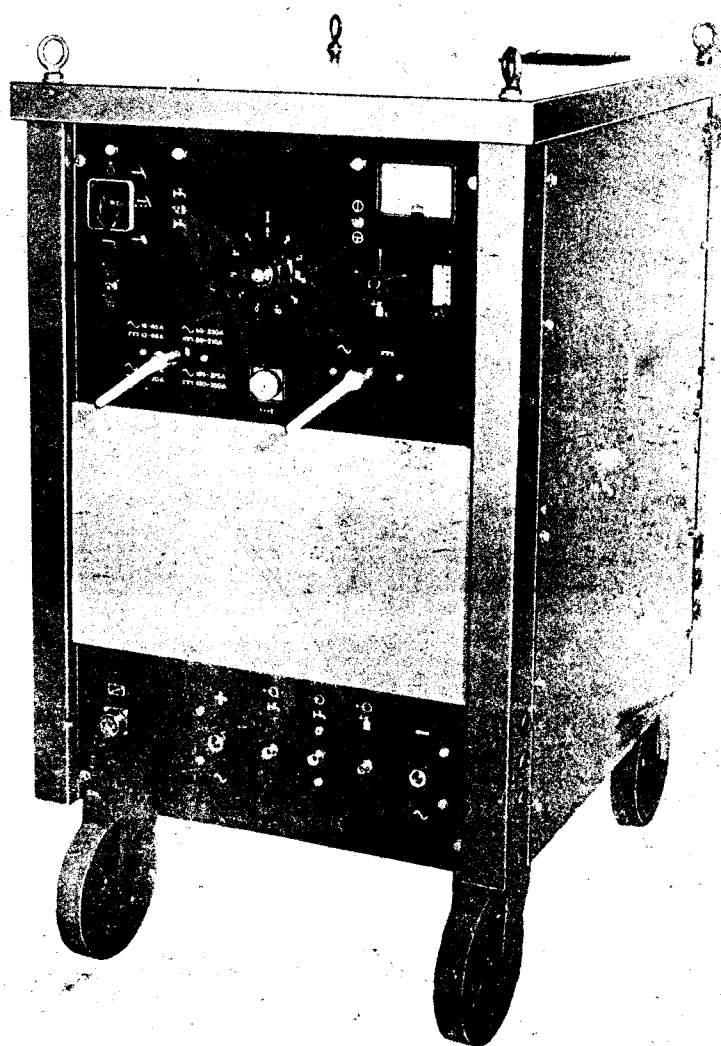




789812
Issue 4

Transtig AC/DC 375

220, 380/440V Version



WARNING

DO NOT SWITCH ON OR OPERATE THE UNIT WITH THE PANELS OR COVERS REMOVED. TO DO SO ENDANGERS THE USER. IT ALSO DIVERTS THE COOLING AIR FLOW, CAUSING COMPONENTS TO OVERHEAT.

IN ACCORDANCE WITH INTERNATIONAL PRACTICE, THE GAS AND WATER CONNECTORS ON THE UNIT FRONT PANEL ARE ELECTRICALLY LIVE. ALTHOUGH THE VOLTAGES APPLIED ARE NOT CONSIDERED DANGEROUS, USERS SHOULD ENSURE THAT THE PROCESS SWITCH IS IN THE OFF POSITION BEFORE TOUCHING THE CONNECTORS.

DESCRIPTION

The Transtig AC/DC 375 is a drooping characteristic power source designed to supply ac and dc current for TIG, TIG spot, plasma and manual arc welding.

The unit controls the welding current, shielding gas, cooling water and welding sequence. It has latching, soft start and post-weld gas delay circuits, a high frequency unit and a mains phase sequence indicator.

Components are cooled by a fan which draws air through a vent in the rear panel and expels it through the bottom mesh. Protection devices are included in the circuitry to safeguard against fan failure and overheating of the welding rectifiers.

Two versions of the unit are available; one designed for a mains voltage range of 380 to 440V and the other for a range of 220, 380/440V.

SPECIFICATION

Input

AC/DC 375	Pt.No.1198009	Pt.No.1198061
Voltage Range	380 to 440V	220 & 380 to 440V
Nominal Voltage		
Tappings:	380 & 420V	220, 380 & 420V
Phase:	3 (unbalanced load)	
Frequency:	50 Hz	

Current:

a.c. Mode (Manual Arc & TIG with d.c. suppressor)

	36%	60%	100%
At 220V	140A	113A	86A
At 380V	81A	65A	50A
At 420V	73A	59A	45A

d.c. Mode (Manual Arc and TIG)

	40%	60%	100%
At 220V	140A	113A	86A
At 380V	81A	65A	50A
At 420V	73A	59A	45A

a.c. Mode (TIG without d.c. suppressor)

	36%	60%	100%
At 220V	200A	172A	143A
At 380V	115A	100A	83A
At 420V	105A	90A	75A

Maximum Input kVA

Without d.c. suppressor	44kVA
With d.c. suppressor:	31kVA

Welding Outputs (at nominal input voltages)

Open Circuit Voltage	
a.c.	80V
d.c.	75V

Output Ranges

a.c. Manual Arc:	25A at 21V to 375A at 35V
a.c. TIG	10A at 10V to 375A at 25V
d.c. Manual Arc:	25A at 21V to 300A at 34V
d.c. TIG	10A at 10V to 350A at 24V

Maximum Welding Current

a.c. Welding:	
100% Duty Cycle	232A
60% Duty Cycle	300A
36% Duty Cycle	375A

d.c. Welding:

100% Duty Cycle	232A
60% Duty Cycle	300A
40% Duty Cycle	350A

Duty Cycle Period: 10 minutes

OTHER RELEVANT DATA

Rating Specification	BS 638:1966
Insulation Class:	Class E
Maximum Ambient Temperature	40°C (See Note 1)
Post-Weld Gas Delay	5 to 30 seconds (approx.)
Dimensions	
Height:	1285mm (50.5in.)
Width:	710mm (28 in.)
Length:	955mm (37.5 in.)
Weight:	460kg (1010 lb.)

Note 1: For an ambient temperature of 50°C multiply either the current ratings by 0.92 or the duty cycles by 0.84.

OPTIONAL EXTRAS

Ordering information for these items is given in the Transtig AC/DC 375 Parts List, No. 2105.

Spot Weld Timer Kit

This kit is required for spot or timed welding. Prior to installation, the range of the timer can be set to 0 to 3 seconds, 0 to 6 seconds, 0 to 60 seconds, 0 to 6 minutes, 0 to 60 minutes or 0 to 6 hours. The user may then vary the spot weld time within the range selected.

DC Suppressor Kit

The purpose of the suppressor is to improve weld quality when aluminium welding by blocking the d.c. component which would otherwise be present in the welding current. Customers are strongly advised to use the suppressor when welding with currents exceeding 232A.

Power Factor Correction Capacitor

By connecting this capacitor across the primary winding of the main transformer, the power factor of the unit will be improved.

Water Recirculating Unit

This unit supplies cooling water to water-cooled TIG torches in situations where tap-water is not available or where conservation is important. The unit consists of a water pump, on-off valve and radiator which are mounted on a panel for ease of attachment to the Transtig AC/DC 375.

Water Flow Switches

These switches protect water-cooled TIG torches by switching off the welding current if the water flow rate drops below the prescribed minimum for the torch.

Foot Switch

This is a foot-operated switch designed to enable welding services to be switched on and off from a remote position.

Foot Control Unit

This unit is similar to a foot switch but also enables the user to control the welding current from a remote position.

CONTROLS AND INDICATORS

(See Fig. 2)

Process Switch

Enables TIG, TIG spot, plasma or manual arc welding to be selected. When in the off position, the switch disconnects the mains supply from the unit circuitry.

Mains Lamp

When lit, indicates that the mains supply and process switch are switched on.

Water Switch

Providing this switch is on, operation of the remote control switch opens the water valve, thus allowing cooling water to flow to the welding torch. The switch is also used for switching on the water recirculating unit (when fitted).

Water Warning Lamp

When lit, indicates that the water switch is NOT switched on.

Latching Switch

When set to the latching position, this switch makes the latching circuit operative. Latching may only be used when the process switch is in the TIG welding position and a torch switch is used; at all other times the switch must be kept in the non-latching position.

Latching Lamp

When lit, warns the user that the welding torch is live. This is important when using the latching facility.

AC/DC Selector Switch

This switch is used to select either ac or dc welding current.

Current Range Switch

A four-position switch which enables the ac and dc welding current ranges to be selected.

Current Control

This control varies the welding current within the range determined by the setting of the current range switch. The calibrations marked on the control are for reference purposes only.

Ammeter

Indicates the ac or dc welding current.

Soft Start Switch

With this switch in the normal start position, the selected welding current will flow as soon as an arc is struck. With the switch in the soft start position, the current will build up slowly to the selected value, so reducing the possibility of cratering at the start of a weld. The soft start circuit should only be used for TIG or plasma welding.

Post-Weld Gas Delay Time Control

Varies the post-weld gas delay time between 5 and 30 seconds.

Gas Control and Flowmeter

Enables the gas flow to be adjusted and indicates the gas flow rate.

Spot Weld Timer (Optional Extra)

Sets the spot weld time. The timer may also be adjusted to give a variety of ranges suitable for timed welds. Details of range adjustments are given in 'Installation of Optional Extras'.

Remote Control Switch

Throughout this Manual the term 'Remote Control Switch' is used to denote a foot control unit, foot switch or torch switch (see 'Optional Extras'). The switch enables welding services to be switched on and off from a position remote from the unit.

Phase Sequence Indicator

The phase sequence indicator lamp is visible through a hole drilled in the input terminal cover at the rear of the unit. When lit, the lamp indicates that the mains supply has been connected to give the correct phase sequence.

SAFETY

The user should comply with all safety recommendations contained in Safety Leaflet D/GN/AA/7.1/1, a copy of which is supplied with this Instruction Manual. Additional copies may be obtained on request.

INSTALLATION

Note: For plasma welding, it is necessary to use a Sabre-arc PW 200 Plasma Welding Console and the recommended de-ionized water cooling unit. Except where stated otherwise in the following instructions, the console should be installed and operated as detailed in the console Instruction Manual (Part No. 789790). It is important that the plasma welding torch, remote control switch, gas supplies and de-ionized water cooling unit are connected to the plasma welding console and NOT to the Transtig AC/DC 375.

