ROMAN MANUFACTURING INC/TRANSPOWER

TESTING SINGLE PHASE DC POWER SUPPLIES FOR TRANSFORMER OR DIODE FAILURES

SEPTEMBER 15, 1999

A. Prerequisites

1. Only personnel familiar with electrical power systems, transformers and rectifiers will be allowed to service and test DC power supplies.

2. Only personnel familiar with safety and lock out procedures of electrical power systems will be allowed to perform the service and test on DC power supplies.

3. The power system supplying the power supply has been checked for proper line voltage and frequency.

4. The welding control has been checked for proper functioning.

5. Make sure the secondary circuit of the welder is open without a part clamped in the tooling or by electrodes.

6. Any load testing of the power supply must be done with proper water cooling.

7. The procedure applies to power supplies equipped with hockey puck diodes such as R2060 or R2121 diode assemblies. These diode assemblies fail in shorted condition. For power supplies equipped with SKWD 7000 diodes the procedure applies if the diode fails in the shorted condition. There is, however, a remote possibility that a diode fails in the open condition.

8. This procedure cannot cover all possible symptoms or reasons for failure thus requiring an analytical approach to determine the problem.

B. Testing the DC Power Supply

1. Figure 1 (page 5) shows a DC Power Supply with a shorted diode in one leg of the rectifier.

2. Figure 2 (page 5) shows a DC Power Supply with a shorted diode in each of the two rectifier legs.

3. Figure 3 (page 5) shows a DC Power Supply with a primary to secondary or primary to case fault in the transformer.

4. Figure 4 (page 5) shows a DC Power Supply with a turn to turn short in the primary or secondary winding of the rectifier transformer.

   NOTE: Figures 1 through 4 are generic diagrams to show the location of the faults discussed in this procedure.

5. Set the DC Power Supply on the lowest voltage tap. Set the control on the lowest heat setting possible and a weld time not exceeding 3 cycles. Initiate the welder with the welding circuit open and without a part in the welder (see A.5). The primary current read out of the control should indicate a negligible current since it only measures the excitation current of the transformers. Repeat this test by gradually increasing to full heat setting. The primary current readout should continue to be negligible up to the full heat setting (99%). Terminate the test if the current exceeds 10 to 30 amperes depending on the size of the power supply. Excessive current indicates a failed power supply.

6. If the power supply fails the test described in B.5 the reasons below are the probable cause and the DC Power Supply must be removed for repair:

   a. A shorted diode or diodes (Figure 1 & 2)
   b. A short in the rectifier/bus system
   c. A transformer fault in form of a primary to secondary or primary to case short. This assumes a properly grounded machine including secondary circuit and grounded power system (Figure 3). In this case one side of the primary winding is always connected to line. Thus a short circuit exists without the control being initiated leading to tripping of the overcurrent protection as soon as power is applied to the control. In an ungrounded power system the overcurrent protection will not trip unless another ground fault exist in the system.
   d. A transformer fault in form of a turn to turn short in the primary or secondary winding of the rectifier transformer (Figure 4). Proceed to section C and D for rectifier bus, diode and transformer testing.

7. If the power Supply has passed the test in B.5 a load test should be performed to support the results of test B.5. Repeat the first test setting of B.5 (lowest tap, lowest heat setting, 3 cycles weld time) with a coupon firmly clamped in the tooling or by electrodes. Connect the probe of a memory scope across the coupon and initiate the welder. The scope should show a rectified wave form with two pulses per cycle of weld time. The pulses should be even in size, shape and spacing. If a continuous DC component exists the current will show an upslope during the first few cycles. A scope isolator might be required to obtain representative wave forms.

8. If the power supply passes the test in B.7 it is in operational condition.

9. If the power supply fails the test in B.7 proceed as follows. Verify first the prerequisites A.3 and A.4 and then the tests in B.5 before committing the power supply to removal from the welder for service. Proceed to section C and D for rectifier bus, diode and transformer testing.

C. Rectifier Bus and Diode Testing

1. The large number of parallel diodes mounted in heatsinks with water cross over connections makes checking for a shorted diode difficult. It is necessary to remove the rectifier output and collection bus system so that each rectifier leg can be tested separately.

