POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V.
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Changed Tables D and C to show 6-volt strapping and (D) and (E) Options.

D.2 Lead designation for negative plant shown in Fig. 3B.

All other headings no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5152-PWC-JMD-CI

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERES POS. AND NEG. 130V.
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 In Fig. 16, the "RFA" lead to the Charge Circuit is added.

D.2 In Fig. 3B charge fuse size options are added.

D.3 In Table C, extra paralleling straps are removed in the range 0.75 ohms to 0.33 ohms.

D.4 Note 114 is added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5152-WJM-HHS-GM

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. 5A was formerly part of Fig. 5.

D.2 Lead sizes specified in various figures are removed. Tables E and F are added to give lead calculation data.

D.3 In Fig. 18 connection of the NDF lead to Fig. 12 is added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5232-WJM-HHS-LR

CD-80942-01
Issue 3-D
Appendix 3-D
Dwg. Issue 14-D

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V.
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 To add requirements for negative 130 volt plants with 66 cells for 10-40 amp. variable loads and 1-25 amp. and 10-40 amp. fixed loads.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 In Note 111, options for 10 to 40 amp. 66 cell negative plants with variable loads added and for 1-25 amp. and to 10 to 40 amp. for fixed loads added.

D.2 In Fig. 5, leads to Fig. 3B added.

D.3 Titles added to Figs. 1, 1B, 2, 3, 4 and 5.

D.4 Options X and Y added to Figs. 17, 18 and 21.

D.5 In Fig. 3B, reference on leads to Fig. 5 added.

D.6 In Figs. 1 and 1B, 177C network was previously shown as 181C network and in Fig. 11, 177F network was shown as 181F.

D.7 In Fig. 23, No. 6 wire is specified for connection to Fig. 17.

D.8 Parallel connectors are shown in Fig. 23 for transition to larger conductors when required.

D.9 Note 113 added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5232-MTA-HHS-SL

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 To provide shunt resistor for (T2) relay (Fig. 20) to give longer release time.

A.2 To specify special adjustment for (H1) and (L1) relays (Fig. 18) to make relays release faster.

A.3 To replace (G1) relay (Fig. 20) to isolate ground paths of (T1) relay and (C1) contactor.

B. CHANGES IN APPARATUS

B.1 Replaced	Replaced By
(G1) U490 relay (Fig. 20A)	(G1) U442 Relay (Fig. 20B)

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

C.1 Operate current values for (H1) & (L1) relays (Fig. 18) were 7.5 Test and 7.1 Readjust and release values were not shown.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. 20A, rated "Mfr. Disc." was part of Fig. 20.

D.2 Fig. 20B was added.

D.3 In Fig. 20, "F" option was added.

D.4 In Note 111, Fig. 20B and "F" option added for +130V, 40 amp. plants.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 5740-SDV-HHS-P1

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V.
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

B. CHANGES IN APPARATUS

B.1

Replaced	Replaced By
Contactor C1, C2 KS-5722 L7	Contactor C1, C2 KS-5722 L11
Contactor C1, C2 KS-5722 L8	Contactor C1, C2 KS-5722 L12

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

C.1 In circuit requirements for Fig. 17, "R" & "H" option was "R" option and "Q" and "H" option was "Q" option, and options "R" & "G" and "Q" & "G" were not shown.

D. DESCRIPTION OF CIRCUIT CHANGES

D.01 In Fig. 3 and Fig. 3B, CHG GRD busbars were shown tied together with No. 8 lead desig. "D".

D.02 In Fig. 9, "A" lead was shown as a No. 10 lead.

D.03 In Fig. 17, "H" and "G" options were added for (C1) and (C2) contactors.

D.04 In titles for Figs. 20 and 21, "contactor" was shown as "contractor".

D.05 In Fig. 17, "A" lead to Fig. 2 or 4 was No. 6 lead.

D.06 In Fig. 21, "A" lead to Fig. 2 or 4 was No. 6 lead and "A" lead to Fig. 8, 9 or 10 was No. 8 lead.

D.07 In Fig. 22, .022 ohm resistance values of R1A, R2A, R1B and R2B resistors were incorrectly shown as 0.22 ohm.

D.08 In table "D" heading, No. 8 wire was shown as No. 10 wire.

D.09 In table "B", "Strapping for Fig. 1D" was added to heading for terminals A, B and C.

D.10 Note 112 was added.

D.11 In Note 111, "N" option was added in table for "+130V variable load 66 cells, 1-25 amps. load." Fig. 16 was removed from table for -130V variable load for both 70 cells and 66 cells 1-25 amp.

D.12 In Note 108, "G" & "H" options were added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 5740-SDV-JMD-P1

POWER SYSTEMS
400 TYPE PLANTS
DISCHARGE CIRCUIT
1-25 AMPERE POS. AND NEG. 130V
AUTOMATIC POWER PLANT
410A PLANT

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 This circuit was revised to provide for increasing the capacity of the positive 66 cell plant from 25 to 40 amperes.