1. The unit must not be switched on after prolonged storage until an insulation test has been carried out as detailed in the maintenance instructions.
2. Install any optional extras to be used as detailed in 'Installation of Optional Extras'.
3. Place the unit near to the welding position ensuring that there is adequate clearance for maintenance and ventilation.
4. Remove the input terminal cover from the rear of the unit.
5. Connect the voltage selector link (Fig. 3) between the terminal marked SEL and the 220V, 380V or 420V terminal on the voltage selection block, depending on the supply voltage.
Connect the auxiliary transformer input link (Fig. 3) between terminal 1 and the 220V, 380V or 420V terminal of terminal block TB3 depending on the supply voltage.
Note: The 220V terminals are not fitted to units designed for a 380 to 440V supply.
6. Ensure that the changeover link situated on terminal block TB7 (see Fig. 5) is connected in the tap-water position. (If a water recirculating unit is to be fitted, instructions concerning the link are given later in this Manual).
7. Connect the unit to the mains supply as described below, using the recommended size of 4-core cable (see table 1).
 - a. Pass one end of the cable through the clamp (see Fig. 3).
 - b. Connect the earth lead to the earth terminal of terminal block TB1 (see Fig. 3) and connect the three remaining leads to terminals U, V and W.
 - c. Ensure that there is no strain on the cable, then tighten the clamp nuts.
 - d. Connect the free end of the cable to the mains supply via a fused-switch rated to suit the maximum input currents detailed in the Specification. The cable earth lead must be connected to the supply earth terminal and the three remaining leads to the supply phase terminals. It is important to ensure that the leads are connected to give the correct phase sequence.

TABLE 1 — Input Cables

Mains Voltage	With dc Suppressor	Without dc Suppressor
220V 380-440V	276/0.4 80/0.4	Not Recommended 196/0.4

8. Refit the input terminal cover.
9. Switch on the mains supply and ensure that the phase sequence indicator lamp lights (Fig. 3).

Note: If the phase sequence indicator lamp does not light, switch off the mains supply, remove the input terminal cover and change over any two of the three phase input leads. Repeat steps 8 and 9.

10. Switch off the mains supply at the wall switch.
11. Attach the cylinder retaining bracket to the unit with the eye nut and bolt supplied and secure the shielding gas cylinder in position by means of the strap.
12. Fit the gas regulator to the cylinder.

Reference to Table 2 will aid the identification of the various connectors referred to below.

13. Connect the gas supply hose between the gas inlet connector on the rear panel (see Fig. 3) and the gas regulator.
14. Except when a water recirculating unit is fitted, remove the two blanking caps from the rear panel (see Fig. 3), push the water supply and drain hoses through the holes in the panel and connect them to the water inlet and outlet connectors on the baffle plate (see Fig. 4).
15. When plasma welding, connect the plasma welding console to the unit as follows:-
 - a. Connect leads 5, 6, 7, 8 and 10 of the control cable assembly (see Parts List) to the correspondingly numbered terminals of terminal block TB1 in the plasma welding console.
 - b. Connect the 6-pin plug at the other end of the cable to the remote control socket in the Transtig AC/DC 375 (see Fig. 2).
16. Connect the work cable to the positive socket on the front panel (see Fig. 2) and clamp the other end of the cable to the workpiece.
17. Connect the welding torch hoses to the appropriate connectors on the front panel (see Fig. 2). The direction of water flow through the torch is indicated by the arrows marked on the hose couplings.
18. When manual arc welding, connect the electrode-holder cable to the positive socket and connect the work cable between the negative socket and the workpiece.
19. Connect the remote control switch to the remote control socket on the front panel (see Fig. 2).

Note: On units prior to Serial No. 7A278 a dummy plug (See Parts List) must be inserted in the remote control socket in order to manual arc weld when a remote control switch is not available.

INSTALLATION OF OPTIONAL EXTRAS

WARNING: ENSURE THAT THE UNIT IS DISCONNECTED FROM THE MAINS SUPPLY BEFORE COMMENCING TO INSTALL ANY OPTIONAL EXTRAS.

Spot Weld Timer

To adjust the timer to the required range proceed as follows:-

1. Insert the special tool supplied into the elongated slot in the underside of the timer case and carefully slide the red plastic pinion until it engages with the required gear wheel as indicated by the range marked on the case.
2. Insert the tool into the small slot beneath the range indicated on the timer face and rotate the range indicator so that the time shown corresponds with the range selected.
3. Rotate the frequency selector on the back of the timer to the correct position for the supply frequency.

Fit and connect the timer kit to the unit as follows:-

1. Remove the blanking plate from the unit front panel and insert the timer into the hole thus vacated.
2. Push the locking sleeve over the rear of the timer case.
3. Holding the timer in position, push the locking sleeve against the unit front panel until the teeth on the locking sleeve tabs engage in the notches on the timer case. Tighten the two locking sleeve screws.

4. Connect the timer leads to terminal block TB10 (see Fig. 5). Each lead is numbered and must be connected to the terminal marked with the same number.

Note: The timer should be supplied with terminal a1 linked to terminal a2, terminal b1 linked to terminal b2, and terminal 15 linked to terminal 24.

5. Insert the two relays supplied with the kit into relay bases RLX and RLZ as marked on the electronic chassis (see Fig. 5).

Water Recirculating Unit

1. Disconnect the internal gas hose (see Fig. 4) from the gas inlet connector on the rear panel (see Fig. 3).
2. Remove the rear panel.
3. Fit the water recirculating unit in place of the rear panel.
4. Connect the hose from the water outlet of the recirculator pump to the water inlet connector on the baffle plate (see Fig. 4).
5. Connect the hose from the water valve on the water recirculating unit to the water outlet connector on the baffle plate (see Fig. 4).
6. Refit the internal gas hose to the gas inlet connector on the water recirculating unit panel.
7. Feed the water overflow hose down the back right hand corner of the frame assembly and out of the bottom hole (see Fig. 4). Fit the top end of the hose to the pipe protruding from the splash-tray on top of the water tank.
8. Feed the pump and water valve cables through the grommet on the baffle plate (see Fig. 5).
9. Connect the pump cable leads to terminal block TB4 (see Fig. 5) as follows:-

Lead 1 (brown) to Terminal 1
Lead 2 (blue) to Terminal 2
Lead 3 (green/yellow) to Terminal 3

10. Connect the water valve cable leads to terminal block TB4 (see Fig. 5) as follows:-

Lead 3 (green/yellow) to Terminal 3
Lead 4 (yellow) to Terminal 4
Lead 5 (yellow) to Terminal 5

11. Move the changeover link on terminal block TB7 (see Fig. 5) to the water recirculating unit position (see Table 2).
12. Coil any spare cable and secure with adhesive tape to prevent fouling against other components.
13. Fill the tank with clean water. Add commercial anti-freeze if necessary.
14. Check and, if necessary, top up the water level after circulating water through the torch.

Water Flow Switch

1. Ensure that the water flow switch is the correct one for the welding torch to be used as indicated in the Parts List.
2. Using the attachment plate provided, bolt the switch to the bracket mounted on the baffle plate (see Fig. 5).
3. Connect the switch into the water return line ensuring that the arrow marked on the switch body points in the direction of water flow.
4. Remove the link (cable 275) between terminals 7 and 8 of terminal block TB4 (see Fig. 5).

Note: It is important to remove this link when using a water flow switch otherwise the switch will not protect the welding torch against failure of the water supply. The link must be re-connected when changing to an air-cooled TIG torch, but not when changing to Manual Arc or Plasma welding.

5. Feed the switch cable through the grommet on the baffle plate (see Fig. 5) and connect the cable leads to terminal block TB4 as follows:-

Water Flow Switch		Terminal Block TB4
Green/Yellow lead	to	Terminal 6
Blue lead	to	Terminal 7
Brown lead	to	Terminal 8

6. Coil any spare cable and secure with adhesive tape so that it does not foul against other components.

DC Suppressor

1. Remove the top cover and right side panel from the unit.
2. Attach the two cross-members supplied with the kit to the suppressor assembly using the nuts and bolts provided.
3. Place the suppressor assembly in the top of the unit with the cable terminals on the right hand side and the cross-members resting on the corner pillars of the unit frame (see Fig. 4).
4. Remove the link (see Fig. 4) from the terminal board and connect the suppressor assembly cables to the terminals from which the link has been removed.
5. Align the holes at the ends of the cross-members with the eye-bolt holes at the top of the corner pillars.
6. Refit and secure the side panel and top cover.

Power Factor Correction Capacitor

1. Remove the top cover and right side panel from the unit.
 2. Attach the cross-member supplied with the kit to the capacitor assembly using the nuts and bolts provided.
- Note:* If a dc suppressor kit is fitted to the unit, discard the cross-member supplied with the kit and attach the capacitor assembly to the underside of the dc suppressor bracket (see Fig. 4).
3. Place the capacitor assembly in position on the unit so that the cross-member ends rest on the top of the right side corner pillars of the unit frame.
 4. Feed the capacitor leads through the grommet on the base of the fan assembly (see Fig. 4) and connect them to the two terminals of terminal block TB6 (see Fig. 3). Ensure that the leads do not foul against other components.
 5. Align the holes at the ends of the cross-members with the eye-bolt holes at the top of the corner pillars.
 6. Place the two spacers supplied with the kit over the two eye-bolt holes at the top of the left side corner pillars.
- Note:* This step is not necessary if a dc suppressor is fitted to the unit.
7. Refit the side panel and top cover.

OPERATION

(See Fig. 2 and Table 2)

TIG Welding

1. Switch on the mains supply.
2. Switch on the water switch if a water-cooled welding torch is to be used.
3. Open the gas cylinder valve.
4. Set the latching switch to non-latching.
5. Set the soft start switch to normal or soft start as required.
6. Set the process switch to TIG welding. The mains lamp will light.
7. Adjust the post-weld gas delay time control to give the maximum delay. Press and release the remote control switch and adjust the gas control to give the required gas flow rate as indicated by the gas flowmeter. If an external cooling water supply is used, adjust the water tap to give an adequate water flow as detailed in the welding torch Instruction Manual.

