

700
CIRCUIT DESCRIPTION
POWER DEVELOPMENT DEPARTMENT

CD-81396-01
Issue 3-A
Appendix 2-B
Dwg. Issue 6-B

POWER SYSTEMS
RECTIFIER CIRCUIT
SEMI-CONDUCTOR TYPE - AUTOMATIC REGULATION
48 & 24 VOLT, 30 AMPERES
J86231A

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1. The manual control potentiometer covered by the T option is being made Mfr. Disc. and the S option is being made A&M. N option added.

D.2 2A keytop shown for (S1) key unit.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5154-FPH-FWC-BK

POWER SYSTEMS
RECTIFIER CIRCUIT
SEMICONDUCTOR TYPE - AUTOMATIC REGULATION
48 & 24 VOLT, 30 AMPERES
J86231A

CHANGES

B. CHANGES IN APPARATUS

- B.1 Resistor R12 (KS-13491,LL) added as part of "S" option.
- B.2 Resistor R4 (100E) added as part of "P" option.

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 "S" option added to increase the rectifier stability when operating on manual control. "S" option should be used if difficulty is encountered in manually adjusting the rectifier output.

- D.2 CAD 2 added.
- D.3 Resistors R4 and R12 added.
- D.4 Tolerance suffix letters were not shown in App. Fig. 1 for the R1-1, R1-2, R2, R3, R5 and R6 resistors (record only).
- D.5 The sketch on Sheet 1 was not labeled Note 302 (record only).
- D.6 20 amp. fusetrans in FS1 were not shown in double line box (record only).
- D.7 Color of RECT FAIL lamp was not shown (record only).

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5154-PWC-CSK

POWER SYSTEMS
RECTIFIER CIRCUIT
SEMICONDUCTOR TYPE-AUTOMATIC REGULATION
48 & 24 VOLT, 30 AMPERES
J86231A

CHANGES

B. CHANGES IN APPARATUS

B.1 (R2) changed to 1000 Ω

B.2 (R8) changed to 91 Ω

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 (V) option rated M.D.

D.2 Leads to transformer (T1) were changed from terminals (1-3) to terminals (2-3)

1. PURPOSE OF CIRCUIT

1.1 This circuit automatically provides d-c power from an a-c source, and regulates the load voltage. When manually turned on this rectifier circuit connects itself to the a-c supply and thereafter automatically regulates its output voltage. A battery is not required for the satisfactory performance of this rectifier.

2. WORKING LIMITS

2.1 200, 210, 220, 230, 240 and 250 $\pm 10\%$ a-c volts rms applied to the proper taps.

60 cycle $\pm 2\%$, single phase.

2.2 D-C Output, Power Circuit Range.

| <u>Amps</u> | <u>Volts</u> |
|-------------|--------------|
| 0-30 | 49-55 |

2.3 D-C Output Voltage Regulation $\pm 1\%$ for output currents 0-30 amperes and including $\pm 8\%$ line voltage variation.

3. FUNCTIONS

3.1 To furnish d-c power to a battery and resistance load or a resistance load only.

3.2 To filter the d-c output.

3.3 To provide a meter indication of the output current.

3.4 To provide a means for manually energizing and de-energizing the rectifier.

3.5 To provide automatic regulation of the output voltage.

3.6 To provide automatic limiting of the output current.

3.7 To provide a means of shutting off the rectifier when the rectifier fails on high output.

4. CONNECTING CIRCUITS

This rectifier was developed for initial use with the following circuits.

4.1 Circuit Package Schematics Regulator Circuits - SD-81452-01.

4.2 Charge and Discharge Circuit 10-120 Amp, 48 Volt - SD-81424-01.

4.3 Charge and Discharge Circuit 10-120 Amp, 24 Volt - SD-81466-01.

5. GENERAL

5.1 The main rectifying stack (CR1-4) with the (CM) mag. amp., CPS1-3 and associated circuitry form a closed loop servo system. The output voltage is compared with a standard voltage, the difference is called an error signal. The rectifier functions to reduce the error signal to a minimum, theoretically to zero. When the error signal is a minimum, the output voltage will be proportional to the standard voltage. With the error signal reduced to a minimum the output of the rectifier is voltage regulated.

