

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

B. CHANGES IN APPARATUS

B.1	Replaced	Replaced By
	23A Varistor	KS-15657, L7
	Rheo. KS-5563, L5 } or Potentiometer } KS-13650, L1 }	Rectifier Stock KS-13790, L1

C. CHANGES IN CIRCUIT REQUIREMENTS
OTHER THAN THOSE APPLYING TO
ADDED OR REMOVED APPARATUS

C.1 In Circuit Requirements table -
Fig. 5 - Arm travel formerly was "spl".

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The code of the meter was removed from
the drawing per Circuit Note 112.

D.2 In Circuit Note 101, leads marked "PT"
were formerly marked "A". The
sentence "Leads marked "A" shall be as short
as possible" was deleted from note. Leads
now marked "D" and "D1" were formerly
marked "A".

D.3 In CD, under 8, Equalizing Charge for
Battery - delete first sentence from
second paragraph about grid battery.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 5750-HMK-DET-P1

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 The (GR) relay was changed from an R to U type to provide a relay suitable for more operations which will be encountered when this rectifier is applied in the 105D power plant.

B. CHANGES IN APPARATUS

B.1 Superseded	Superseded By
(GR) relay R1089	U349 relay
AM wire	KS-13385 solid wire

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Figures 4 and 5 added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 5740-FWA-DET-B

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS & AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

Superseded	Superseded By	Remarks
B.1 (E) and (F) resistances 38W or KS-8059	(KS-13491 L1)	See Note 1.
B.2 (S) resistance KS-8059 2 Megohms	(KS-13491L3) 2.2 Megohms	Value was changed to preferred RMA value. See Note 1.
B.3 (A) ammeter Blj or Weston Model 301	HLJ	
B.4 Type "F" wire	Type "AN" wire	
B.5 Grid battery KS-7889 49.5 V.	KS-7889 46.5 V.	The rectifier operates satisfactorily with either grid battery voltage.
D.6 Portable cord type S 2 conductor No. 14 3' long and Hubbell No. 7185 cap or type P cord and Hubbell No. 7057 cap or KS-8401 cord and cap	Input cord and plug	See Note 1.

B.7 KS-13650L1 has been added as an
alternate at (R) in Fig. 3.

drawing. This informa-
tion is shown on the
equipment drawing.

Note 1: The resistance tolerance
and wattage rating have
been added at (E), (F)
and (S) resistances. The
code numbers of these
resistances and the input
cord and plug have been
removed from the circuit

B.8 Weston Model 613 Time Delay Re-
lay formerly specified as an
alternate for KS-5596L01 has been re-
moved, as this is only another method
of specifying the relay.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT, 3250-FWA-CHA-PH

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS 60 CYCLES A-C
50 VOLTS, 8 AMPS. CONT. 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 "V" wiring and apparatus was added to improve the filtering of the rectifier noise at carrier and low radio frequencies.

B. CHANGES IN APPARATUS

- B.1 The 226A condenser (T) was added.
- B.2 The 310A condensers (H), (H1) and (D) were changed to 310B.
- B.3 The 38W resistances (E) and (F) were changed to KS-8059.
- B.4 The Time Delay Relay (TD) is described as KS-5596, List 01 instead of per Power Data Sect. 15.71, Item 1601.
- B.5 The B1J ammeter was made optional with the Weston Model 301.
- B.6 Hubbel Cap 7057 and Type "P" Cord was made optional.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 To improve the filtering with "V" wiring in the carrier and low radio frequency range the condenser (T) was shunted across the secondary of the (T1) plate transformer. The size of the plate filter condensers (H) and (H1) was doubled. The condenser (D) on the plus output lead was doubled.

D.2 The B1J meter was made optional with the Weston Model 301. These meters are electrically and mechanically interchangeable.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3250-DET-CHA

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

B.1 The (S) resistance was added.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO
ADDED OR REMOVED APPARATUS

C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The (S) resistance was added to by pass the small amount
of current picked up by the tube grids around the grid
battery.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3250

DET) TI
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POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS, CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED
J86207J

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

B.1 None.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Requirements were added to facilitate testing the (GR) relay when the rectifier is used with either positive or negative ground batteries.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 On issue 4-D only, the "M" wiring provided for the connection of the (A) resistance to the (G+) punching instead of the (A+) punching.

All other headings, no change.

DEPT. 3250

BELL TELEPHONE LABORATORIES, INC.

DET)
RDdek } MT

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED

CHANGES

A. CHANGED AND ADDED FUNCTIONS

- A.1 Provisions were made to enable this rectifier to be operated with batteries having their negative terminal grounded.

B. CHANGES IN APPARATUS

- B.1 Punching (G+) was added.
B.2 KS-8401 Cord and cap was made optional equipment.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

- C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 The positive regulating lead was formerly connected internally to the positive output lead, shown now as "M" wiring. This part of the circuit was changed to "N" wiring, by connecting the regulating lead to a punching (G+). This makes it possible to fuse the ungrounded regulating lead.
D.2 Note 108 - Reference to the (G+) punching was added. Notes 113 and 114 were added.