8. Set the ac/dc selector switch to either ac or dc as required.

9. Set the current range switch to the desired range.

10. Adjust the current control to give the approximate welding current required.

11. Re-adjust the post-weld gas delay time control to give the required delay.

12. If a water-cooled torch is to be used, ensure that the water warning lamp is NOT lit.

13. If latching is required, set the latching switch to latching.

TIG Spot Welding

Note: The optional spot weld timer kit is required for TIG spot welding. The latching facility should not be used.

1. Carry out steps 1 to 4 detailed in 'TIG Welding'.
2. Set the soft start switch to normal start.
3. Set the process switch to TIG spot welding. The mains lamp will light.
4. Carry out steps 7 to 12 detailed in 'TIG Welding'.
5. Adjust the spot weld timer to give the required spot weld time.

Plasma Welding

1. Connect the recommended plasma welding console and de-ionized water cooling unit to the Transtig AC/DC 375 as described in 'Installation'.
2. Switch on the mains supply.
3. Set the latching switch to non-latching.
4. Set the soft start switch to normal or soft start as required.
5. Ensure that the water switch is off.
6. Set the ac/dc selector switch to dc.
7. Set the current range switch to the desired range.
8. Adjust the current control to give the approximate welding current required.
9. Set the process switch to plasma welding. The mains and water warning lamps will light.
10. Proceed to weld as detailed in the plasma welding console 'Operating Notes' which are included in the console Instruction Manual.

Manual Arc Welding

1. Switch on the mains supply.
2. Ensure that the water switch is off.
3. Set the latching switch to non-latching.
4. Set the soft start switch to normal start.
5. Set the ac/dc selector switch to either ac or dc as required.
6. Set the current range switch to the desired range.
7. Adjust the current control to give the approximate welding current required.
8. Set the process switch to manual arc welding. The mains and water lamps will light.

CIRCUIT DESCRIPTION

(See Fig. 6)

For this description it is assumed that latching switch S4 is in the non-latching position, soft start switch S5 is in the normal start position, and that no water recirculating unit or water flow switch is fitted. A description of these circuits is given later in this section.

A foot control unit (FCU) is shown connected to remote control socket SK3. If a torch switch or foot switch is connected to the socket, pins C and E will be linked.

TIG Welding	
Action	Result
Mains Supply Switched On 1. LP4 lights, indicating that the mains phase sequence is correct.	Gas and water flows commence
Process Switch S1 Set to TIG 1. LP1 lights, indicating that the mains supply is connected to the internal circuitry. 2. If water switch S3 is set to 'Water Off', LP2 also lights. 3. Fan motor M rotates and centrifugal switch CS closes.	
Remote Control Switch RS Operated 1. The 25V supply from T2 energises RLB and RLC. A. RLB-2 energises gas valve GV and also water valve WV1 if S3 is set to 'Water On'. B. RLB-1 completes a circuit to gas delay board G, causing G/RLA to energise (A description of the gas delay board circuit is given later in this section). i. G/RLA-1 completes a circuit stage to RLK and RLL. ii. G/RLA-2 provides a hold-on circuit for gas valve GV and water valve WV1. C. RLB-3 completes a circuit stage to RLE. D. RLC-3 lights LP3. E. RLC-2 completes a circuit stage to RLK and RLL and energises RLM via soft start switch S5. i. RLM-1 applies the 35V supply from T2 to MR2. The output from MR2 provides the supply for the control winding of magnetic amplifier TD1. This supply, and thus the welding current, can be varied by current control RV1. F. RLC-1 energises RLG. i. RLG-3 completes a circuit stage to RLN. ii. RLG-1 energises main contactor MC1 a. MC1-3 provides a hold-on circuit for gas delay board G. b. MC1-1 and 2 apply the mains supply to T1. The resulting welding output from SK4 and 5 will be ac or dc depending on the position of ac/dc selector switch S6. Note that SK4 is connected to the torch, gas and water unions on the lower front panel of the unit. 2. The open circuit voltage across the welding lines is rectified by MR3 and applied to VSR. A. VSR-1 energises RLD. i. RLD-2 energises RLK. a. RLK-1 provides a hold-on circuit for RLK. b. RLK-2 provides a hold-on circuit to RLN when S6 is in the ac position. ii. RLD-1 energises RLE. a. RLE-2 provides a hold-on circuit to RLN.	

b. RLE-1 energises RLN. RLN-1 provides a hold-on circuit to RLN, while RLN-2 connects the 110V supply from T2 to high frequency unit H.	High frequency supply available
Welding Arc Struck 1. VSR senses the drop in welding output voltage and de-energises. A. VSR-1 breaks the circuit to RLD. i. RLD-1 de-energises RLE. a. If S6 is in the dc position RLE-1 breaks the circuit to RLN. After a short delay imposed by the resistor/capacitor network across its coil, RLN will de-energise and remove the 110V supply to high frequency unit H. ii. RLD-2 energises RLL via RLK-1. a. RLL-1 provides a hold-on circuit for RLL. b. RLL-2 closes but has no effect when S5 is in the normal start position (see 'Soft Start Circuit').	Welding current flows If dc welding, the high frequency supply ceases
Remote Control Switch RS Released 1. RLB and RLC de-energised. The opening of RLB-1 and 2 will have no effect as they are shorted out by MC1-3 and G/RLA-2 respectively. A. RLC-1 de-energises RLG. i. RLG-1 de-energises MC1. MC1-1 and 2 break the mains supply to T1. MC1-3 also opens but gas valve GV and water valve WV1 will remain energised due to the action of gas delay board G. B. RLC-2 de-energises RLL, RLM and RLK. i. If S6 is in the ac position, RLK-2 de-energises RLN. RLN-1 breaks the supply to high frequency unit H. C. RLC-3 extinguishes LP3. D. After a delay determined by the setting of RV2, the gas delay board de-energises gas valve GV and water valve WV1.	Welding supply switched off If ac welding the high frequency supply ceases Gas and water flows cease

TIG Spot Welding

For TIG spot welding, spot weld timer TM (optional extra) must be fitted to the Transtig AC/DC 375

Action	Result
Mains Supply Switched On As for TIG welding	Gas and water flows start
Process Switch S1 Set to TIG Spot Welding As for TIG welding	
Remote Control Switch RS Operated 1. The 25V supply from T2 energises RLB and RLC. A. RLC-3 lights LP3. B. RLC-2 completes a circuit stage to RLK and RLL and energises RLM via soft start switch S5. i. RLM-1 applies the 35V supply from T2 to MR2. The output from MR2 provides the supply for the control winding of magnetic amplifier TD1. This supply and thus the welding current, can be varied by current control RV1. C. RLB-2 energises gas valve GV and also water valve WV1 if S3 is set to 'Water On'.	

D. RLB-1 completes a circuit to gas delay board G, causing G/RLA to energise. (A description of the gas delay board circuit is given later in this section).

- i. G/RLA-1 completes a circuit stage to RLK and RLL.
- ii. G/RLA-2 provides a hold-on circuit for gas valve GV and water valve WV1.

E. RLB-3 energises RLF via RLH-1.

- i. RLF-1 provides a hold-on circuit for RLF.
- ii. RLF-2 energises MC1.
 - a. MC1-3 provides a hold-on circuit for gas delay board G.
 - b. MC1-1 and 2 apply the mains supply to T1. The resulting output from SK4 and SK5 will be ac or dc depending on the position of ac/dc selector switch S6. Note that SK4 is connected to the gas and water unions on the lower front panel of the unit.

The open circuit voltage across the welding lines is rectified by MR3 and applied to VSR.

A. VSR-1 energises RLD.

- i. RLD-3 energises RLX.
 - a. RLX-1 provides a hold-on circuit to RLX.
 - b. RLX-2 prepares a hold-on circuit to RLN.
- ii. RLD-2 energises RLK.
 - a. RLK-1 provides a hold-on circuit for RLK.
 - b. RLK-2 completes the hold-on circuit to RLN when S6 is in the ac position.
- iii. RLD-1 energises RLE.
 - a. RLE-2 provides a hold-on circuit to RLN.
 - b. RLE-1 energises RLN. RLN-1 prepares a hold-on circuit to RLN, while RLN-2 connects the 110V supply to high frequency unit H.

Welding Arc Strikes

VSR senses the drop in welding output voltage and de-energises.

A. VSR-1 breaks the circuit to RLD.

- i. RLD-1 de-energises RLE.
 - a. If S6 is in the dc position, RLE-1 breaks the circuit to RLN. After a short delay imposed by the resistor/capacitor network across its coil, RLN will de-energise and remove the 110V supply to high frequency unit H.
 - b. RLD-2 energises RLL. RLL-1 provides a hold-on circuit for RLL. RLL-2 is ineffective as it is shorted by S5. RLL-3 energises RLH and also connects the 110V supply to drive unit DU of timer TM. RLH-1 opens but RLF remains energised via RLB-3, RLJ-1 and RLF-1.

2. Drive unit DU starts to run and TM-1 closes, energising RLG.

- A. RLG-3 provides a hold-on circuit for RLN.
- B. RLG-1 closes in parallel with RLF-2.
- C. RLG-2 energises RLJ.

Welding current available

High frequency supply available

Welding current flows

If dc welding the high frequency supply ceases

i. RLJ-1 de-energises RLF but MC1 remains energised via RLG-1.

ii. RLJ-2 closes in parallel with RLL-3.

iii. RLJ-3 energises RLZ.

a. RLZ-2 closes in parallel with RLC-2 to keep RLK, RLL and RLM energised in the event of RS being released before the end of the spot weld.

b. RLZ-1 de-energises RLX. RLX-2 opens but, owing to contact RLG-3 RLN remains energised so that, when S6 is in the ac position, the high frequency supply will be maintained.

3. At the end of the spot weld time, TM-2 de-energises RLG.

A. If S6 is in the ac position, RLG-3 de-energises RLN which stops the high frequency supply.

B. RLG-1 de-energises MC1. Welding will cease and, providing RS is released, the circuit will reset in preparation for the next weld.

C. After a delay determined by the setting of RV2, gas delay board G will de-energise gas valve GV and water valve WV1.

If ac welding, the high frequency supply ceases

Welding supply switched off

Gas and water flows cease

Plasma Welding

For plasma welding, the plasma welding console is connected to the unit as described in 'Installation'. The console provides the pilot arc, controls the plasma and shielding gases, and provides the timing and protection circuits. The circuit diagram for the console is required for a full understanding of this section of the circuit.

When set up for plasma welding, latching switch S4 must be in the non-latching position, water switch S3 in the 'Water Off' position and ac/dc selector switch S6 in the d.c. position.