   EXCEPTION:
   On smaller single phase DC power supplies the diodes of the two rectifier legs may be mounted to the same + DC bus. In this case follow the same procedure as outlined below, however, both rectifier legs are tested simultaneously.

2. Connect the leads of a multimeter set in "diode check" position or a continuity tester with a 6 volt DC power source between the AC bus and the + DC bus to check the conduction in the "forward" and blocking in the "reverse" direction of the diodes in each rectifier leg. A shorted diode in a rectifier leg will show conduction in the forward and reverse direction. Since there are multiple diodes in parallel in one rectifier leg it is necessary to remove and check each diode assembly in the rectifier leg to find the faulty diode(s). The diodes are forward voltage drop matched in each rectifier leg. The replacement diode(s) must have the same forward voltage drop as the ones remaining in the leg. If this cannot be accomplished a new matched set of diodes must be installed. After changing the diodes the rectifier leg should be checked for proper function.

   If a short in a rectifier leg persists after all diodes have been checked the short is most likely in the rectifier bus system. A short between the AC bus and + DC bus within the rectifier bus system acts like a shorted diode (See Section C2). A short between the – DC bus and AC bus within the rectifier bus system acts like a shorted secondary turn. (See Section D.) A short between – DC bus and + DC bus within the rectifier bus system can be tested using an Ohm meter or continuity tester. For this purpose the diodes must be removed.

   Disassemble and inspect the bus bars for shorts which will be evident by burned spots on bus bars and insulation.

3. After each rectifier leg has been tested and found operational but before reinstalling the rectifier collection and output bus system the transformers should be checked.

D. Transformer Testing

1. The insulation resistance between primary and secondary as well as primary to case must be tested. For this test a 500 or 1000 volt DC insulation tester should be used. Disconnect the power supply from the weld control (Figure 3). Any component such as primary terminal boards, switches, etc. become part of the insulation test unless they are disconnected from the transformer.

   CAUTION: If a rectifier is mounted to the secondary output pads the "centertap and AC pads" must be connected together with a wire (#14 AWG Cu minimum) to assure that the test voltage cannot be accidentally applied to the diodes.

A minimum insulation resistance of 10,000,000 OHMS should be measured between primary and secondary as well as primary to case at an ambient temperature not exceeding 30°C. If the insulation resistance is less the integrity of the insulation is questionable which might require repair of the transformer. After the test make sure the wire is removed.

2. To test the transformer for a turn to turn failure energize the primary winding of the transformer with a low voltage variable AC power source. (VARIAC, 0 to 120 volt AC rated 10 amperes minimum) Slowly increase the primary voltage from zero and monitor the primary current. If the transformer has a turn to turn failure the primary current will rapidly increase as soon as voltage is applied. If the transformer is operational the primary current will be negligible after the available voltage is fully applied. (ie: 120 volts) The transformer must be repaired if a turn to turn failure exists. Note: It is highly unlikely that the secondary of the rectifier develops a turn to turn short. Thus the shorted turn is either in the primary winding or the short caused by the rectifier bus system.

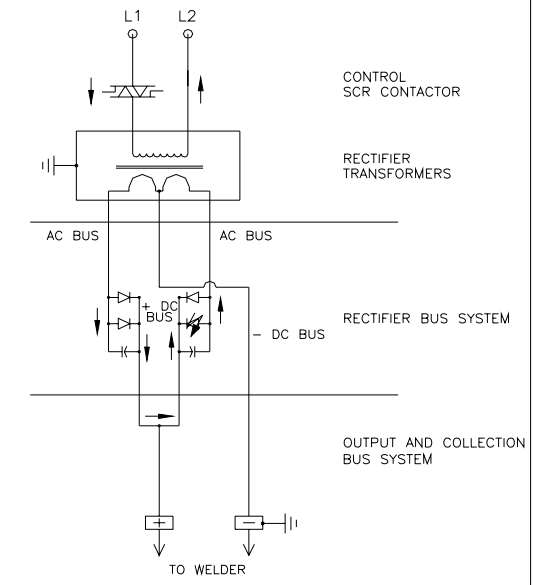
E. Reassembly

1. After all tests and repairs in section C and D are completed reassemble the output and collection bus system making sure all connections have a good fit up and are tight. Contact surfaces must be cleaned before reassembly.

