confined spaces should be avoided. Leaked gas in large quantities can dangerously alter oxygen levels in the air surrounding the weld sight. Do not place gas cylinders in confined spaces.
 - **DO NOT WELD** where solvent vapors can be drawn into the welding shield atmosphere or where arc rays can come into contact with even minute quantities of trichloroethylene or perchloroethylene.

1.2.4 Explosions



- Do not weld above or near containers under pressure.
- Do not weld in environments containing explosive dusts, gases or vapours.

When this machine is used for MIG welding, one of the following gases or gas mixtures must be used to shield the arc: Carbon Dioxide, Argon, or Argon mixed with Oxygen. When using a shielding gas pay careful attention to the following:

A) GAS CYLINDERS

- **NEVER DEFACE** or alter the name, number, or other markings on a cylinder. It is illegal and dangerous!
- Do not use cylinders whose contents are not clearly identified.
- Do not directly connect cylinder to the unit without using a pressure regulator.

- Handle and use pressure cylinders with care and in conformity with existing safety standards.
- Do not use leaking or damaged cylinders.
- Do not use cylinders which are not well secured.
- Do not transport or move cylinders without the protection of the installed valve and protective valve cap.
- Do not lift cylinders off the ground by: their valves or caps, by chains, by slings, or by magnets.
- Never try to mix gases in a cylinder.
- Never refill a cylinder!
- Never lubricate the cylinder valve with oil or grease.
- Never allow an electrode to touch a cylinder!
- Do not expose cylinders to excessive heat, sparks, molten slag or flames.
- Do not tamper with the cylinder valve.
- Do not try to loosen tight valves by means of a hammer, a wrench, or any other object.

B) PRESSURE REGULATORS

- Keep pressure regulators in good condition. Damaged regulators may cause damages or accidents. They should be repaired by skilled personnel only.
- Do not use regulators for gases other than those for which they were manufactured.
- Never use a leaking or damaged regulator.
- Never lubricate regulators with oil or grease.

C) HOSES

- Replace hoses which appear to be damaged.
- Keep hoses unwound in order to prevent kinks.
- Keep the excess hose neatly wound and out of the working area in order to avoid damage.
- Cylinder fittings should never be modified or exchanged.

1.2.5 Radiation



Ultra-violet radiation emitted by arc rays may damage your eyes and burn you skin. Therefore:

- Wear proper clothing and helmet.
- Use a mask or helmet equipped with lens shades that have a minimum DIN rating of 10
- Warn people in the area surrounding the welding sight that you are going to be welding.

Remember: the arc may dazzle or damage the eyes. It is considered dangerous up to a distance of 15 meters (50 feet). Never look at an arc with the naked eye.

- Prepare the welding area so as to reduce the reflection and transmission of ultra-violet radiation: paint walls and exposed surfaces in black to reduce reflection, install shielding systems or curtains to reduce the transmission of ultra-violet rays.
- Replace protective lenses whenever damaged or broken.

1.2.6 Electric shock



Electric shocks are hazardous and potentially fatal!!!

- Do not touch live electrical parts.
- Insulate yourself from the workpiece and the ground by wearing insulated gloves and clothing.
- Keep garments (gloves, shoes, hats, clothing) and body dry.
- Do not work in humid or wet areas.
- If you are welding near a body of water take precautions to ensure that the machine cannot fall into the water.

- Avoid touching or holding the workpiece by hand.
- Should you work in a dangerous area or close to one, use all possible precautions.
- Stop welding immediately if you should feel even the slightest sensation of electric shock. Do not use the machine until the problem is identified and corrected.
- Often inspect the mains input cable.
- Disconnect the power input cable from the mains supply before replacing cables or before removing the unit covers.
- Do not use the unit without protection covers.
- Always replace any damaged parts with GENUINE SPARE PARTS.
- Never disconnect any of the unit's safety devices.
- Make sure that the mains power supply line is equipped with a good electrical ground.
- Servicing of the machine must be done by qualified personnel who are aware of the risks involved with the high voltage levels necessary to make the machine operate.

1.2.7 Pacemaker

Magnetic fields created by the high currents in the weld circuit can affect pacemaker operation. Persons wearing electronic life support equipment (pacemakers) should consult their doctor before going near any arc welding, gouging, cutting, or spot welding equipment in operation.