A.2 Provision is made for operation with a positive or negative 70 cell battery.

A.3 Provision is made for use with new two-group resistor panel in place of the three-group resistor panel.

B. CHANGES IN APPARATUS

B.1 Added

Fig. 1E, 1F, 3B, 17, 19, 20, 22, 23

B.2 Table A changed to add fixed fuse capacities.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. 1E was added to show 4 cell CEMF Groups for 70 cell battery operation.

D.2 Fig. 1F was added to show resistor groups for 70 cell battery operation.

D.3 Fig. 3A was part of Fig. 3.

D.4 Note 107 rated "Mfr. Disc." replaced by note 111.

D.5 "J" option added to show 70 cell battery and "K" option for 66 cell battery.

D.6 Fig. 3B added to show charge circuit connections for rectifiers 6, 7 and 8.

D.7 Fig. 17 added to show contactor circuit for 40 ampere plants.

D.8 Fig. 18 added to show voltage control circuit for Fig. 17 or 21 contactor circuits.

D.9 Fig. 19 added to show two-group resistor circuit for 1-25 ampere. 66 cell plants.

D.10 Fig. 20 added to show contactor control circuit for Fig. 17.

D.11 Fig. 21 added to show contactor and control circuit for Fig. 19.

D.12 Fig. 22 added to show two-group resistor circuit for 10-40 ampere 66 cell plants.

D.13 Fig. 23 added to show two-group CEMF cell circuit for 25-40 ampere 66 cell plants.

D.14 Notes , , , added.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 To cover a 130 volt power discharge circuit for 1-25 ampere positive or negative 66 cell battery with provision for increasing capacity of positive plant to 40 amperes.

1.2 To cover a positive or negative 130 volt power discharge circuit for 1-25 ampere loads with 70 cell battery.

2. WORKING LIMITS

2.1 The limits for this supply during emergency operation are 125-135 volts.

3. FUNCTIONS

3.1 To provide a regulated battery supply for positive or negative 130 volt supply for fixed or variable loads with either a 66 cell or 70 cell battery.

4. CONNECTING CIRCUITS

4.1 Charge Circuit SD-80943-01.

4.2 Alarm Circuit

4.3 Auxiliary Charging Circuit SD-81016-01

DESCRIPTION OF OPERATION

5. GENERAL

This circuit is automatic in operation and may be used in unattended

stations. It uses a regulated tube rectifier of the grid controlled type to automatically float and charge a 66 cell battery.

Three groups of three counter-cells each are in series with variable loads and are automatically cut in and out as required to maintain limits of 125-135 volts. For fixed positive loads, the counter-cells may be replaced by resistors.

The positive 66 cell plant may be modified to increase its capacity to 40 amperes with the CEMF cells or resistors in two groups instead of three by specifying figures as covered in the circuit notes.

The 25 ampere plant may be modified to work with a 70 cell battery with three groups of counter-cells for variable positive or negative loads or three groups of resistors for fixed positive loads.

Normally the battery is floated by rectifiers described in the circuit description for the connecting charge circuit CD-80943-01.

The regulating leads to the charging units are run direct to the battery terminals and the 66 cell battery floated at 142 volts. The 70 cell battery is floated at 151 volts. Under this condition, in order not to exceed circuit limits of 125-135 volts, one or more groups of CEMF cells or resistors are inserted in the discharge circuit. The operation of these CEMF cells or resistors is automatically controlled as described below.

6. CEMF CELL OR RESISTOR CONTROL

6.1 Control of Three CEMF Cell or Resistor Groups (Fig. 18, 1C, 1E or 1F) 1-25 Amps.

With the circuit as shown in Fig. 1, all CEMF groups are in series with the load. This condition occurs when the battery voltage is high during periods of overcharge. When the voltage at the battery is lowered on completion of charge or due to power failure or rectifier failure, relay (VR1) makes its low contact operating relay (L1). Relay (L1) then places battery on the locked up contact of the (G3) relay causing the latter to release.

