4

POWER SYSTEMS
REGULATOR CONTROL CIRCUIT
SEMICONDUCTOR TYPE
J87214A

CHANGES

D. Description of Changes

D.1 The "W" Option is added and the "Z" Option is rated Mfr Disc. This change sharpens the droop characteristics of the J87211A rectifier when it is utilized in the 2A automatic call distributor battery reserve power plant.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5454-RR-CSK-EJO

CIRCUIT DESCRIPTION

CD-81541-01
ISSUE 3AC
APPENDIX 1D
DWG ISSUE 6D

3

POWER SYSTEMS
REGULATOR CONTROL CIRCUIT
SEMI-CONDUCTOR TYPE
J87214A

CHANGES

B. Changes in Apparatus

B.1 Added

R10 Resistor "X" Option 145A 2050

B.2

Superseded	Superseded By
R1 Resistor 145A 1470 ohm "Y" Option	R1 Resistor 145A 3160 ohm "X" Option

D. Description of Changes

D.1 The R1 resistor is changed to increase the pulse output power by increasing the supply voltage of the blocking oscillator circuit. The R10 resistor is added to prevent reverse charging of capacitor C2 when Q1 turns on. This change eliminates erratic pulse signals at light loads.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5154-RR-CSK-EAF

POWER SYSTEMS
REGULATOR CONTROL CIRCUIT
SEMI-CONDUCTOR TYPE
J87214A

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The control regulator herein described is to be used in conjunction with single phase PNPN rectifiers. This circuit automatically provides means whereby the output of the connected circuit is voltage and current regulated.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The control circuit was developed to be used in conjunction with a full wave rectifier circuit. A typical rectifier circuit is shown in Information Note 302.

2.02 A transformer and diodes form the full wave rectifier circuit. A PNPN device blocks the output of the rectifier.

2.03 Q2 transistor acts as an error detector and senses the output voltage. This voltage is compared with the voltage developed across the Z1 and Z2 zener diodes in the emitter circuit of Q2. The difference or error signal is then fed to Q1 transistor, a blocking oscillator, which fires a pulse in accord with the error signal. This pulse is developed across T1 transformer and applied to the gate circuit of the PNPN device. The PNPN then conducts and permits current to flow from the rectifier to the load.

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

SECTION II - DETAILED DESCRIPTION

1. VOLTAGE REGULATION

1.01 The voltage developed across the PNPN device fires Z3 zener diode through R1 resistor. The emitter of Q1 blocking oscillator transistor is held negative with respect to the base by the voltage drop across Z3 zener diode, also at the start of each half cycle of the power frequency the voltage across the C2 capacitor is approximately zero. Therefore, at the beginning of each half cycle the base to emitter circuit of Q1 transistor will be reverse biased and Q1 transistor will be in the nonconducting state. A current sink consisting of Q2 transistor and R2 resistor charges the C2 capacitor until the base of Q1 transistor becomes slightly negative with respect to the emitter. Q1 transistor then turns on and pulses T1 transformer. This pulse is fed to the gate circuit of the PNPN device to switch it to its conducting state.

1.02 The voltage across the PNPN device collapses. D2 diode becomes forward biased and clamps the base of Q1 transistor to the cathode of the PNPN device to bias the Q1 transistor in the off condition. D2 diode also discharges C2 capacitor through R1 resistor and the PNPN device, to its initial value of zero volts.

1.03 At the end of each half cycle of the power frequency the "flyback" diode in the rectifier discharges the filter inductor. The "flyback" action reduces the current through the PNPN device below the required holding current, thereby turning the PNPN off. At the beginning of each half cycle the PNPN device is in a blocking condition and must be pulsed in order to permit current flow.

1.04 By relaxing a periodic step function onto the C2 capacitor, through a current sink Q2 transistor the wave shape appearing across the C2 capacitor will be a periodic ramp function. The slope of the ramp function and hence the point at which the PNPN device is fired, is dependent upon the current in the current sink. When this current is increased the slope is increased and the PNPN device is fired early in the cycle. When the current in the current sink is decreased the PNPN is fired later in the cycle.

1.05 Voltage regulation is achieved by making the current in the current sink, Q2 transistor, inversely proportional to the output voltage. This is done by using Q2 transistor for two purposes; 1, as a current sink which has been previously described, and 2, as an error detector which will now be described.

1.06 Q2 transistor is connected across the output voltage in a manner such that a portion of the output voltage is compared with a reference voltage developed across the Z1 and Z2 zener diodes in the emitter circuit. The difference between that portion of the output voltage and the reference voltage is applied between the base and emitter of Q2 transistor. If the output voltage is high the difference voltage VBE is reduced, thereby decreasing current flow through the Q2 transistor, and as discussed previously, decreasing the slope of the ramp function, and forcing the PNPN to fire later, thus

reducing the output voltage. In a similar manner output voltage may be increased. The output voltage is controlled by the setting of R7 resistor (Volt Adj.).

2. CURRENT REGULATION

2.01 Q3 transistor along with R3, R4 and R5 resistors (C.C.) current regulate the rectifier. At current values below the preset value Q3 transistor is reverse biased and is in a nonconducting condition. When the preset value of current is exceeded, which depends on the setting of R5 resistor, Q3 transistor is turned on due to the drop across the portion of R5 in the circuit exceeding the drop in R4 and varistor RV2. This action shunts down Z1 and Z2 zener reference diodes to reduce the output voltage so as to maintain constant current.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Working limits are determined by the connected rectifier circuit.

2. FUNCTIONAL DESIGNATIONS - None.

3. FUNCTIONS

3.01 To provide means of automatic regulation of the output voltage of the connected rectifier.

3.02 To provide means of automatic limiting of the output current of the connected rectifier.

3.03 To provide pulses in the proper sequence to PNPN rectifiers in the associated circuit.

4. CONNECTING CIRCUITS

4.01 This regulator control circuit was developed for initial use with the following circuits

Regulated Rectifier - SD-81540-01.
Regulated Rectifier - SD-81567-01.

SECTION IV - REASONS FOR REISSUE

CHANGES

B. Changes in Apparatus

B.1 Added:

R9 Resistor 10,000Ω, 145A

D. Description of Changes

D.1 Circuit note 105 was added.

D.2 The R9 resistor is added with the "Z" option. The option is required when the control circuit is used with the J87211A rectifier in the battery reserve power plant of the 2A Automatic Call Distributor.

The change provides a minimum firing angle signal to the rectifier to establish an output voltage at the rectifier terminals at no load. The voltage is required for alarm systems in the above power plant.

D.3 Rating changed from AT&TCo. Provisional to AT&TCo. Standard.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5154-RR-CSK-EAF