1.2.8 Noise



These power source alone do not produce noise levels exceeding 80 dB. The welding procedure, however, may produce noise levels in excess of 80 dB. In which case the machine operator must take the necessary safety precautions as prescribed by the national safety regulation.

2 GENERAL TECHNICAL DESCRIPTIONS

2.1 SPECIFICATIONS

This manual has been prepared with the intent of instructing the operator on how to install, operate, and properly maintain this electric arc welding machine.

This machine is a constant voltage power source for MIG/MAG and OPEN-ARC welding.

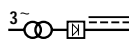
Upon receiving and unpacking the machine, make a careful inspection to ensure that there are no damaged parts. Should there be a claim for losses or damages it must be made by the purchaser directly to the shipper who handled the goods.

When requesting information about this welding machine please state the machine's part number and serial number to ensure receiving accurate information relating to your machine.

2.2 DESCRIPTION OF TECHNICAL SPECIFICATIONS

EC 974.1... This machine is manufactured according to the EN 60947.1 IEC 974 international standard.

Nº. Machine Serial Number which must appear on requests or inquiries concerning the machine.



Single-phase transformer-rectifier.



Flat characteristic.

		N°:		CE			
EN 60 974.1 IEC 974.1							
3~ 		- A / - V - - A / - V					
 MIG - MAG		U ₀ - V PEAK		X(40°C)	40%	60%	100%
				I ₂	A	A	A
				U ₂	V	V	V
3~ 50/60Hz		U ₁ - V U ₁ - V		I ₁ I ₁	A A	A A	A A
PROTEZIONE TERMICA THERMAL PROTECTION PROTECTION THERMIQUE THERMISCH GESCHUTZT PROTECCION TERMICA				VENTILAZIONE FORZATA FORCED VENTILATION VENTILE KUHLART F VENTILACION			
CLASSE DI ISOLAMENTO CLASS OF INSULATION CLASSE DES ISOLANTS ISOLIERSTOFFKLASSE CLASE DE AISLAMIENTO				IP 21		S	
H				MADE IN ITALY			

MIG/MAG.. Continuous wire welding

U₀..... Secondary no-load voltage

X..... Duty-Cycle Percentage

The duty-cycle is the number of minutes the machine can operate (arc on) within a ten minute period without overheating. The duty cycle varies according to the output current.

I₂..... Output welding current

U₂..... Secondary voltage with welding current I₂

U₁..... Nominal supply voltage

3~50/60Hz Three-phase input supply at 50 or 60 Hz

I₁..... Input Amps absorbed corresponding to different output levels (I₂).

IP21..... Protection class of the machine's case

The 1 in the singles digit place means that this unit is not fit to work outdoors in the rain.

S..... Fit to work in hazardous areas.

NOTE: This machine has also been designed to work in class 3 pollution areas (see IEC 664)