Action	Result
Mains Supply Switched On As for TIG Welding.	
Process Switch S1 Set to Plasma Welding As for TIG Welding.	
Remote Control Switch (Connected to Console) Operated	
1. A contact in the plasma welding console completes the circuit to RLB and RLC via pins B and D of socket SK3.	
A. RLB-1 completes a circuit to gas delay board G, causing G/RLA to energise.	
i. G/RLA-1 completes a circuit stage to RLK and RLL.	
B. RLC-3 lights LP3.	
C. Assuming that soft start switch S5 is in the normal start position, RLC-2 energises RLM.	
i. RLM-1 applies the 35V supply from T2 to MR2. The output from MR2 provides the supply for the control winding of magnetic amplifier TD1. This supply, and thus the welding current, can be varied by current control RV1.	
D. RLC-1 energises RLG.	
i. RLG-1 energises MC1.	
a. MC1 and 2 apply the mains supply to T1.	
2. The open circuit voltage across the welding lines is rectified by MR3 and applied to VSR.	Welding supply available

<p>A. VSR-1 energises RLD.</p> <p>i. RLD-2 energises RLK.</p> <p>a. RLK-1 closes to provide a hold-on circuit for RLK.</p>	
<p>Welding Arc Struck</p> <p>1. VSR senses the drop in output voltage and de-energises.</p> <p>A. VSR-1 breaks the circuit to RLD.</p> <p>i. RLD-2 changes-over to energise RLL via RLK-1.</p> <p>a. RLL-2 closes but has no effect when soft start switch S5 is in the normal start position.</p>	Welding current flows
<p>Remote Control Switch (Connected to Console) Released</p> <p>1. The contact in the console opens and de-energises RLB and RLC, switching off the welding services.</p>	Welding supply switched off

Manual Arc Welding

When set up for manual welding, soft start switch S5 must be in the normal start position.

Action	Result
<p>Mains Supply Switched On As for TIG welding.</p> <p>Process Switch S1 Set to Manual Arc</p> <p>1. RLM energised and also MC1 via RLC-2.</p> <p>A. RLM-1 applies the 35V supply from T2 to MR2. The output from MR2 provides the supply for the control winding of magnetic amplifier TD1. This supply, and thus the welding current, can be varied by current control RV1.</p> <p>B. MC1-1 and 2 apply the mains supply to T1. The resulting output from SK4 and 5 will be ac or dc depending on the position of ac/dc selector switch S6.</p>	Welding current available

Gas Delay Board

This circuit is only used when TIG welding.

When RLB-1 closes, the supply from G/MR1 is fed to the base of G/TR4. Prior to the closure of the contact, G/TR4 and G/TR3 are conducting and G/TR1 and G/TR2 are switched off. As soon as the contacts close, G/C2 and C12 rapidly charge via G/R1 and G/R7. At the same time, G/TR4 is switched off due to the positive going potential applied to its base. This switches off G/TR3 and the cessation of current flow through G/R2 raises the potential applied to the emitter of G/TR2 causing G/TR1 and G/TR2 to conduct and G/RLA to energise.

When RLB-1 and MC1-3 open, G/C2 and C12 commence discharging through G/R9, R6 and post-weld gas time delay control RV2. After a time determined by the setting of RV2, the potential applied to the base of G/TR4 will have fallen sufficiently to switch on G/TR4 and hence G/TR3, causing G/TR1 and G/TR2 to switch off and de-energise G/RLA.

Soft Start Circuit

This circuit is only used when TIG or plasma welding.

When soft start switch S5 is in the soft start position, RLM will not be energised until RLL-2 closes. Therefore, during the delay between arc striking and the closure of RLL-2 no supply will be applied to the control circuit of magnetic amplifier TD1. Under these conditions, the main winding of the magnetic amplifier will act as a high reactance, ensuring a slow build up of welding current at the start of the weld.

Latching Circuit

This circuit is only used when TIG welding.

With latching switch S4 in the latching position, operation of remote control switch RS will energise L/RLY via the contacts of L/RLW. L/RLY-1 will close and energise RLB and RLC, starting the

welding sequence as described in 'TIG Welding'. L/RLY-2 also closes but has no effect at this stage because L/RLW is shorted out by the remote control switch. When the remote control switch is released, the short is removed and L/RLW is placed in series with L/RLY so that both relays are energised. L/RLW-1 and L/RLW-2 change over so that when the remote control switch is again pressed, L/RLY is shorted out and de-energised, breaking the circuit to RLB and RLC. When the remote control switch is again released, L/RLW is de-energised, causing its contacts to change over and the circuit to reset in preparation for the next weld.

Water Flow Switch and Water Recirculating Unit

If a water flow switch WS is fitted, the link between terminals 7 and 8 of terminal block TB4 will be removed. The water flow switch closes when the flow of cooling water is adequate. If the flow rate falls below the prescribed minimum for the torch, the switch will open and break the circuit to MC1.

Where a water recirculating unit is used, link CL must be in the water recirculating unit position. When water switch S3 is set to the 'water on' position, water valves WV1 and WV2 will open. In addition, the 220V supply will be connected to pump motor P and the pump will circulate water through the system.

Protection and Suppression

Circuit protection is provided by centrifugal switch CS which opens and de-energises MC1 if fan motor M fails, and by thermostatic switch TH1 which also de-energises MC1 if a temperature exceeding 105°C is sensed in the vicinity of MR1. C1 to C5 and R1 provide protection against voltage surging.

A high frequency suppressor consisting of R7, R8 and C8, C9 prevents the output from high frequency unit H being fed back to T1.

MAINTENANCE

Daily

If a water recirculating unit is fitted, check the water level in the tank and top up as necessary. The water level should also be checked whenever the welding torch is changed.

Six-Monthly

1. Switch off the supply at the mains.
2. Remove the top cover, side panels and input terminal cover.
3. Using a soft brush and a supply of clean dry air at a pressure not exceeding 2kg/cm² (30lb/in²), remove any dirt or dust from the interior of the unit. Take great care when cleaning the printed circuit boards.
4. Check the security of all components and connections.
5. Remove the contact covers from the main contactor (see Fig. 3) and examine the contacts. Clean or renew the contacts as necessary. Refit the contact covers.
6. Check the condition of the high frequency spark gap assemblies (see Fig. 4) and clean or renew the electrodes as necessary. Check and, if necessary, reset the spark gaps. They should be set between 0.25mm and 0.35mm (0.010in and 0.014in).
7. Carry out an insulation and continuity test as detailed below.
8. Refit the covers and panels.









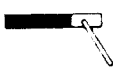









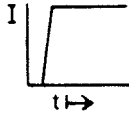

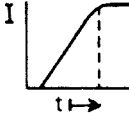


Insulation and Continuity Test (see Fig. 7)

These tests should only be undertaken by personnel experienced in the testing of electrical equipment.

1. Switch off the supply at the mains.
2. Disconnect the input cable from the mains supply.
3. Remove the top cover, left side panel and input terminal cover.
4. Using suitable lengths of 5A fuse wire, link the following points, making sure that the wire does not short against the unit frame or other components:-
 - a. Socket SK4 and socket SK5.
 - b. Terminal block TB8 terminals 1 and 2.
 - c. Terminal block TB9 terminals 1 and 2.
 - d. All terminals of bridge rectifier MR2.
5. Set the process switch to TIG welding.
6. Set the ac/dc selector switch to dc.

7. Press and hold the plunger of main contactor MC1 (see Fig. 3) to close the contacts.
8. Using a 500V insulation resistance tester (e.g. a Megger), ensure that the insulation resistance is not less than one megohm between:-
 - a. Terminal block TB1 pins U and earth.
 - b. Terminal block TB1 pin U and the secondary windings of transformers T1 and T2.
 - c. Terminal block TB1 earth and the secondary windings of transformers T1 and T2.
 - d. The secondary windings of transformers T1 and T2.
 - e. Each secondary winding of transformer T2.
9. Release the plunger of main contactor MC1.
10. Remove all shorting links fitted at step 4.
11. Reconnect the input cable to the mains supply, ensuring that the earth lead is connected to the mains supply earth connection.
12. Using an ohmmeter or a lamp and battery, check that there is continuity between the unit frame and the mains supply earth connection.
13. Refit the top covers, left side panel and input terminal cover.

TABLE 2 The symbols used on the unit indicate as follows:-

 Off	 Current
 TIG Welding	 Spot Weld Time
 TIG Spot Welding	 Post - Weld Gas Delay Time
 Plasma Welding	 Gas
 Manual Arc Welding	 Water
 Water On	 In
 Water Off	 Out
 Latching	 Water Recirculating Unit
 Non-Latching	 Tap Water
 Normal Start	 Remote Control
 Soft Start	 DC
 AC	012 684