2. Repeat test D.2 which will verify that there are no shorts in the power supply if the primary current is negligible with full voltage (120 volts) applied.

3. Install the power supply in the welder.

4. Repeat tests B.5 and B.7 after the power supply has been reinstalled. Only after the DC power supply passes tests B.5 and B.7 should it be returned to service.

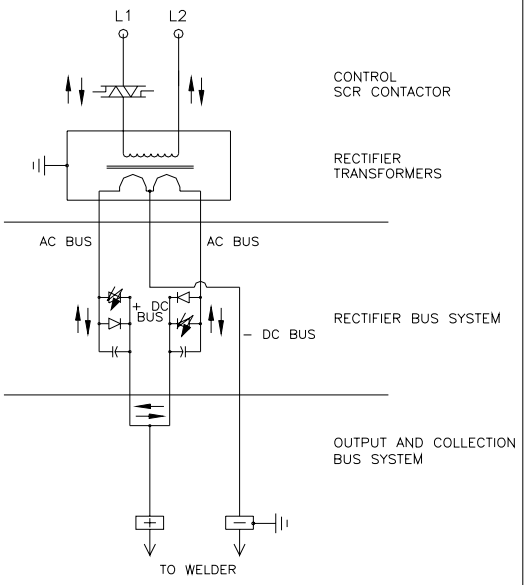


NOTE:

◄— INDICATES FLOW OF FAULT CURRENT

THE SHORTED DIODE REPRESENTS A SHORT CIRCUIT ON THE SECONDARY OF THE RECTIFIER TRANSFORMER DURING THE HALF CYCLE THE HEALTHY RECTIFIER LEG IS CONDUCTING

Fig. 1

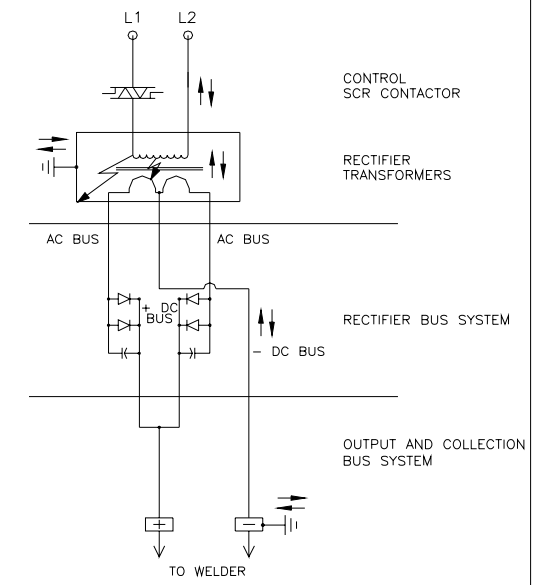


NOTE:

◄— INDICATES FLOW OF FAULT CURRENT

THE SHORTED DIODES REPRESENT A SHORT CIRCUIT OF THE RECTIFIER TRANSFORMER DURING THE POSITIVE AND NEGATIVE HALF CYCLE

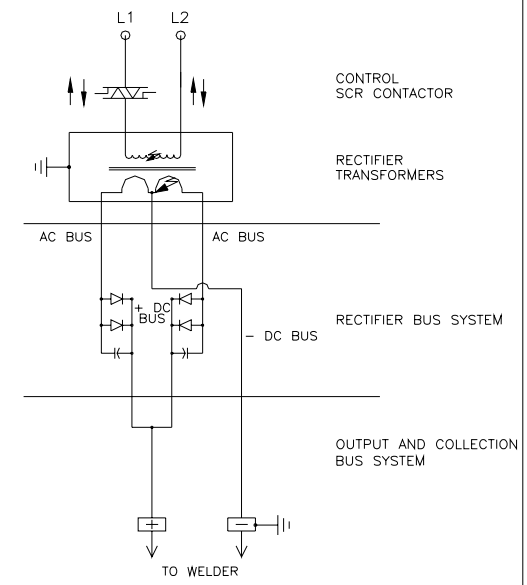
Fig. 2



NOTE:

◄— INDICATES FLOW OF FAULT CURRENT

Fig. 3



NOTE:

◄— INDICATES FLOW OF FAULT CURRENT

Fig. 4

Rev. A – Clarified overlapping lines that do not tie together. – 12–9–98

4/21/98