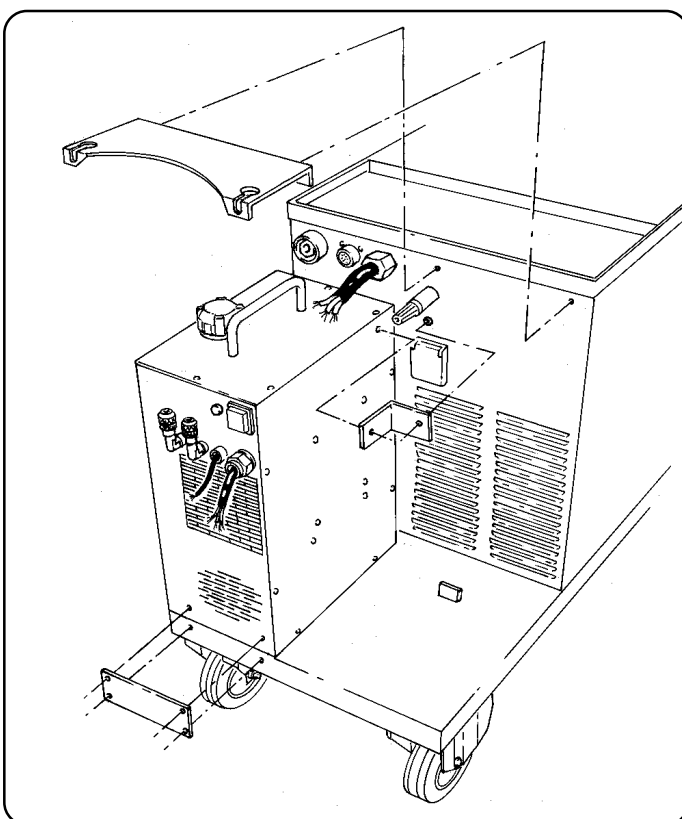
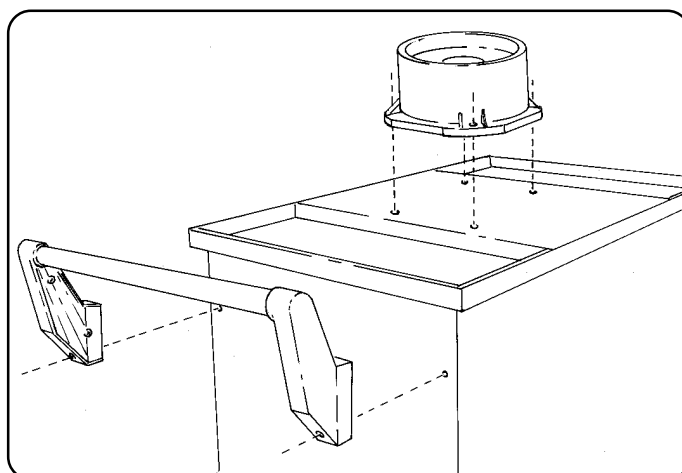
3 INSTALLATION

3.1 SETUP

Place the machine in a ventilated area.

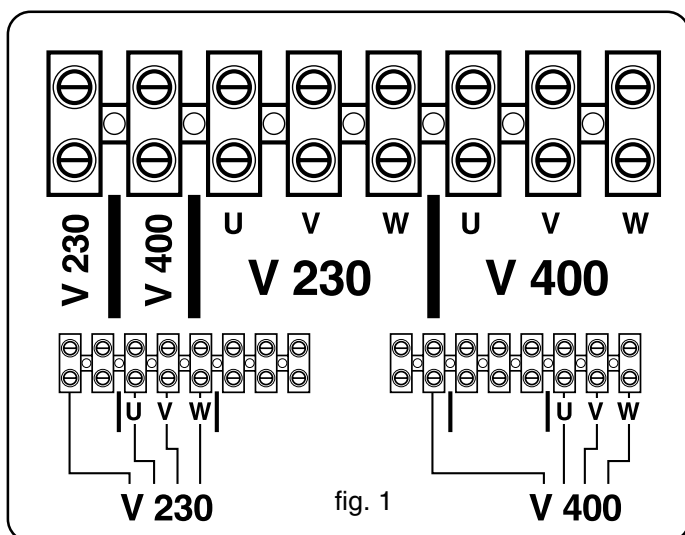
Dust, dirt, or any other foreign material that might enter the machine may restrict the ventilation which could affect the machine's performance.

Fasten the rotating support to the machine top and fix the handle, the wheels, the bottle support and, if any, the cooling unit.



3.2 INPUT POWER CONNECTIONS

- All sections concerning the installation of this machine must be read carefully.
- This machine must be installed by skilled personnel.
- Make sure that the input power plug has been disconnected before inspecting, maintaining, or servicing.
- Connect the yellow-green wire to a good electrical ground.
- **Do not use water pipes as earth conductor.**
- **After a final inspection, the machine should be connected to the input supply voltage marked on the input power cord.**
- **If you wish to change the input supply voltage, remove the right side panel (15), locate the voltage-changing terminal board and arrange the connections as shown in figure 1.**
- After having changed the supply voltage, re-place the upper cover.
- This machine must never be used without the top and side covers. This is both for obvious safety reasons and to avoid



interference with the machine's internal cooling system. The warranty is to be considered null and void if this machine is used without the protection of its top and side covers.



- Mount a plug on the power supply cable that corresponds to the input power drawn by the machine.

3.3 OUTPUT CONNECTIONS

3.3.1 Wire feeder connection

This power source is compatible with the wire feeders TFA2 and TFA4. To connect the power source to the wire feeder units use the extension art. 1186 (5 mt) or 1186.20 (10 mt). Performances and operating features of the wire feeder are described in the operating manuals supplied with the wire feeder itself.