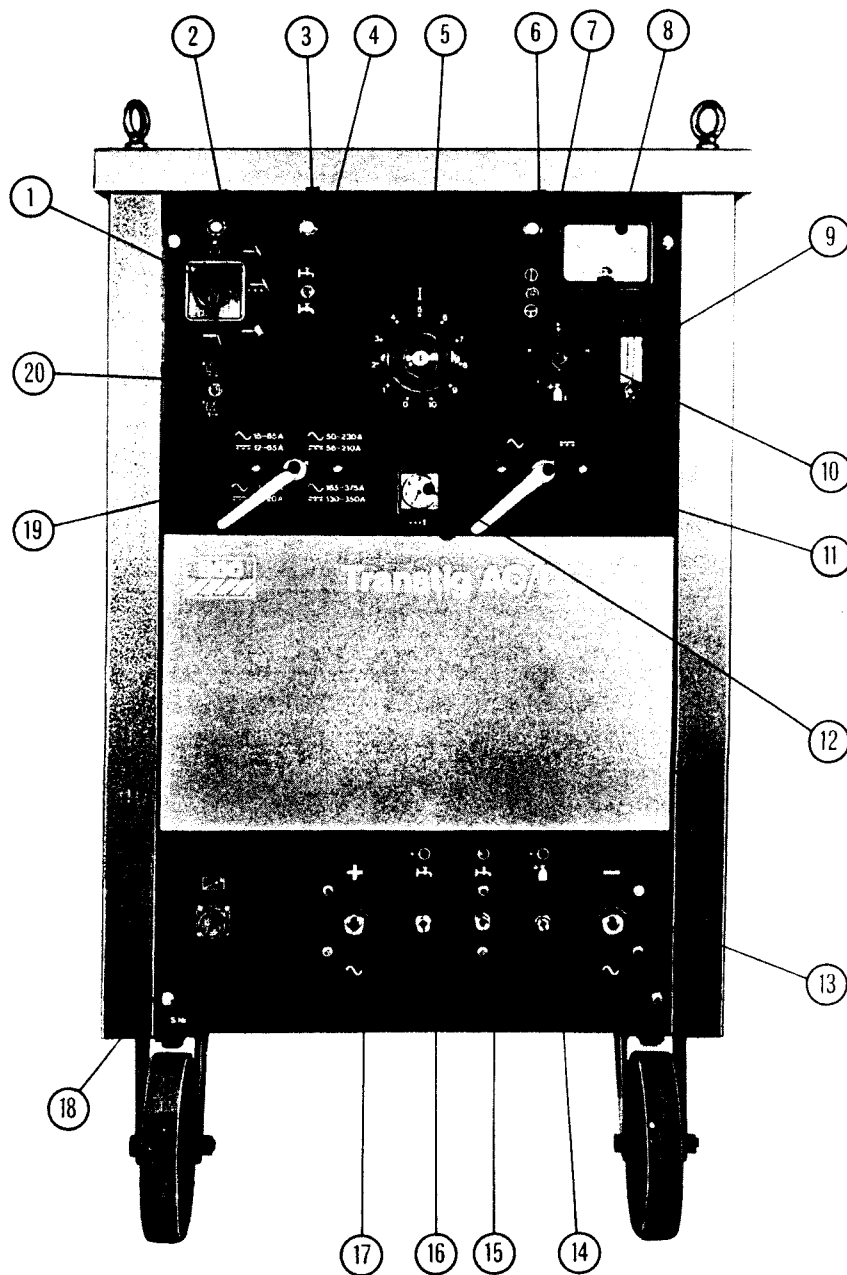


Fig. 2 Front Panel

- | | |
|------------------------------------------|--------------------------------------|
| 1. Process Switch S1 | 11. AC/DC Selector Switch S6 |
| 2. Mains Lamp LP1 | 12. Spot Weld Timer (Optional Extra) |
| 3. Water Warning Lamp LP2 | 13. Welding Output Socket (Negative) |
| 4. Water Switch S3 | 14. Gas Outlet Connector |
| 5. Current Control RV1 | 15. Water Return Connector |
| 6. Latching Lamp LP3 | 16. Water Supply Connector |
| 7. Latching Switch S4 | 17. Welding Output Socket (Positive) |
| 8. Ammeter A | 18. Remote Control Socket |
| 9. Gas Control and Flowmeter | 19. Current Range Switch S2 |
| 10. Post-Weld Gas Delay Time Control RV2 | 20. Soft Start Switch S5 |

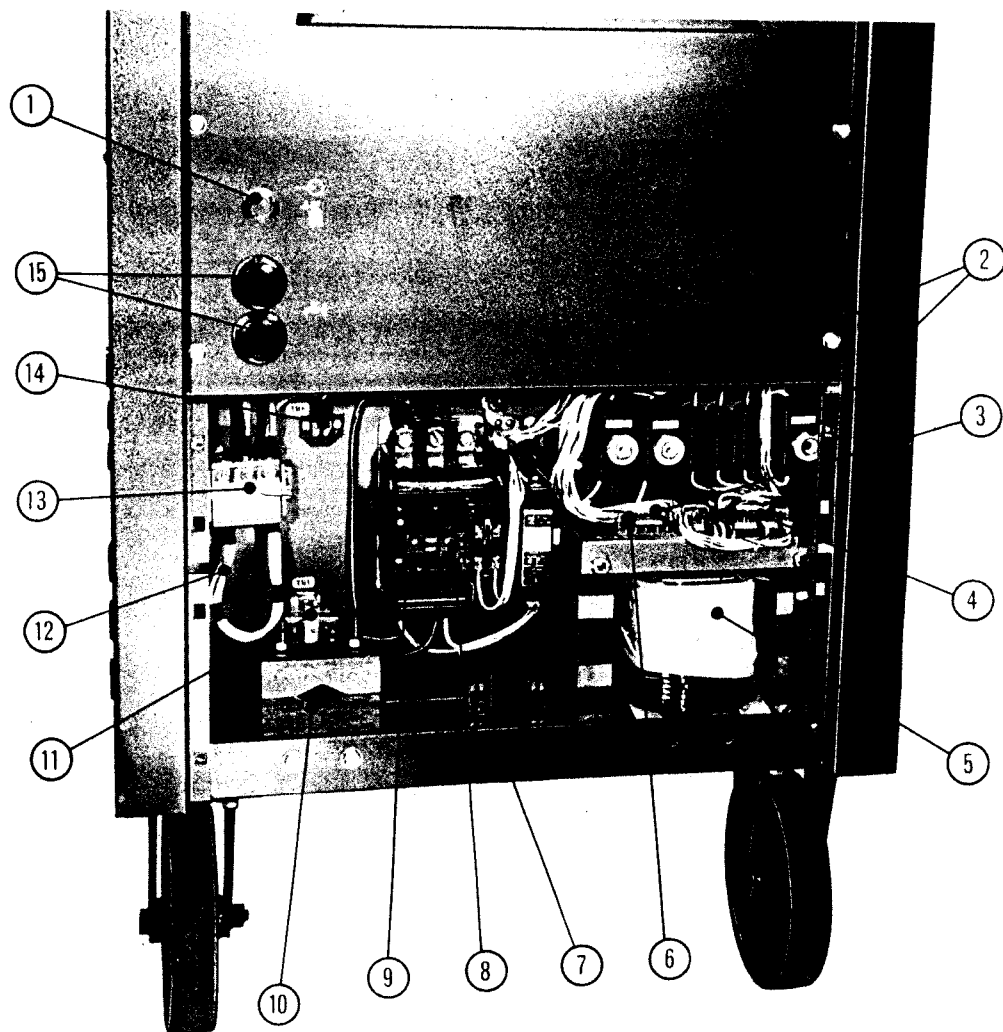


Fig. 3 Input Panel

1. Gas Inlet Connector
2. Fuses FS1 to FS6
3. Auxiliary Transformer Input Link
4. Terminal Block TB2
5. Auxiliary Transformer T2
6. Terminal Block TB3
7. Phase Sequence Indicator
8. Contact Plunger
9. Main Connector MC1
10. Cable Clamp
11. Input Terminal Block TB1
12. Voltage Selector Link
13. Voltage Selection Block VSB
14. Terminal Block TB6
15. Blanking Caps

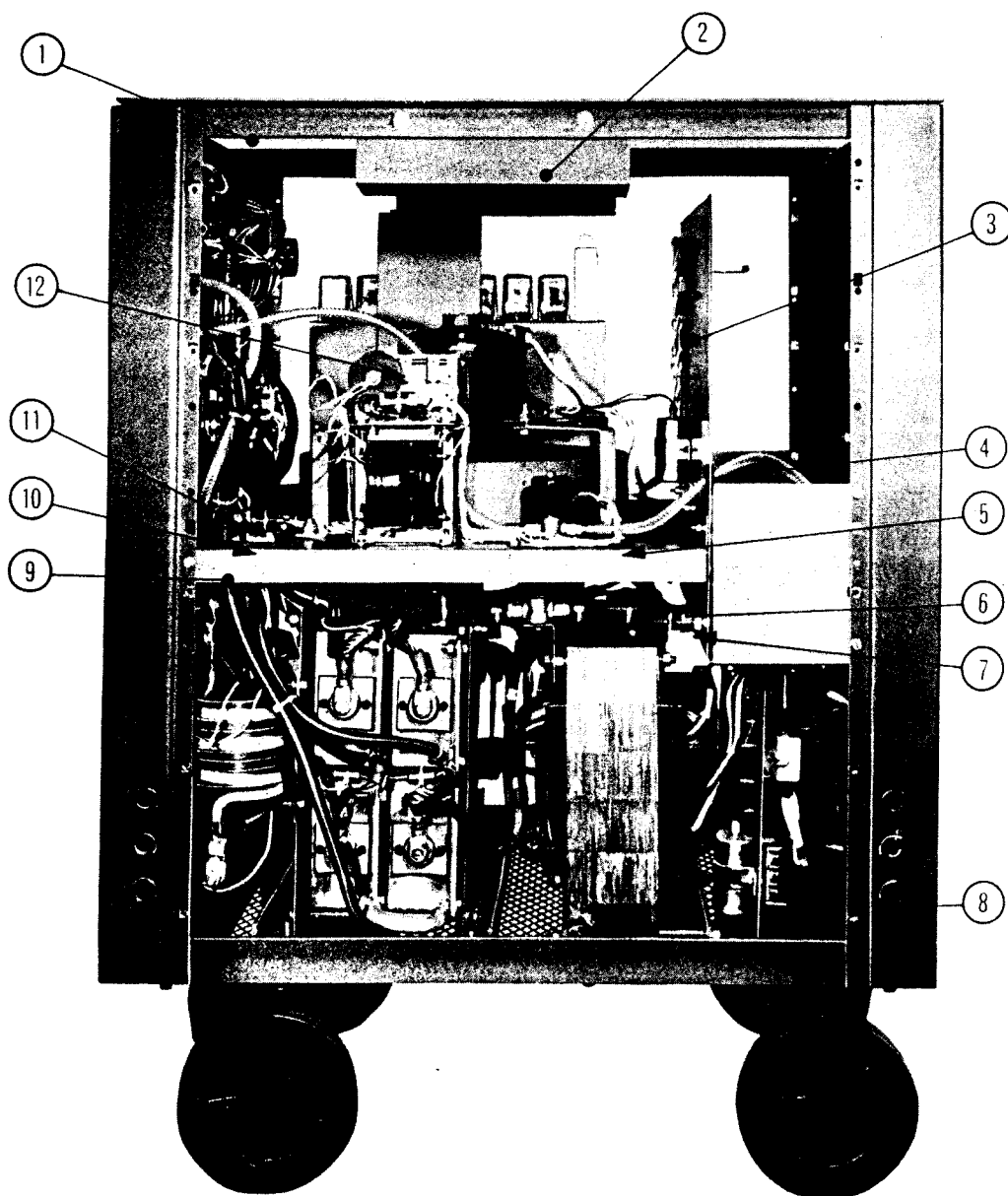


Fig. 4 Right Side

1. Cross-Member
2. DC Suppressor Bracket
3. Baffle Plate
4. Internal Gas Hose
5. Grommet
6. Water Outlet Connector
7. Water Inlet Connector
8. Bottom Hole
9. Fan Assembly Base
10. Terminal Board
11. Link
12. Spark Gap Assemblies

