RECTIFIER J86273

48 VOLTS, 200 AMPERES

CURRENT-REGULATED OUTPUT CONTROL

OPERATING METHODS

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1. GENERAL

1.01 The J86273 semiconductor-type, current-regulated rectifier using saturable reactor control is used in the 301C and 302A power plants to float and charge storage batteries.

1.02 This section is reissued to bring the section up-to-date. Since this is a general revision, arrows ordinarily used to indicate changes have been omitted.

Note: The J86273A rectifier (Mfr Disc.) is replaced by the J86295A rectifier. J86273B (voltage-regulated) and J86273C (current-regulated) are rated A & M only and are also replaced by the J86295A rectifier (see Section 169-630-303).

1.03 The J86273 rectifier requires a 3-phase, 3-wire, 206-, 220-, 230-, or 240-volt ±7 percent, 60-Hz ±2 percent ac input. Its current regulated control responds automatically to signals from connecting circuits to connect to the ac supply and to increase or decrease its output current in response to raise and lower signals. A four position switch (S1) is provided to select the desired battery condition (BAT OFF, BAT, GR1, or GR1 & GR2). This is a ganged switch which also selects the correct T1 primary connections to provide suitable voltage adjustment range for each battery condition. RECT FAIL, OVERLOAD, and FAN FAIL indicating lamps provide an indication of trouble and aid in localizing the source of trouble. An EM CELL lamp indicates operation of the S1 switch to the GR1 or GR1 & GR2 position.

Caution: Voltages inside the rectifier case are over 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time, as destructive or dangerous short circuits may occur. Battery voltage will be present on the terminals of the S1 rotary switch.

1.04 The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

1.05 Routine checks and adjustments, other than those required by trouble conditions, should be made during a period when they will least interfere with service.

1.06 The instructions are based on circuit schematic drawing SD-81317-01, Fig. 1 and 3. For a detailed description of operation, see the corresponding circuit description.

1.07 For more detailed information on operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practices.

1.08 Battery voltage readings called for may be made with the plant voltmeter or a

KS-8039 volt-milliammeter, provided that the instrument is connected at the battery and has been calibrated for accuracy at float voltage. The accuracy of the meter when compared with a standard shall be within ±0.2 volts. These limits apply at any point in the float voltage range.

2. TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
418A	5/16- and 7/32-Inch Open Double-End Flat Wrench
—	Blocking and insulating tools, as required. Use tools and apply, as covered in Section 069-020-801.
—	3-Inch C Screwdriver
TEST APPARATUS	
KS-3008	Stopwatch
KS-8039	DC Volt-Milliammeter
KS-14510	Volt-Ohm-Milliammeter

3. OPERATION

PREPARING TO START

3.01 When putting the rectifier into service check that:

(a) The RECT switch is in the OFF position.

(b) The S1 rotary switch is in the BAT position.

(c) The TST-NOR-MAN key is in the NOR position.

(d) The 48V CONT 1 (CB1), 48V CONT 2 (CB2), and BLOWER (CB3) circuit breakers are closed.

(e) Sufficient office load or a variable resistance load, capable of carrying the rated output of the rectifier, is provided.

(f) The associated supply and control fuses are in place.

STARTING THE RECTIFIER

3.02 With the S1 rotary switch in the BAT position, start the rectifier by operating the RECT switch to NOR.

3.03 To operate the rectifier manually, proceed as follows:

(1) With the RECT switch at OFF, operate the S1 rotary switch to BAT, GR1, or GR1 & GR2 position.

(2) Operate the TST-NOR-MAN key to MAN.

(3) Verify that the MAN potentiometer is fully ccw.

(4) Operate the RECT switch to NOR.

(5) Rotate the MAN potentiometer cw to increase the rectifier output to the desired value.

Note: Continuity of service is provided by this manual control. The MAN potentiometer should always be restored to maximum ccw at the completion of a check or when returning to automatic regulation.

3.04 ***Summary of Nominal Settings:*** For normal operation on 23-cell battery, the following adjustments should prevail unless plant requirements differ.