3.3.2 Connecting the work return lead clamp.

- Some versions have one impedance socket only.
- Connect the male end of the work return lead to one of the impedance taps on the front panel of the machine. The impedance tap designated by the  provides the maximum amount of impedance which will produce nicely filleted weld beads. This tap is recommended when welding aluminium, stainless steel, and carbon steels of binary or ternary composition. The impedance tap designated by the  provides the least amount of impedance and is recommended when using carbon dioxide as a shielding gas to weld carbon steels, in the upwards vertical position, of binary or ternary composition.
- It is generally advisable to use low impedance values for small diameter wires and high values for big diameter wires.
- After having selected the proper impedance tap, attach the work return clamp to the work to be welded.
- Make sure that the ground clamp is tightly fastened to the work return cable and periodically check that this connection remains well tightened. A loose connection can cause weld current drops or overheating of the work return lead and clamp which, in turn, creates the risk of burns from accidental contact with the work return lead.
- The weld circuit must not be placed deliberately in direct or indirect contact with the ground conductor if it is not in the work to be welded.
- If the work to be welded is attached deliberately to the ground by a protection lead, then the connection must be the most direct possible and it must be done using a lead that has a cross section that is at least equal to the cross section of the work return lead being used for the weld circuit. The

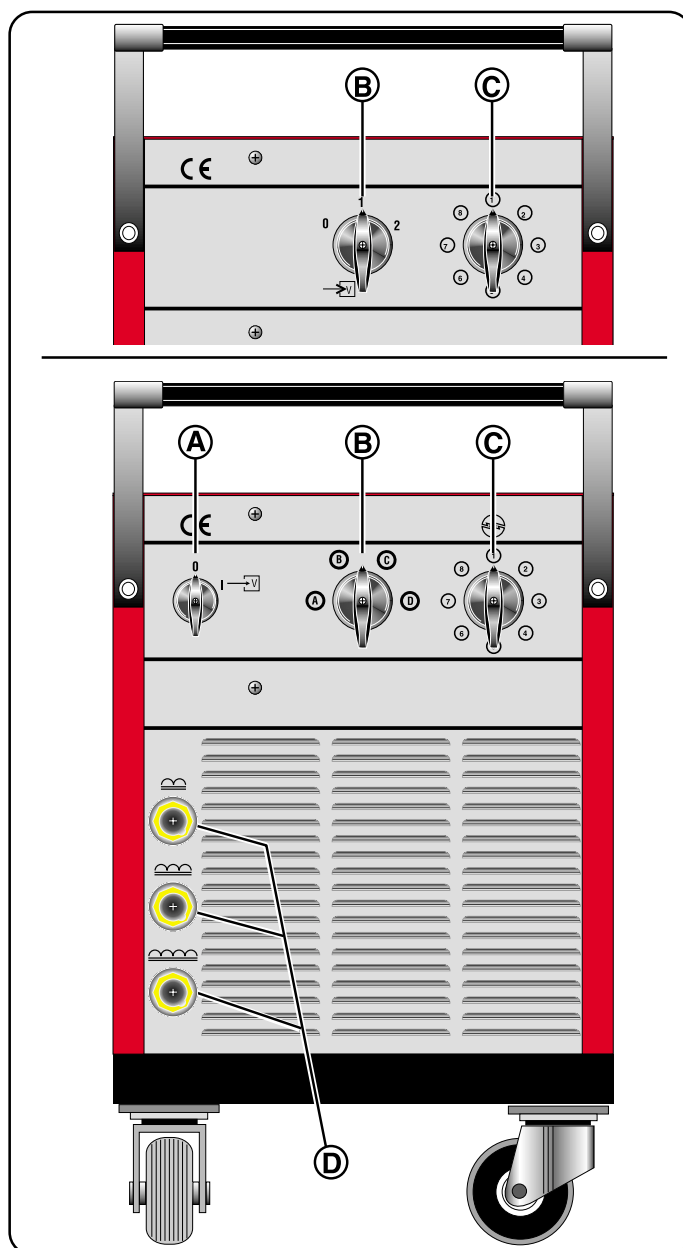
protection lead must also be attached to the work at the same spot as the work return lead. To do so, a second ground clamp, fitted to the protection lead, must be attached next to the ground clamp of the work return lead.