When the output current exceeds a preset value the circuit transfers from voltage regulation, that is the error signal is proportional to the output current.

A familiarity with the circuits shown on SD-81452-01 is required for the understanding of this circuit.

6. VOLTAGE REGULATION

6.1 The circuit between (6L) and (2L) in CPS3 is a voltage divider circuit consisting of the (R2) and (R4) resistors of CPS3, the (R1) resistor in CPS1 and the volt adj potentiometer. The regulated voltage is fed over the (RG-) and (RC-) leads to this circuit and the voltage between (1L) and (6L) of CPS3 is proportional

to the regulated voltage. The voltage between (4R) and (6L) of CPS3 is equal to the voltage developed across the voltage stabilized diode in CPS3 and is substantially constant. The voltage between (1L) and (4R) of CPS3 is proportional to the difference between the regulated voltage and the stabilized voltage. This voltage difference is called an error signal. The error signal is applied to (2R) and (3L) of CPS2 where it is amplified. The output of CPS2 is applied to the base of the (Q3) transistor over the (6L) terminal. A change in base current, results in a change of collector current in the (Q3) transistor. This collector current is sent back to CPS2 on the (6R) terminal where it is passed through the (CR1) diode and returned over the (1L) terminal. This current is then passed through the (4-3) winding of the (CM) saturable reactor. An increase in the collector current increases the output current of the rectifier a decrease in the current decreases the output current of the rectifier.

7. CURRENT REGULATION

7.1 (T2) is a current transformer. The current in the secondary is proportional to the output current. Part of the secondary current is bypassed through the (R2) resistor, for safety reasons the remainder is sent over (6R) and (1R) to CPS1 where it is rectified. This equipment shall never be operated with the (R2) resistance disconnected since a high voltage may appear on terminals 3 and 4 of T2 if CPS1 should be removed for any reason. The output appears at (6L) and (1L) of CPS2, and the voltage across the (CC) potentiometer in series with the (C) relay is proportional to the output current. (1L) and (6R) of CPS3 are connected through the (CR1) diode. When the voltage between (1L) and (6L) is more negative than the voltage between (6R) and (6L) and (CR1) diode is back biased and the rectifier output is under control of the (Volt Adj) potentiometer e.g. the rectifier is voltage regulated. When the voltage between (6R) and (6L) is more negative than the voltage between (1L) and (6L) the (CR1) diode is forward biased, then the rectifier is under control of the (CC) potentiometer e.g. the rectifier is current regulated. The error signal for current regulation is the difference between the standard voltage and the voltage

between (6R) and (6L) of CPS3. The regulator acts on this signal in the same manner as that described above for voltage regulation.

8. RECTIFIER OPERATION

8.1 Placing the Rectifier in Service

To place the rectifier in service operate the (ON-OFF) key to (ON) position. With (ON-OFF) key in the (ON) position and the (RF) relay released the (CT) contactor will operate and close the (L1-T1) and (L2-T2) contacts and connect the rectifier to the AC service.

8.2 Adjustments

Rotate the (CC) pot and the (Volt Adj) pot to the maximum CCW position. Operate the (ON-OFF) key to the (ON) position. The R4 potentiometer is factory adjusted and locked and should not be moved for normal maintenance. The usual factory adjustment will provide approximately 15 volts across the (bias) terminals with normal line voltage on a transformer (T1) primary tap. Rotate the (Volt Adj) pot in a CW direction until the rectifier is voltage regulating. Increase the load until the (OUTPUT) meter is reading 33 amperes. Rotate the (CC) pot in a CW direction until the (OUTPUT) meter is reading 32 amperes.

9. RECTIFIER FAILURE

If the rectifier is putting out more than 15 amperes the (C) relay will be operated. If the plant reaches high discharge voltage limit battery will be applied to the (F-) lead. If the (C) relay is operated and high float is reached the (RF) relay is operated. If a fuse fails the (RF) relay will be operated over its primary winding. An operated (RF) relay opens the operate path of the (CT) contact and disconnects the rectifier from the AC power. The (RF) relay locks up on a back contact through the (R8) resistor and the (ON-OFF) key.

In order to restore the rectifier the (ON-OFF) key must be first operated to the (OFF) position then to the (ON) position.

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DEPT. 5152-KK-CSK