(a) AR1 ammeter relay:

(1) Low contact set at 10 amperes.

(2) High contact set at 200 amperes.

(b) BIAS potentiometer 100 amperes with SAT CURRENT 1 at 110 milliamperes.

(c) OL relay operates at 225 amperes in less than five seconds.

(d) OLF relay operates at 250 amperes in less than 20 seconds.

4. ROUTINE CHECKS

4.01 Routine checks of the electron tube should be made periodically with a tube tester in

accordance with the standard information on that tester.

4.02 As often as local experience demands, the contactor and relays should be inspected for adjustment and condition of contacts making sure that they are in accordance with the circuit requirements tables and Bell System Practices which apply.

4.03 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

4.04 Periodically as local conditions require, perform the checks in 4.05 through 4.09. To facilitate maintenance, the rectifier is provided with a TST-NOR-MAN key. Operation of this key to either TST or MAN removes the rectifier from the control of the connecting plant. The output is then under manual control and the rectifier is connected to the supply and the load. In performing these checks, the following switch and potentiometer positions apply prior to beginning the checks.

CONTROL	POSITION
RECT switch	OFF
S1 switch	BAT
TST-NOR-MAN key	MAN
MAN potentiometer	Midposition
COMP, AHL, AHR, and CON CUR TST potentiometers	Max ccw

All other switches shall be in the normal position.

Note: When adjusting the COMP, OL ADJ, and BIAS potentiometers, use the 418A tool to unlock the locking nut of the potentiometer. When the required setting is obtained, use the tool to lock the potentiometer.

4.05 ***Automatic Operation:*** To check automatic operation of the rectifier, proceed as follows:

STEP	PROCEDURE
1	Connect ac power to the rectifier.
2	Operate the RECT switch to NOR. ***Requirement:*** SAT CURRENT 2 milliammeter indicates about 100 milliamperes.
3	Rotate the MAN potentiometer fully ccw. ***Requirement:*** The SAT CURRENT 2 milliammeter increases and, at 190 to 250 milliamperes, the TC relay operates. SAT CURRENT 1 milliammeter indicates approximately 250 milliamperes.
4	Rotate the MAN potentiometer cw to give an indication of 110 milliamperes on SAT CURRENT 2 milliammeter. *Note:* Artificial load may be required to hold battery voltage at float value when the rectifier starts to deliver output current.
5	With the BIAS potentiometer in the maximum cw position, adjust the COMP potentiometer so that the OUTPUT CURRENT (AR1) ammeter relay indicates 100 amperes at float voltage or until SAT CURRENT 1 milliammeter indicates 370 milliamperes. *Note:* The MAN potentiometer may be adjusted to maintain SAT CURRENT 2 at 110 milliamperes, if necessary.
6	If 370 milliamperes is reached before the 100-ampere output is obtained, rotate the BIAS potentiometer ccw and readjust the COMP potentiometer slightly to obtain an indication of 100 amperes on the OUTPUT CURRENT ammeter relay, with SAT CURRENT 1 below 370 milliamperes and SAT CURRENT 2 at 110 milliamperes. Lock the COMP potentiometer.
7	With the MAN potentiometer, verify that five percent load is obtained with approximately 140 to 160 milliamperes on SAT CURRENT 2 and that full load, 200 amperes, is obtained with approximately 60 to 100 milliamperes on SAT CURRENT 2 milliammeter.
8	Operate the RECT switch to OFF, the TST-NOR-MAN key to TST, and then the RECT switch to NOR.