3.3.3 Connecting the gas hose.

- Keep the cylinders in an upright position by chaining them to their support.
- Keep the cylinders in a place where they cannot be damaged.
- Do not lift the machine with the cylinder on its support.
- Keep the cylinder away from the welding area and uninsulated electric circuits.
- Cylinders containing inert gas have to be equipped with a pressure reducer and a flowmeter.
- After having positioned the cylinder, connect the gas hose that comes out from the rear of machine to the pressure reducer output.
- Regulate the gas flow to 8÷10 l/min.

4 DESCRIPTION OF CONTROLS

4.1 CONTROLS ON GENERATOR FRONT PANEL



A- On/Off switch

This switch turns the machine on or off.

B- Switch

This switch adjusts the weld voltage range and, in some versions, turns the machine on and off.

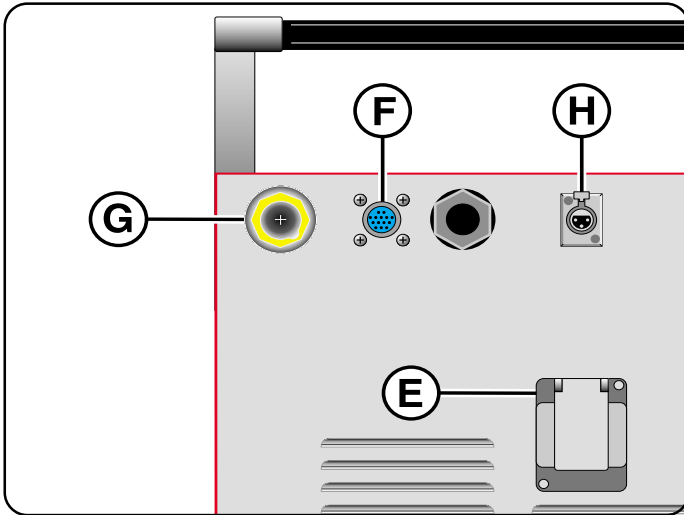
C- Rotary weld voltage switch

This switch allows the fine tuning of the welding voltage selected with switch B. (Step adjustment)

D - Impedance Taps

Connect the male end of the work return lead to one of the three impedance taps.

4.2 CONTROLS ON GENERATOR REAR PANEL



E - 230V power supply socket.

440 W max. power. For cooling unit only. (**Warning: Do not connect other equipment to this socket.**)

F - 6-pin socket connector.

For the 6-pin plug connector on extension lead.

G - Socket.

For the extension lead power supply connector ('+' pole).

H - Socket.

For connection to the safety device on the cooling unit.

N.B. If no cooling unit is used with the machine, plug the connector supplied with the machine into the socket H.

from the torch.

WARNING: Keep your face away from the terminal nozzle while the wire comes out.

- Screw the current nozzle again, making sure that the hole diameter be the same as that the wire used.

- Insert the welding conic gas nozzle by rotating it clockwise.

- Open the gas cylinder and adjust flowmeter at 8÷10 l/min.

WARNING: Check that the gas used is compatible with the material to be welded.

5.3 WELDING CARBON STEELS.

To weld carbon steels the following things are necessary:

1) The use of a binary shielding gas which is most commonly Argon and Carbon dioxide, in a ratio of 75÷80 % Argon and 25÷20% Carbon dioxide. Some applications, however, may require a mix of three gases: Argon, Carbon dioxide (CO₂), and dioxide (O₂). These gas mixtures generate heat during welding and as a result the weld bead will be well filleted and neat in appearance. The penetration, however, will not be deep.

The use of Carbon dioxide as the shield gas results in a narrow weld bead with deep penetration but the ionization of the gas will have an influence on arc stability.

2) The use of a filler wire of the same quality as the steel to be welded. It is recommended that high quality wires be used and that welding with rusted wires be avoided because they can give rise to defects in the weld bead. Generally, the current range within which a wire can be used is calculated in the following manner:
Ø of wire x 100 = minimum number of Amperes.
Ø of wire x 200 = maximum number of Amperes.

Practical example: 1.2 Ø wire = 120 Amps minimum and 240 Amps maximum. These amperages are based on the use of an Argon/CO₂ mixture as the shield gas and welding in the Short Arc transfer mode.