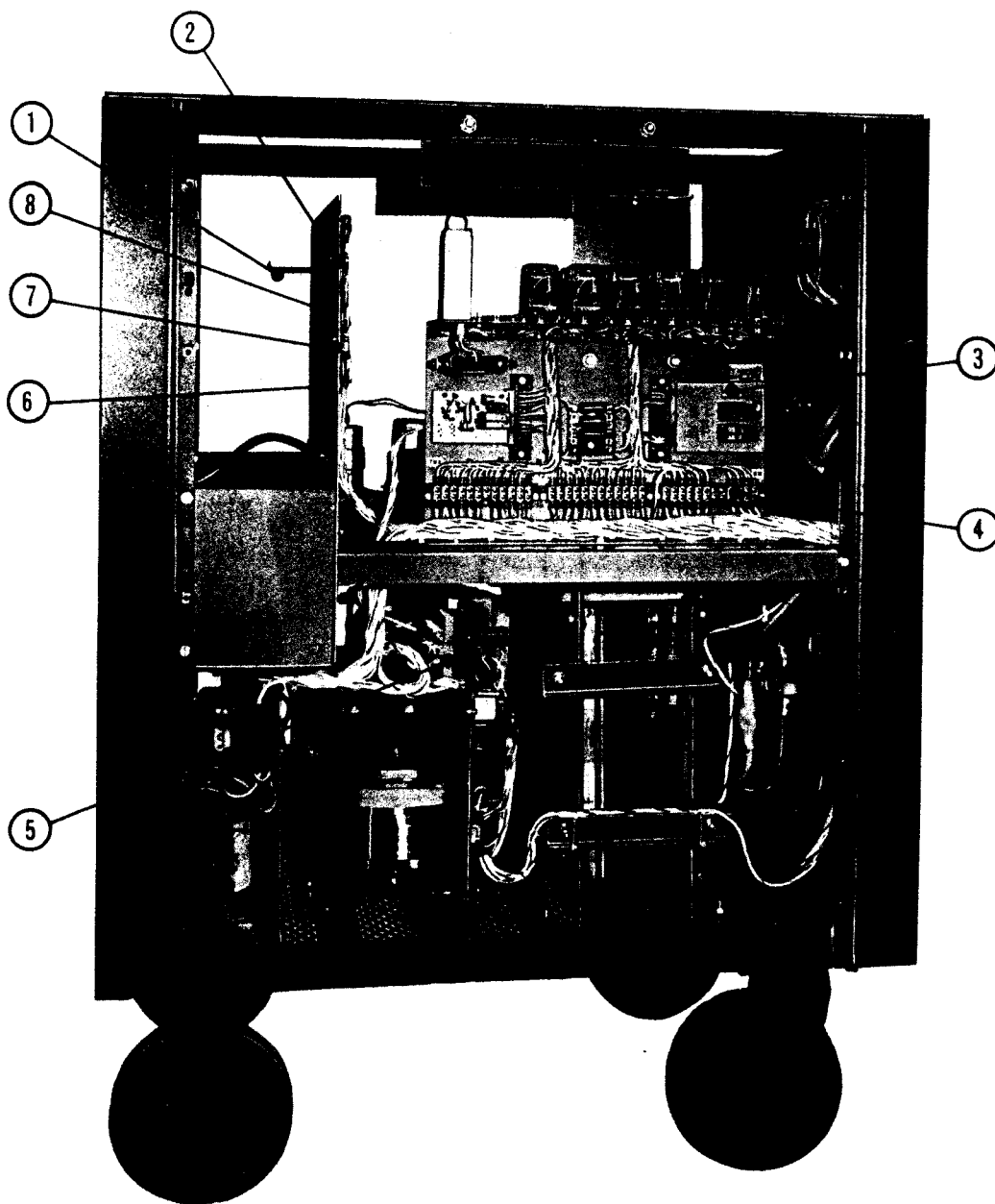


Fig. 5 Left Side

1. Bracket
2. Terminal Block TB4
3. Electronic Chassis
4. Terminal Block TB10
5. Bridge Rectifier MR2
6. Baffle Plate
7. Terminal Block TB7
8. Grommet

TABLE 3
Circuit Components — Fig. 6

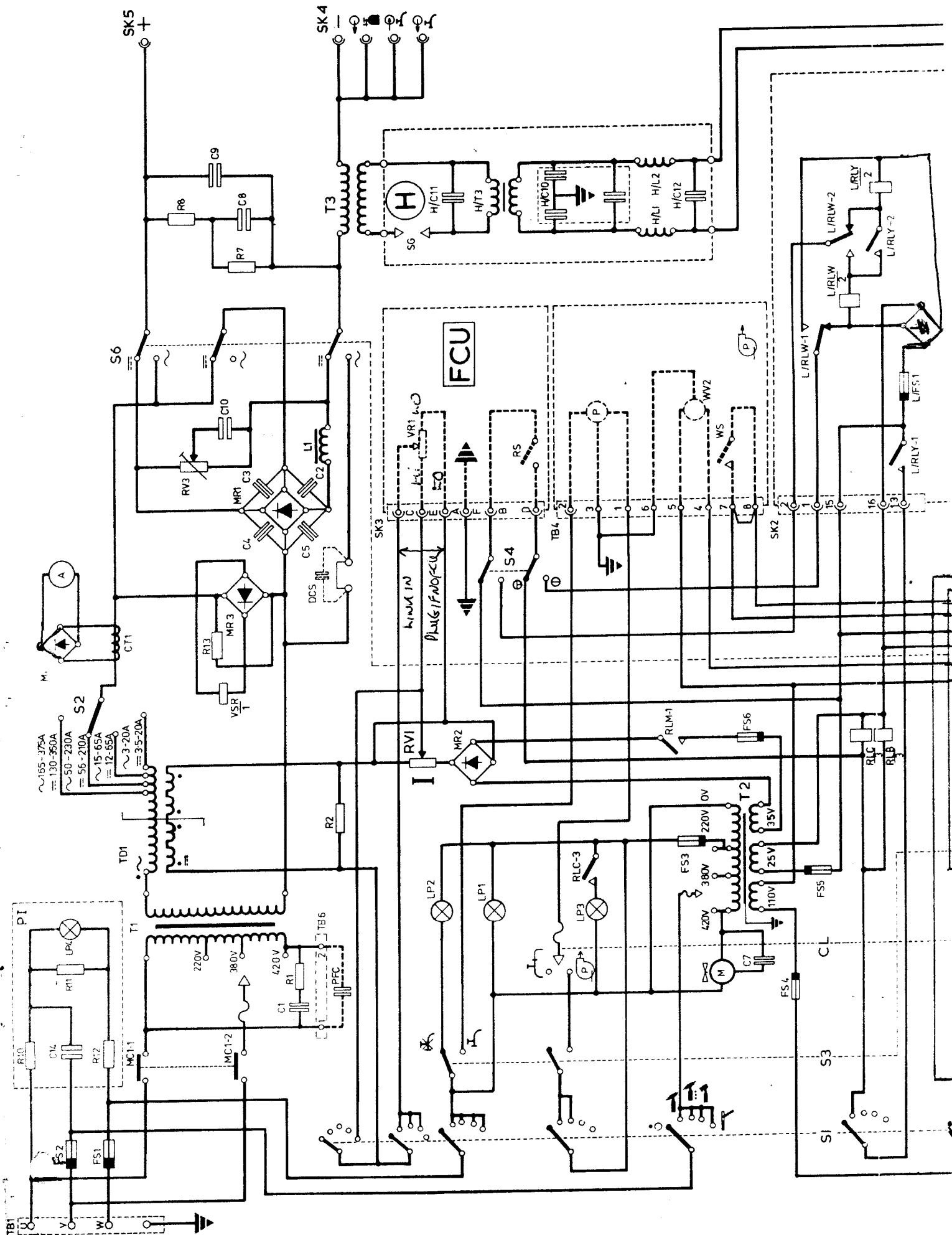
A	500A	R1	100 ohm, 30W
C1 & 7	4 μ F, 500V	R2	50 ohm, 20W
C2, 3, 4 & 5	0.22 μ F, 630V	R3	10 ohm, 7.5W
C8	10 μ F, 600V dc	R6	4.7 ohm, 1W
C9	0.005 μ F, 1kV dc	R7	20K ohm, 12W
C10	2200 μ F, 100V dc	R8	10 ohm, 40W
C12(3)	220 μ F, 25V dc	R10	120k ohm, 2W
C13	1 μ F, 600V dc	R11	100k ohm, 1W
C14	0.022 μ F, 600V dc	R12	68k ohm, 1W
C15	33 μ F, 250V	R13	1k ohm, 1W
G/C1	100 μ F, 25V	R14	33k ohm, 1W
G/C2	4.7 μ F, 35V	R15	300 ohm, 1W
H/C10	0.1 + 0.005 + 0.005 μ F	R16	3k ohm, 1W
H/C11	3000pF, 1kV dc	G/R1	120 ohm, 5W
H/C12	0.001 μ F, 1kV dc	G/R2 & 9	1.5k ohm, 1W
G/D1	IS 132	G/R3	470 ohm, 1W
FS1, 2 & 6	20A	G/R4	10k ohm, 1W
FS3 & 4	T7A	G/R5	1.2k ohm, 1W
FS5	1A	G/R6	2.4k ohm, 1W
L/FS1	500 mA	G/R7	10 ohm, 1W
MR1	S3 KN 200	G/R8 & 10	20k ohm, 1W
MR2	H192 LO1, BO2	RV1	6.2 ohm, 500W
MR3 & 5	B500 C1000	RV2	250k ohm
MR4	DD000	RV3	166 ohm (see Note 1)(vedi Nota 1) (see Nota 1)(see Anm. 1)
		G/TR1 & 4	2N2924
		G/TR2 & 3	2N 3703
		G/Z1 & 2	BZX 85

Note 1: The potentiometer is fitted so that 100 ohms are in parallel with C10.