STEP	PROCEDURE
	Requirement: Rectifier starts. SAT CURRENT 2 milliammeter indicates about 240 to 280 milliamperes.
9	Operate the RAISE switch to decrease the SAT CURRENT 2 milliammeter indication and thereby increase the rectifier output to full load (200 amperes).
	Note: The rate of change may be increased by cw rotation of the AHR potentiometer.
10	Operate the LOWER switch to decrease the rectifier output to no load.
11	Adjust the AHR potentiometer to give no load to full load or the AHL potentiometer to give full load to no load in about 30 seconds.
	Note: With 301C-type plants, a slower rate may be desirable to prevent overcorrection and hunting.
12	Set the high contact on the OUTPUT CURRENT ammeter relay at 250 amperes.
13	With the rectifier at no load, operate and hold the CON CUR TST switch in the TST position.
	Note: The CON CUR TST is a momentary contact switch and must be held operated in the TST position.
14	While holding the CON CUR TST switch in TST, slowly rotate the CON CUR TST potentiometer cw to obtain an indication of 225 amperes on the OUTPUT CURRENT ammeter relay.
	Requirement: OL relay causes RL relay to operate within 20 to 60 seconds.
	Note: If the OL relay does not operate as specified, adjust it in accordance with 4.08.
15	Rotate the CON CUR TST potentiometer cw to increase the OUTPUT CURRENT ammeter relay indication to 250 amperes.
	Requirement: OLF relay operates within 10 to 60 seconds causing operation of the OLF1 relay and shutdown of the rectifier.
16	Release the CON CUR TST switch and operate the RECT switch to OFF.

4.06 ***Manual Operation:*** To check the rectifier for manual operation, perform the procedure in 3.03.

4.07 ***OL Relay Circuit:*** Check the OL relay circuit as follows.

Note: Perform 4.07 and 4.08 only when required.

STEP	PROCEDURE
1	With the RECT switch at OFF and the TST-NOR-MAN switch at MAN, operate the S1 rotary switch to BAT OFF.
2	Operate the RECT switch to NOR.
3	Rotate the OL ADJ potentiometer to maximum cw.
4	Operate and hold the CON CUR TST switch in the TST position and rotate the CON CUR TST potentiometer cw to obtain an indication of 206 amperes on the OUTPUT CURRENT (AR1) ammeter relay. Wait five minutes with CON CUR TST switch at TST for the OL relay to stabilize before proceeding.
5	Rotate the CON CUR TST potentiometer cw to obtain an indication of 225 amperes on the OUTPUT CURRENT ammeter relay.
6	While holding the CON CUR TST switch in the TST position, rotate the OL ADJ potentiometer ccw slowly, in steps, until the OL relay operates, resulting in operation of the RL relay.
7	Rotate the CON CUR TST potentiometer to maximum ccw, release the CON CUR TST switch.
8	Wait one minute and repeat the procedure to verify that the OL relay operates within 20 to 60 seconds.
	Note: If the OL relay does not operate within the required time, it may be neces-

STEP	PROCEDURE
	sary to adjust the OL relay in accordance with 4.08.

4.08 ***OL Relay:*** To check adjustment of the OL relay, proceed as follows:

STEP	PROCEDURE
1	With the RECT switch at OFF, operate the S1 rotary switch to BAT OFF and the TST-NOR-MAN key to TST.
2	Disconnect the OL ADJ potentiometer (if present) from the circuit.
3	Turn the small adjusting screw at the top of the OL relay about two turns downward.
4	Operate the RECT switch to NOR.
5	Operate and hold the CON CUR TST switch in the TST position and slowly rotate the CON CUR TST potentiometer to obtain an indication of 206 amperes on the OUTPUT CURRENT (AR1) ammeter relay. Wait five minutes with CON CUR TST switch at TST before continuing with the following.
6	While holding the CON CUR TST switch in the TST position, slowly rotate the CON CUR TST potentiometer cw to obtain an indication of 225 amperes on the ammeter relay. Immediately turn the adjusting screw of the OL relay in, very slowly, in steps, until the OL relay operates causing operation of the RL relay.
7	Slowly rotate the CON CUR TST potentiometer ccw until the ammeter relay indicates 206 amperes. Wait five minutes before proceeding.
8	Rotate the CON CUR TST potentiometer cw to obtain 225 amperes on the ammeter relay. ***Requirement:*** OL relay operates within two seconds as evidenced by operation of the RL relay.
9	Rotate the CON CUR TST potentiometer cw to obtain an indication of 250 amperes on the OUTPUT CURRENT ammeter relay. ***Requirement:*** OLF relay operates within 10 to 60 seconds causing operation of the OLF1 relay and shutdown of the rectifier. ***Note:*** If required, adjust the OLF relay in accordance with the OL relay adjusting procedure, except substitute 250 amperes on the OUTPUT CURRENT ammeter relay instead of 225 amperes.
10	Operate the RECT switch to OFF, reconnect the OL ADJ potentiometer, if applicable, and repeat Steps 2 through 6 of 4.07 to verify that the OL relay operates within 20 to 60 seconds.
11	Return the high contact of the OUTPUT CURRENT ammeter relay to 200 amperes.