3) Avoid welding on rusted work pieces or work having spots of oil and grease present on the surface.

4) The use of a welding torch suitable to the welding currents that are going to be used.

5) Periodically check that the two handles making up the ground clamp are not damaged and that the welding cables (torch cable and the work return lead) do not have any cuts or burn marks that would reduce their efficiency.

5 WELDING

5.1 INSTALLATION AND STARTER

- Machine installation must be done by a competent staff. All connections must correspond to the rules in force (CEI 20-10 HD 427) and must respect laws concerning accidents.
- Check that the wire diameter corresponds to that indicated on the roll and mount the wire coil.
- Connect the pipe coming out of the extension with the cylinder flowmeter.
- Position the welding machine so as to allow free air circulation inside it and avoid that metal or any other.

5.2 THE MACHINE IS READY TO WELD

- Connect the ground terminal to the part to be welded.
- Turn the machine on.
- Extract the conic gas nozzle by rotating it clockwise.
- Unscrew the current nozzle.
- Press the torch trigger to feed the wire until it comes out

5.4 WELDING STAINLESS STEEL

Welding stainless steels in the 300 series (the austenitic series) must be done using a shield gas mixture of predominantly Argon with a small percentage of O₂ added to stabilize the arc. The recommended mixture is AR/O₂ in the ratio of 98/2. Do not use CO₂ or AR/CO₂ mixtures as the shield gas.

Do not touch the welding wire with your bare hands.

The filler metal (the wire) must be of a higher quality than the work to be welded and the weld area must be clean.

5.5 WELDING ALUMINIUM

The following is required for aluminium welding:

1) 100% Argon as welding protection gas.

2) A torch wire of composition suitable for the basic material to be welded.

For ALUMAN welding wire 3.5% silicon.

For ANTICORODAL welding wire 3.5% silicon.

For PERALUMAN welding wire 5% magnesium.

For ERGAL welding wire 5% magnesium.

3) A torch prepared for aluminium welding.

If you only have a torch for steel wires, the same shall be modified in the following way:

- Make sure that length of torch cable does not exceed 118 inches (it is advisable not to use longer torches).
- Remove the brass sheath-holding nut, the gas and the current nozzles, then slip the sheath off.
- Insert the teflon sheath for aluminium and ensure it protrudes from both ends.
- Screw the current nozzle so that the sheath adheres to it.
- Insert the sheath holding nipple, the O-Ring in the free end of the sheath and secure with the nut without tightening too much.
- Slip the brass tube on the sheath and insert both into the adapter (after removing the iron tube which was fitted inside the adapter).
- Cut the sheath diagonally so that it stays as close as possible to the wire slide roller.

4) Use drive rolls that are suitable for aluminium wire. The drive rolls, when being installed, must be tightened as tight as possible.

5) Use contact tips that are suitable for aluminium wire and make sure that the diameter of the contact tip hole corresponds to the wire diameter that is going to be used.

6) Use abrasive grinders and tool brushes specifically designed for aluminium. Never use these tools on other materials.

REMEMBER that cleanliness equals quality.

The wire spools must be stored in plastic bags with a dehumidifier.

6 WELDING DEFECTS

1- DEFECT- **Porosity** (in, or on the surface of the weld bead)

- CAUSES
- Bad wire (rust on the surface).
 - Insufficient gas shielding due to:
 - Inadequate gas flow due to a block in the gas line.
 - Defective flowmeter.
 - Gas regulator covered with frost because a gas heater was not used to heat the CO₂ shielding gas.
 - Failure of gas valve solenoid.
 - Gas nozzle plugged up with spatter.
 - Gas flow holes plugged up.
 - Air drafts in the welding area.

2- DEFECT- **Shrinkage Cracks**

- CAUSES
- Welding wire or work to be welded dirty or rusty.
 - Weld bead too small.
 - Weld bead too concave.
 - Too much weld bead penetration.

3- DEFECT- **Lateral cracking**

- CAUSES
- Welding speed too fast.
 - Low current and high arc voltages.

4- DEFECT **Too much Spatter**

- CAUSES
- Voltage too high
 - Insufficient impedance
 - No gas heater used for CO₂ shielding gas.

7 MACHINE MAINTENANCE

Gas nozzle . Periodically clean the nozzle of all weld spatter that may have accumulated during welding operations. If the nozzle should become distorted or oval in shape then it must be replaced.