ABBREVIATIONS — FIG. 6.

FCU	—	Foot Control Unit
G	—	Post Weld Gas Delay Board
H	—	High Frequency Unit
L	—	Latching Board
PI	—	Phase Sequence Indicator
TM	—	Timer

To add to the understanding of the circuit, a foot control unit (FCU) is shown connected to remote control socket SK3. If a foot switch or foot control unit is connected to the socket, pins C and E of the socket will be linked.



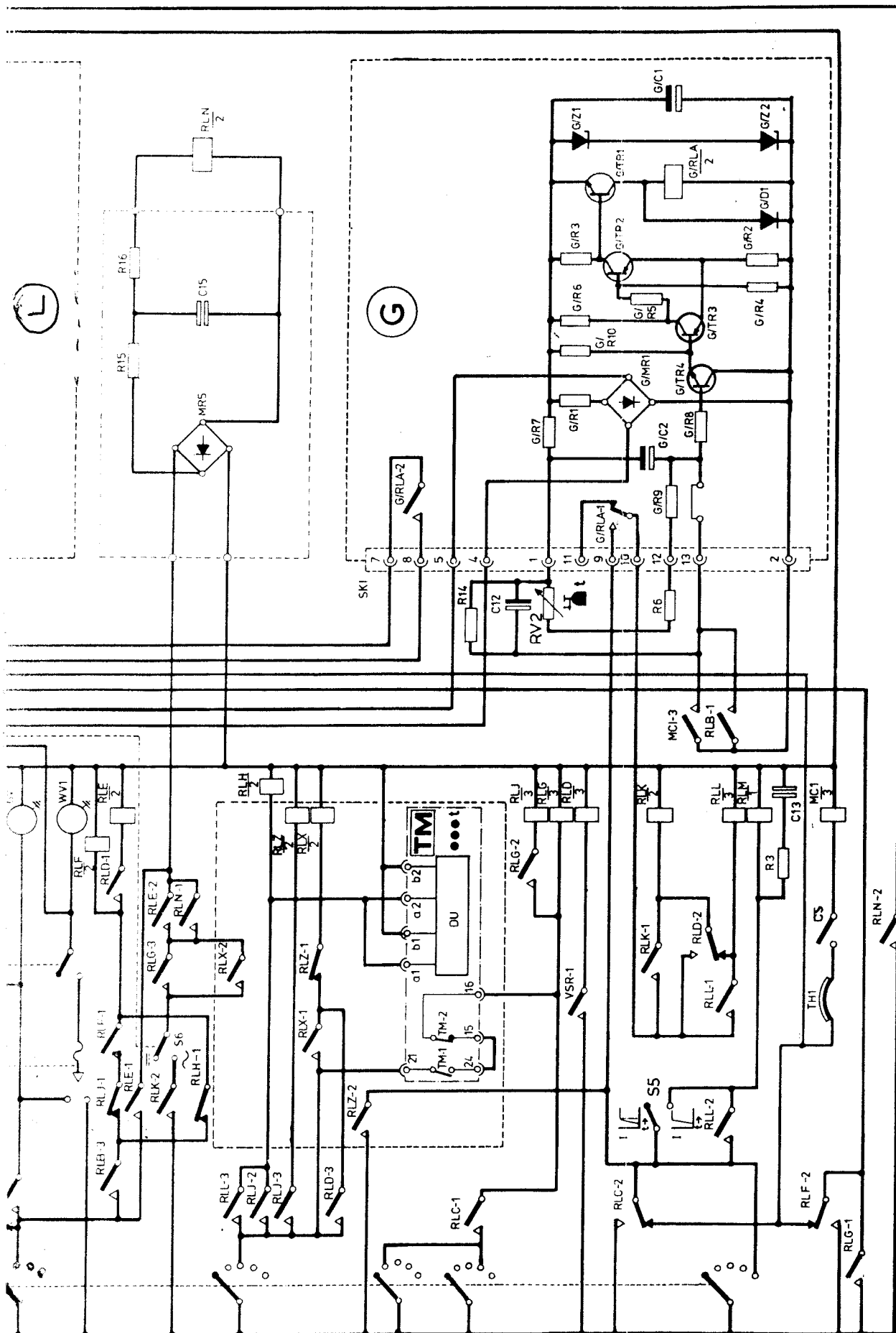
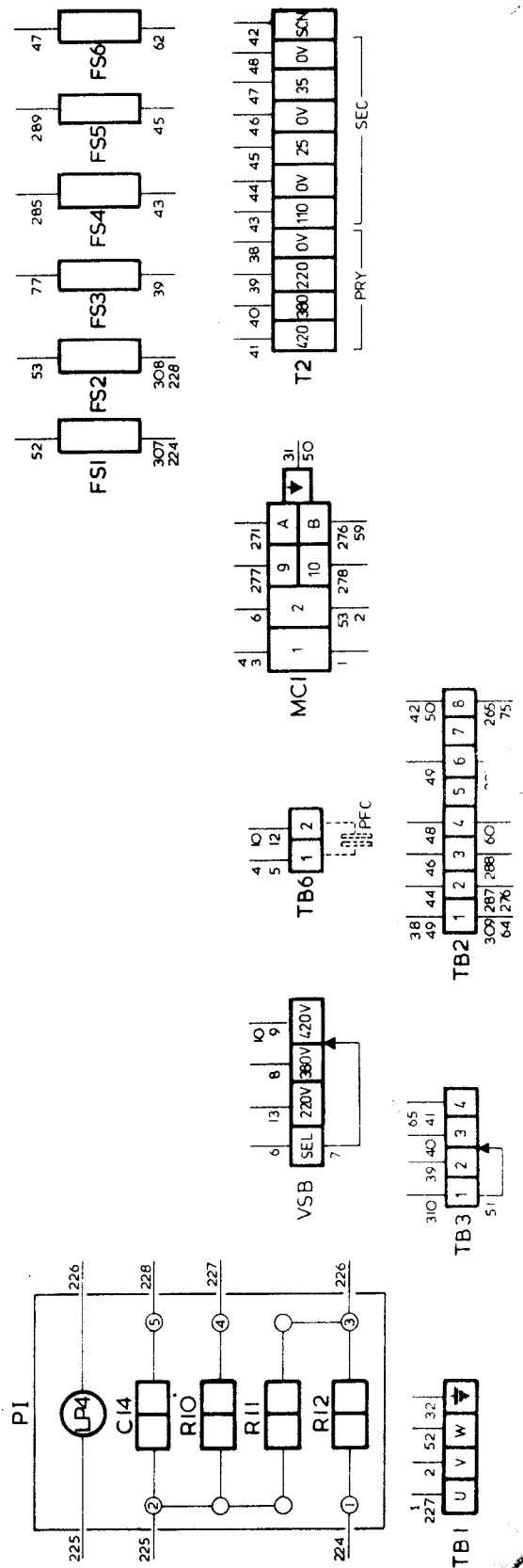
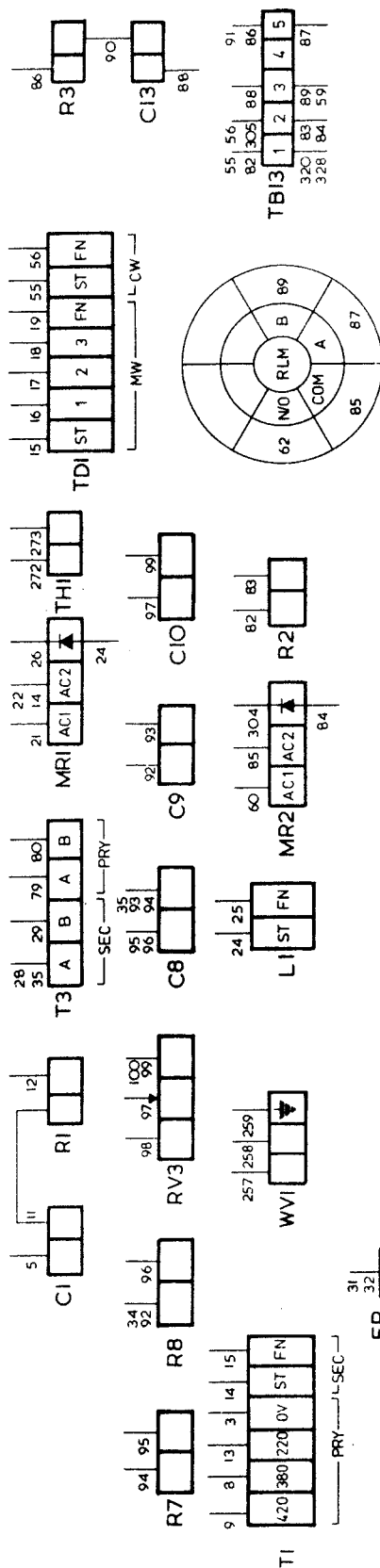
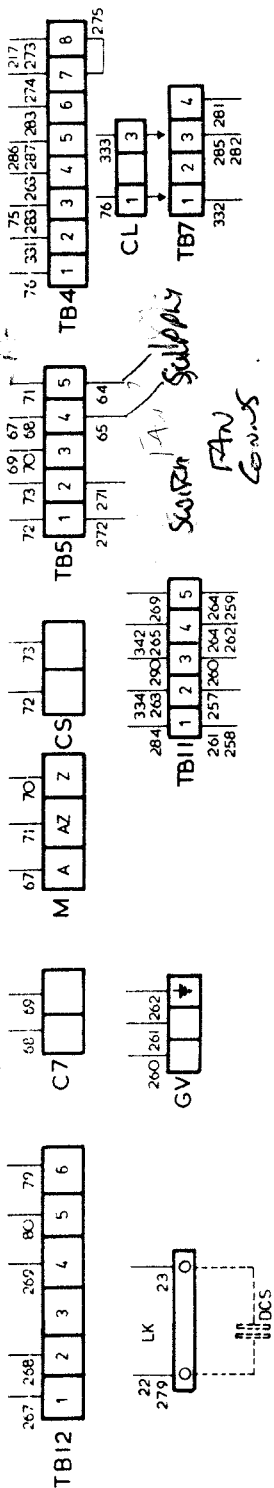


Fig. 6 Circuit Diagram



ABBREVIATIONS

- ① Front Panel
- ② Electronic Panel
- ③ Fan Compartment
- ④ Base Compartment
- ⑤ Input Panel


Colour			
BK	Black	R	Red
BL	Blue	SL	Slate
BN	Brown	V	Violet
G	Green	W	White
O	Orange	Y	Yellow
COM	Common	NS	Normal Start
CS	Centrifugal Switch	PRY	Primary
CW	Control Winding	SCN	Screen
FN	Finish	SEC	Secondary
FR	Frame	SEL	Selector
LK	Link	ST	Start
MW	Main Winding		

WIRING TABLE – 220, 380/440V Version



This table may be used in conjunction with Fig. 7 to obtain the internal cable connections for the 220, 380/440V version of the AC/DC 375.