4.09 ***Fan Failure Alarm:*** Check the fan failure alarm circuit as follows:

STEP	PROCEDURE
1	Operate the RECT switch to NOR.
2	Block the air intake of the blower at the rear of the rectifier cabinet with a piece of cardboard. ***Requirement:*** Vane switch opens, rectifier shuts down, and FAN FAIL lamp lights.
3	Remove the cardboard and operate the RECT switch to OFF and then to ON. ***Requirement:*** Vane switch closes and FAN FAIL lamp extinguishes.

4.10 Changing the air filter as required and keeping rectifying cells clean is especially important to prevent excessive heating.

5. TROUBLES

5.01 In general, the only item likely to become defective with use is the V1 electron tube which is subject to aging.

5.02 The control potentiometers and the switches should be replaced if they become defective in any respect.

5.03 To avoid unbalance, only the complete rectifying element (stack) should be replaced. In no case should any attempt be made to replace part of the rectifier cells in the stack or bolt assembly which is part of the rectifying element.

5.04 The saturating current, although it may vary widely in extreme conditions, when observed in daily routine can serve as a guide to the causes of unusual operation or trouble conditions.

TROUBLE CHART

5.05 Should any of the following troubles develop, it is suggested that the possible causes be checked in the order given. If the trouble is not found, look for loose or open connections or short circuits due to foreign matter lying across wiring terminals. If a check of the possible causes listed or the use of the point-to-point voltages (Table A) does not lead to the location of the trouble, it is advisable to make resistance measurements with the circuit completely de-energized, comparing the measured values with the values shown on the circuit drawing.

TROUBLE	POSSIBLE CAUSE
(a) No dc output current (no saturating current)	Blown ac supply fuse. CB3 circuit breaker in OFF position.
(b) No dc output current (high SAT CURRENT 2, no SAT CURRENT 1)	TC relay failure. Faulty R1 resistor or COMP potentiometer.
(c) No dc output current (high SAT CURRENT 2, normal SAT CURRENT 1)	LC or RL relay failure. Faulty R19, V1, CR7, CR8, C16.
(d) High dc output current	AR1 ammeter relay high contact set incorrectly.
(e) Rectifier does not raise or lower the output current (under these conditions rectifier shuts off normally)	Faulty Q1, Q2, or Q3 transistor. RL or RR relay failure.
(f) Output excessively noisy	Defective filter capacitors. Unbalanced ac line voltage (more than 5 percent). Defective germanium rectifiers. BAL 1 through BAL 6 potentiometers misadjusted (see Section 169-623-306). Open CR1 through CR6 germanium rectifiers.
(g) Rectifier shuts off after short interval of operation	OL relay misadjusted.
(h) Too fast raising or lowering of the dc output current upon application of the raise or lower signal	AHR or AHL potentiometer misadjusted.

6. POINT-TO-POINT VOLTAGES

6.01 Point-to-point voltages are intended for use when unsatisfactory operation is encountered, in which case, they may prove useful in locating the defective conditions. They are not operating requirements to be checked in routine and are not needed while the rectifier unit is operating satisfactorily. Voltages given are approximate and typical of a unit connected to normal power supply, adjusted to the voltage, and carrying load as indicated.

6.02 ***High voltages*** are present in the rectifier unit and every precaution should be observed to avoid any contact with exposed metal parts or terminals when the rectifier unit is in operation.