Contact tip . A good contact between the contact tip and the wire ensures a stable arc and optimal current output. Therefore, following steps must be followed:

- A) The contact tip hole must be kept free of dirt or oxidation.
- B) After lengthy welds, spatter can easily accumulate on the contact tip and prevent the wire from being fed. The contact tip must be cleaned regularly and if necessary it must be replaced.
- C) The contact tip must always be screwed tightly on to the body of the torch. The thermal cycles which the torch undergoes during operation may loosen the contact tip which, in turn, may cause the torch body and nozzle to overheat or cause unsteady wire feed.

The Wire Liner is an important part that must often be checked since, during normal operations, the wire can deposit copper dust or tiny metal shavings in the lining. Periodically clean the liner and the gas line with a jet of dry, compressed air. Wire liners are exposed to continual wear and therefore they must be replaced after a certain period of time.

Wire feed motor. Periodically clean the wire feed assembly and the drive rolls from any rust or metal shavings due to the feeding of the wire. A periodic check of all the components of the wire feed assembly, spool holder, drive rolls, wire liner and the contact tip is recommended.

8 TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Limited electric output	A phase is missing	Check the phase of the feed line and/or the remove control switch contacts
	A line fuse is burnt	Replace it
	Wrong connection on the voltage changer terminal board	Check the terminal board connections by following the plate scheme
	The rectifier diode/s is/are burnt	Replace the rectifier
	Loosened torch or ground connections	Tighten all connections
	Welding regulation commutator has an uncertain contact	Replace the commutator
Welding with a lot of metal spatter	transformer wire interrupted on the commutator	Unscrew the commutator contact, remove the wire insulation and put it under the contact
	Wrong adjustment of the welding parameters	Select the correct parameters through the welding-voltage switch and the wire-speed adjustment potentiometer
	Wire advancing improperly	Uncorrect sheath diam.
Wire not advancing or advancing improperly	Insufficient grounding	Check grounding connections
	Wire roller with too wide groove	Replace roller
	Obstructed or clogged liner	Extract it and clean
	Loose wire pressing roller	Tighten it
	Coil reel friction too tight	Loosen and adjust it
The wire jams or entangles between the drive rolls and the torch infeed wire guide	Current nozzle clogged	Replace it
	Wrong current nozzle diameter	Replace it
	Wrong roller groove alignment	Align it
	Obstructed or clogged sheath	Remove and clean

Note: All repair work must be done by qualified personnel.

Disconnect the power input cable from the mains supply before replacing cables or before removing the unit covers.

The machine is equipped with a thermostat that shuts the machine down when the power source overheats. After the thermostat intervenes, let the power source cool down for several minutes before resuming welding operations.

The troubleshooting table lists troubles, causes and remedies for those troubles that occur most commonly.

9 WELDING MACHINE SERVICING

Experience has shown that many fatal accidents originated from servicing improperly executed. For this reason, a careful and thorough inspection on a serviced welding machine is just as important as one carried out on a new welding machine.

Furthermore, in this way producers can be protected from being held responsible for defects stemming from repairs not carried out by the manufacturer.

9.1 Prescriptions to follow for servicing

- After rewinding the transformer or the inductance, the welding machine must pass the applied-voltage test in accordance with indications in table 2 of 6.1.3 of the EN 60974.1 standard (CEI 26.13).

Conformity must be checked as specified in 6.1.3.

- If no rewinding is done, a welding machine which has been cleaned and/or reconditioned must pass an applied-voltage test with voltage values equal to 50% of the values given in table 2 of 6.1.3. Conformity must be checked as specified in 6.1.3.

- After rewinding and/or the replacement the no-load voltage shall not exceed the values given in 10.1 of EN 60974.1.

- If the servicing is not done by the manufacturers, the repaired welding machines which underwent replacements or modifications of any component, shall be marked in a way such that the identity of the person having serviced it is clear.

- After making repairs, take care to re-order the cables so that there is sure to be insulation between the primary and secondary sides of the machine. Make sure that the wires cannot come into contact with moving parts or parts that heat during operation. Replace all clamps in their original positions on the machine, to prevent a connection between the primary and secondary circuits if a conductor accidentally breaks or disconnects.