All other headings, No Change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3250

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POWER SYSTEMS
REGULATED TUBE RECTIFIER CIRCUIT
MAGNITUDE CONTROL
115/230 VOLTS, 60 CYCLES A-C
50 VOLTS 8 AMPS. CONT., 10 AMPS. INTR. D-C
PANEL MOUNTED

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

B.1 Resistance "A", changed from 100B to 63CY.

B.2 Resistance "B", changed from 63DN to 63 DT.

B.3 Rheostat "R", changed from 1500 ohms Power Data Section 14.19 Item 710 to 2500 ohms Power Data Section 14.19 Item 811.

B.4 Condensers "D", "H" and "H1", 310A was made optional.

B.5 Tubes V1 and V2, 355A tubes were made optional.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. 2 was formerly part of Fig. 1.

D.2 Fig. 3 was added.

D.3 "X" and "Y" wiring was added, Fig. 1 formerly showed "X" wiring.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

TPT. 331

(deK)
(ET)c

POWER SYSTEMS
REGULATED TUBE RECTIFIER CKT.
MAGNITUDE CONTROL
115/230 VOLTS, 60-CYCLES A-C
50 VOLTS 8 AMPS. CONT. 10 AMPS. INTR. D-C
PANEL MOUNTED

CHANGES

A. CHANGED AND ADDED FUNCTIONS

- A.1 Retardation Coil (L1) has been included as part of the rectifier code.

B. CHANGES IN APPARATUS

- B.1 Punching (C) removed.
B.2 Retardation coil (L1) was added.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

- C.1 3T(GR) was added in "Block or Insulate" Column for (GR) relay.
C.2 Test Note 1 formerly specified that relay operate in 45 ± 5 seconds.

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 Output punching (C) was formerly connected to the terminal on the ballast lamp which now is connected to Terminal 6 on (T1).
D.3 The last three sentences were added to Circuit Note 101.

D.3 "A&M ONLY" was added to Note 105.

D.4 Notes 108 and 109 were added.

All other headings, No Change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 331

DET }
RDdek } HE

POWER SYSTEMS
REGULATED RECTIFIER CIRCUIT
115/230 VOLTS, 60 CYCLES, A-C
50 VOLTS, 8 AMP. CONT., 10 AMP. INTR., D-C
PANEL MOUNTED

1. PURPOSE OF CIRCUIT

- 1.1 This circuit is designed for providing d-c power for charging storage batteries from an a-c supply.

2. WORKING LIMITS

- 2.1 A-C input 105-125 volts or 190-250 volts, 60 cycles.
- 2.2 D-C output at nominal line voltages:
50 volts, 8 amperes - continuous - floating
50 volts, 10 amperes - intermittent - charging
54 volts, 7 amperes - continuous - charging

3. FUNCTIONS

- 3.1 To provide a means for rectifying a-c power to filtered d-c supply for charging a 23 cell storage battery. The rectifier will float loads up to its continuous rated load of 8 amperes with changes in line voltage not exceeding $\pm 5\%$. For loads above this, and without change in adjustment, the rectifier will deliver the intermittent rating of 10 amperes, but at a reduced voltage. If it is desired to fully float the battery at all times, the load connected to the battery must be limited to 8 amperes. However, this rectifier may be used for batteries having variable loads larger than 8 amperes if there is sufficient time to charge the battery during light load periods when the load is less than the output of the rectifier. The excess load is taken from the battery during the heavy load period and no change in the adjustment of the rectifier is required due to this method of operation.

4. CONNECTING CIRCUITS

- 4.1 Power charge, and discharge circuits.

DESCRIPTION OF OPERATION

5. The power rectifier circuit consists of a transformer "T1" which furnishes plate voltage for the rectifier tubes "V1" and "V2". Transformer "T2" furnishes the filament for the rectifier tubes "V1" and "V2" and has an additional winding to supply 5 volts to the time delay relay and 8.5 volts to the varistor "H". The d-c output of the rectifier is filtered by means of a retardation coil connected in the negative charge lead, which is part of the charge and discharge circuit. It is necessary to use this coil in order to obtain regulation from this rectifier. Ballast lamp (V3) is used to absorb the excess voltage from the rectifier when operating with high line voltage and low battery voltage. Ammeter "A" is provided to read the charging current.