Caution: When using any portable instrument, the leads should be carefully examined to make sure the insulation is undamaged. The leads should be connected at the instrument before making contact with the circuit to be tested. If connections are to be changed from one instrument range to another, the ac should first be disconnected from the equipment being tested or, if test picks are being used, they should be removed from the equipment under test.

6.03 Readings may be made with the KS-14510 volt-ohm-milliammeter, the resistance of which is 20,000 ohms per volt, or with any available instrument having higher resistance. Values of voltage given are obtained with the KS-14510 meter. The output of the rectifier will not be appreciably affected by connecting either of these instruments to check the values given in the table.

6.04 The voltage readings represent typical values at 206 volts ac line voltage, measured at the rectifier input and with the output voltage and current as indicated.

TABLE A — POINT-TO-POINT VOLTAGES

OUTPUT VOLTS = 50 VOLTS

OUTPUT CURRENT = 100 AMPERES

SAT CURRENT 2 = 110 MILLIAMPERES

METER CONNECTIONS		METER	READING
TEST POINT	TEST POINT	SCALE VOLTS	VOLTS
Contactor AC			
T1	T2	300	206 AC
T1	T3	300	206 AC
T2	T3	300	206 AC
Transformer T1			
Term. 1	Term. 4	300	206 AC
Term. 8	Term. 9	60	50 AC
Transformer T2			
Term. 1	Term. 2	300	206 AC
Term. 8	Term. 9	60	28 AC
Term. 6	Term. 7	300	150 AC
Transistor Q1			
*Emitter TP9	Base TP10	0.300	0.125 DC
*Base TP10	Collector TP11	60	17 DC
Transistor Q2			
*Emitter (CAN)	Base TP13	0.300	0.150 DC
*Base TP13	Collector TP12	60	17.5 DC
Transistor Q3			
*Emitter (CAN)	Base TP15	0.300	0.150 DC
*Base TP15	Collector TP14	60	17.5 DC
Resistors			
R3	Across Each Resistor	60	22.5 DC
R8		60	40 DC
R9		60	38 DC
R12 & R14		12	5.5 DC

*In taking meter readings, connect the + side of the meter to the transistor terminals indicated by an asterisk. AC readings have no polarity.

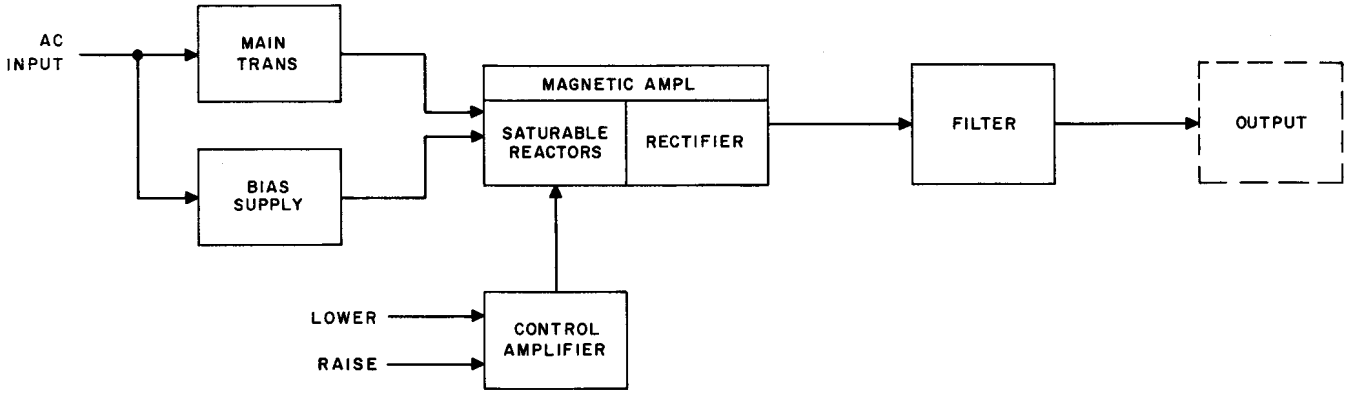

Fig. 1 — J86273 Rectifier — Block Diagram