The connections for the 380/440V version are almost identical. The differences are given in the wiring table at the end of this section.

Wire No.	Colour	From	To
1	R	TB1-U	MC1-1
2	Y	TB1-V	MC1-2
3		MC1-1	T1-PRY-OV
4	R	MC1-1	TB6-1
5		C1	TB6-1
6	Y	MC1-2	VS8-SEL
7	Y	VS8-SEL	VS8-380V/420V
8		T1-PRY-380	VS8-380V
9		T1-PRY-420	VS8-420V
10	O	TB6-2	VS8-420V
11		C1	R1
12	O	R1	TB6-2
13		T1-PRY-220	VS8-220V
14		T1-SEC-ST	MR1-AC2
15		T1-SEC-FN	TD1-ST
16		TD1-MW-1	S2-1
17		TD1-MW-2	S2-3
18		TD1-MW-3	S2-4
19		TD1-FN	S2-6
20		S2-2 & 5	S6-4
21		MR1-AC1	S6-3
22		MR1-AC2	LK
23		S6-7	LK
24		MR1-	L1-ST
25		S6-9	L1-FN
26		MR1+	S6-6
27		SK5	S6-5
28		T3-SEC-A	S6-8
29		T3-SEC-B	SK4
30			
31	G/Y	MC1- } \perp	FR
32	G/Y	TB1- }	FR
33	BN	TB8-5	S6-2
34	R	R8	SK5
35	W	C8	T3-SEC-A
36	BN	FS3	TB3-2
37	G	TB8-4	S6-1

Wire No.	Colour	From	To
38	BK	T2-PRY-OV	TB2-1
39	O/BK	T2-PRY-220	TB3-2
40	BN	T2-PRY-380	TB3-3
41	R	T2-PRY-420	TB3-4
42	G/Y	T2-SCN	TB2-8
43	W	T2-SEC-110	FS4
44	Y	T2-SEC-OV	TB2-2
45	V	T2-SEC-25V	FS5
46	BL	T2-SEC-OV	TB2-3
47	O	T2-SEC-35V	FS6
48	SL	T2-SEC-OV	TB2-4
49	BK	TB2-1	TB2-6
50	G/Y	TB2-8	MC1- 
51	Y	TB3-2/3	TB3-1
52	B	FS1	TB1-W
53	Y	FS2	MC1-2
54			
55	BN	TB13-1	TD1-CW-ST
56	BL	TB13-2	TB1-CW-FN
57			
58			
59	Y	TB13-3	MC1-B
60	SL	TB2-4	MR2-AC1
61			
62	O/BK	RLM-N/O	FS6
63			
64	BK	TB5-5	TB2-1
65	R	TB5-4	TB3-4
66			
67	R	M-A	TB5-4
68		C7	TB5-4
69		C7	TB5-3
70	W	M-Z	TB5-3
71	Y	M-AZ	TB5-5
72		CS	TB5-1
73		CS	TB5-2
74			
75	G/Y	TB4-3	TB2-8
76	BN	CL-1	TB4-1
77	BN	TB10-2	FS3
78			
79	BN	TB12-6	T3-PRY-A
80	SL	TB12-5	T3-PRY-B
81			
82	BN	TB13-1	R2
83	Y/BL	TB13-2	R2
84	Y/BL	TB13-2	MR2-
85	O/BK	RLM-COM	MR2-AC2
86		TB13-5	R3
87	O/BK	TB13-5	RLM-A
88		TB13-3	C13
89	Y	TB13-3	RLM-B
90		C13	R3
91	O/BK	TB8-11	TB13-5
92	R	C9	R8
93		C8	C9
94		C8	R7
95		R7	C8
96	W	R8	C8
97	O	RV3	C10
98	R	RV3	S6-6
99	BK	RV3	C10
100	BK	RV3	S6-9
101	Y	RLE-7	RLD-10
102	Y	RLE-7	RLG-10
103	Y	RLG-10	RLF-7
104	Y	RLF-7	RLH-7
105	Y	RLH-7	RLJ-10
106	Y	RLJ-10	RLL-10
107	Y	RLL-10	RLK-7
108	R	MR5+	RLN-7
109	Y	RLK-7	RLX-7
110	Y	RLX-7	RLZ-7
111	Y	RLZ-7	RB8-1
112	BK	RLN-2	MR5-

Wire No.	Colour	From	To
113	W	RLC-7	RLF-6
114	W	RLF-6	RLG-3
115	W	RLG-3	RLK-6
116	W	RLK-6	RLN-6
117	W	RLN-6	VSR-N/O
118	W	VSR/N/O	TB8-2
119	BK	RLC-5	TB10-7
120	BK	RLF-5	TB10-7
121	G	RLK-8	TB8-4
122	BN	TB10-9	MR5-AC2
123	BN	RLX-6	RLG-9
124	BN	RLG-9	TB8-5
125	BK	RLX-3	RLD-9
126	BK	RLD-9	RLJ-7
127	BK	RLJ-7	RLJ-9
128	BK	RLJ-9	RLL-9
129	BK	RLL-9	TB8-6
130	R	RLH-2	RLJ-6
131	R	RLJ-6	RLL-11
132	R	RLJ-11	TB8-7
133	SL	RLC-1	RLG-7
134	SL	RLG-7	RLG-2
135	SL	RLG-2	TB8-8
136	Y/BL	RLC-3	TB8-9
137	O/BK	RLC-6	RLL-7
138	O/BK	RLL-7	TB8-10
139	BL	RLL-6	TB8-11
140	R/V	RLF-8	RLG-1
141	R/V	RLG-1	TB8-12
142			
143	G	SK1-1	TB9-4
144	O	SK1-2	TB9-6
145	BL	SK1-4	TB9-1
146	Y/BL	SK1-5	TB9-7
147	SL	SK1-7	TB10-6
148	Y	SK1-8	TB10-5
149	O/BK	SK1-9	TB8-10
150	BN	SK1-10	RLL-3
151	BN	RLL-3	RLK-3
152	BN	RLK-3	RLD-7
153	W	R6	SK1-12
154	R	TB9-5	SK1-13
155			
156	Y	SK2-1	TB9-10
157	BK	SK2-2	TB9-9
158	BN	SK2-13	TB9-11
159	V	SK2-15	TB9-2
160	BL	SK2-16	RLB-10
161	BL	RLB-10	RLC-10
162	BL	RLC-10	TB9-1
163			
164	SL	R6	TB9-3
165	G	C12-	TB9-4
166	R	C12+	TB9-5
167	R	C12+	RLB-3
168	O	RLB-1	TB9-6
169	BN	RLC-2	TB9-8
170	BN	RLC-2	RLB-2
171	BL	RLN-8	TB9-12
172			
173	O	RLC-11	TB10-1
174	BN	RLC-9	TB10-2
175	W	MR3-AC1	TB10-3
176	O/BK	MR3-AC2	TB10-4
177	R	MR3+	VSR-A
178	BK	MR3-	VSR-B
179	Y	RLB-6	TB10-5
180	SL	RLE-3	TB10-6
181	SL	RLE-3	RLB-9
182	SL	RLB-9	RLB-7
183			
184	BK	RLB-11	RLH-4
185	BK	RLH-4	RLJ-4
186			
187	BN	RLF-3	RLJ-1

Wire No.	Colour	From	To
188	O	RLD-3	RLF-2
189	O	RLF-2	RLF-1
190	O	RLF-1	RLH-1
191			
192	Y	RLE-8	RLE-1
193	Y	RLE-1	RLN-1
194	W	RLN-1	MR5-AC1
195	G	RLD-1	RLE-2
196	BL	RLG-11	RLE-6
197	BL	RLX-8	RLN-3
198	SL	RLZ-1	RLX-2
199	W	RLD-11	RLX-1
200	W	RLX-1	RLZ-4
201	BK	RLJ-11	RLZ-2
202	BN	VSR-COM	RLD-2
203	R	RLD-6	RLK-1
204	R	RLK-1	RLK-2
205	O	RLD-5	RLL-2
206	O	RLL-2	RLL-1
207	Y	RLG-6	RLJ-2
208			
209	Y	TB8-1	TB10-9
210	BK	TB8-6	TB10-10
211	R	TB8-7	TB10-11
212	SL	TB8-8	TB10-12
213			
214	O/BK	RLZ-8	RLC-6
215	W	RLZ-6	RLC-7
216	BL	RLG-11	RLN-3
217	BK	TB10-7	TB4-8
218			
219			
220			
221			
222			
223			
224	BL	FS1	PI-1
225	R	LP4	PI-2
226	R	LP4	PI-3
227	R	TB1-U	PI-4
228	Y	FS1	PI-5
229			
230			
231		R14	C12-
232		R14	C12+
233			
234			
235			
257		TB11-2	WV1
258		TB11-1	WV1
259	G/Y	TB11-5	WV1- 
260		TB11-3	GV
261		TB11-1	GV
262	G/Y	TB11-4	GV - 
263	O	TB11-2	TB4-4
264	G/Y	TB11-4	TB11-5
265	G/Y	TB2-8	TB11-4
266			
267	Y	TB8-1	TB12-1
268	BL	TB9-12	TB12-2
269	G/Y	TB11-5	TB12-4
270			
271	BN	TB5-2	MC1-A
272	SL	TB5-1	TH1
273	BK	TB4-8	TH1
274	R/V	TB8-12	TB4-7
275	BK	TB4-7	TB4-8
276	Y	TB2-2	MC1-8
277	O	TB9-6	MC1-9
278	R	TB9-5	MC1-10
279	O/BK	TB10-4	LK
280	W	TB10-3	S2-2
281	Y	TB10-5	TB7-4
282	W	TB8-2	TB7-3
283	G/Y	TB4-3	TB4-6