The regulating circuit consists of resistances "B", "E", "F", rheostat "R", varistor "H" and the grid battery. A point between the resistance "B" and the rheostat "R" is connected to the rectifying tubes through the "C" battery and the resistances "E" and "F" by way of the lower contacts 1-2 of the "GR" relay. The drop across the resistance "B" is negative with respect to the cathode of the rectifying tubes and the "C" battery is poled to oppose this voltage sufficiently to allow a net negative voltage of 1 to 3 volts to be applied to the grids of the rectifying tubes. When the battery voltage is at the floating value this negative grid voltage is sufficient to reduce the output of the tube to a small value just sufficient to float the battery. When a load is applied to the battery, its terminal voltage drops slightly and this small change in voltage is reflected over the regulating lead (-RC) to the varistor "H", rheostat "R", grid battery and resistances "E" and "F" to the grids of the tubes, reducing the value of the net negative voltage. With reduced negative voltage the output current of the tubes increase until it is sufficient to return the battery voltage to the floating value. This operation will continue until the load on the battery has reduced the net grid voltage to approximately less than one volt. If the grid voltage is less than one volt, the grids lose control and the tubes carry current during practically their entire cycle and operate in the same manner as the conventional two element tubes. Under this condition, when the load on the battery is equal to the full load capacity of the rectifier or greater, the output current of the rectifier is determined by the battery voltage, transformer secondary voltage, drop over the ballast lamp and the impedance drops in the series charging circuit. The ballast lamp at loads less than full load has a small voltage drop. With loads of 10 amperes the voltage drop increases rapidly and tends to limit the rectifier output current. The resistances "E" and "F" limit the grid current to a small value and assist in load regulation.

The relays "GR" and "TD" serve as a time delay to prevent bombardment of the cathodes of the rectifier tubes "V1" and "V2" while their filaments are heating. During the starting period, negative voltage is obtained from the varistor lead through lower control 3 of the (GR) relay to the grids. This furnishes a negative voltage sheath around the cathode to protect it until the filament has normal emission. At the same time, the filament starts to heat and voltage from the 4-5 winding of "T2" is applied through the top contacts "2-1" of the "GR" relay to the heater of the "TD" relay. After 45 ± 5 seconds, the "TD" relay contacts close and operate the "GR" relay, using current from the varistor "N". The "GR" relay locks up over its top contacts "3-4" which, disconnects the heater of the "TD" relay with its top "2-1" contacts and transfers the grid from the regulating lead on its lower contact "3" to the normal regulating circuit connected to its lower contact "1". The varistor "H" and condenser "C" provide a small source of filtered d-c to operate the "GR" relay and also to provide a variable voltage to the grids of the rectifying tubes "V1" and "V2". This compensates for line voltage changes. When the line voltage changes, the small d-c source changes in direct proportion and this fraction of volt change, reflected through the regulating circuit to the grids of the rectifying tubes is of sufficient magnitude to compensate for the change in the grid characteristics of the tubes due to a change in the plate voltage supply to the tubes. This feature permits the line voltage to change with very little effect on the regulated voltage when the grids of the rectifying tubes have control.

The retardation coils "L3" and "L4", condensers "H", "H1" and "D" serve to suppress the radio interference generated in the rectifying tubes.

a 49.5 volt grid battery (33 cells) shall be connected to the C+ and C- terminals. It is important to use the correct number of cells in the grid battery. When the battery is new the rheostat "R" shall be near the counter-clockwise end of its travel (facing the front of the rectifier) and when the rheostat "R" is in its maximum clockwise position, it will indicate that the grid battery has aged and should be replaced. Cells should not be added to compensate for decreased battery voltage but the entire battery should be replaced when aged.

6. ADJUSTING THE REGULATING VOLTAGE

Charge the battery by removing the fuse in the (-RC) lead until its voltage is at the upper end of the floating range. Replace the fuse and turn the rheostat "R" until the rectifier output is approximately 3 amperes with the voltage still at the upper end of the floating range. The rectifier current will in several minutes change to the value required to float the load and the voltage will remain

in the floating range if the rectifier output is less than 8 amperes. With larger rectifier output current the voltage will decrease to approximately two volts per cell. Never attempt to adjust the regulated voltage by rheostat "R" when the voltage is not at the upper end of the regulating range. The voltage should be checked again at suitable intervals and the regulated voltage adjusted as described above if necessary. When checking the regulated voltage be sure that the rectifier output is less than 3 amperes.

7. POWER FAILURE CONDITION

No adjustments are required after a power failure. If the battery is discharged, the rectifier when the power is restored will charge the battery at a rate between 9 and 11 amperes until the voltage is up to the floating value.

8. EQUALIZING CHARGE FOR BATTERY

An equalizing charge may be given to the battery by removing the fuse in the (-RC) lead. The rectifier is designed to give a voltage output of approximately 54 volts to give a proper equalizing charge for 23 cells. However, at the higher output voltages the current output will decrease, the decrease being greater for lower a-c line voltages. After completion of the equalizing charge replace the fuse in the (-RC) lead and the voltage will return to the floating value all with no change in the rheostat "R".

It is important that the grid battery used in the rectifier should be less than three months old when installed, as the life of this type of battery is approximately two years from its date of manufacture. After a new battery is installed there might be a slight increase in the regulated voltage which will decrease with time. When regulated voltage decreases, the rheostat "R" should be turned in a clockwise position to bring the voltage up to the floating value.

An open in the regulating circuit will cause the rectifier to deliver its maximum output.

If the regulating circuit is functioning a counter-clockwise rotation of the rheostat "R" will always reduce the rectifier output current to approximately no load or a removal of the fuse in the (-RC) lead will cause the output current to increase to its maximum value.

BELL TELEPHONE LABORATORIES, INC.

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