Release of the (G3) relay causes the (C3) relay to operate thereby shorting out three CEMF cells or resistor (R3) and raising the output voltage accordingly. Operation of the (C3) relay also removes battery from the winding of the (T3) relay releasing it. If the power or low voltage condition continues until the low voltage contact of the (VR1) relay is made a second time, relay (L1) will again operate placing battery on the locked up contact of the (G2) relay causing the latter to release. Release of the (G2) relay places ground on the (C2) relay operating it and shorting out three more counter-cells or resistor (R2) thereby raising the output voltage. Operation of the (C2) relay also removes battery from the (T2) relay releasing it. If the power failure continues until (VR1) makes its low contact a third time, (L1) will again operate to release (G1), operate (C1) and short out one more CEMF group or resistor (R1) again raising the output voltage. Operation of (C1) relay releases (T1) relay and if low voltage continues until (VR1) makes its low contact a fourth time, relay (L1) will remain operated since there are no more CEMF groups to cut-out to raise the voltage and an alarm will be given after relays (D1) and (D2) of Fig. 18 operate and (D1) releases again to operate relay (VA1). This alarm will continue until the voltage is raised or the alarm cut-off key is operated. On resumption of charge as the battery voltage is raised (VR1) makes its high contact operating relay (H1). (H1) operated places ground through the back contact of the (T1) relay causing the (G1) relay to operate (G1) relay operated locks up through its secondary winding to ground and removes ground from the winding of the (C1) relay releasing it. Release of the (C1) relay inserts 3 CEMF cells or resistor (R1) in the discharge circuit reducing the output voltage. It also places battery on the (T1) relay operating it. If the battery voltage again rises to the point where (VR1) again makes its high contact, relay (H1) again operates placing ground on the winding of the (G2) relay operating it and thereby releasing (C2). Relay (C2) released inserts the second CEMF group or resistor (R2) reducing the voltage and releasing (VR1). Relay (G2) operated locks up over its secondary and relay (C2) released operates relay (T2). Should the voltage continue to be raised until the high contact of (VR1) is again made, the third CEMF group will be cut into the discharge circuit to reduce the load voltage in the same manner as for the previous groups. Should the battery be charged to such a high voltage as to cause the high contact of (VR1) to make when all CEMF groups are in circuit, relay (H) will remain operated and an alarm will be given after time delay of the (D1) and (D2) relays.

6.2 Control of Two CEMF Cell or Resistor Groups 1-25 Amperes (Fig. 18, 21 & 19)

With a normal or high voltage condition both contactors are released as

shown. When the voltage at the battery is lowered, (VR1) makes its low contact, relay (L1) operates and places battery on the locked up contact of relay (G2) causing it to release. The release of the (G2) relay causes the (C2) relay to operate thereby shorting out resistor (R2) and raising the output voltage. Operation of the (C2) relay removes battery from the (T2) relay releasing it. The next operation of (VR1) on its low contact again operates relay (L1) to release (G1), operate (C1) and short out resistor (R1). Operation of (C1) relay releases (T1) relay and reoperation of (VR1) on its low contact causes relay (L1) to remain operated since there are no more resistors to cut out to raise the voltage.

An alarm will be given after relays (D1) and (D2) of Fig. 1B operate and (D1) releases again to operate relay (VR1).

As the battery voltage is raised (VR1) makes its high contact operating relay (H1) which places ground thru (T1) released to operate relay (G1) which locks. Relay (G1) operated releases relay (C1) which cuts in resistor (R1) and operates relay (T1). If (VR1) again makes its high contact, (H1) again operates, operating (G2) relay which locks and releases (C2) relay cutting in Resistor (R2) and operating relay (T2). Should the voltage rise high enough to operate (VR1) on its high contact again, an alarm will be given after a time delay by relays (D1) and (D2).

6.3 Control of Two CEMF Cell or Resistor Groups 10-40 Amperes (Fig. 17, 18, 20 and 22 or 23)

Under conditions of low voltage, when (VR1) makes on its low contact it operates relay (L1) which connects battery thru relay (T2) operated to the winding of relay (G2) causing (G2) to release. The release of relay (G2) deenergizes relay (T2) which is a slow release relay. The release of relay (G2) also closes ground to contactor (C2) which operates to short out Resistor (R2) or CEMF cells (GR2) and increase the output voltage. Relay (T2) is made slow release to allow time for the (C2) contactor to operate, reduce the output voltage, and permit (VR1) to release relay (L1) before relay (T2) extends the path to cut out the next resistor or counter-cell group.

The next operation of (VR1) on its low contact again operates relay (L1) which connects battery thru (T1) and (T2) released to shunt down relay (G1). The release of (G1) operates contactor (C1) and relay (T1). Contactor (C1) shorts out resistor (R1) or CEMF cells (GR1) thereby raising the output voltage. Reoperation of (VR1) on its low contact causes alarms to be given as above.

As the battery voltage is raised, (VR1) makes its high contact operating relay (H1) which connects ground thru relay (T1) operated to operate relay (G1) which locks. Relay (G1) in operating releases contactor (C1) to cut in resistor (R1) or CEMF cells (GR1) and reduce the output voltage and also starts relay (T1) releasing. Relay (T1) is made slow release to allow time for contactor (C1) to release, reduce the output voltage and get VR1 off its high contact to release relay (H1) and remove the ground on lead "H" before the path is closed to operate relay (G2). The next operation of (VR1) on its high contact operates relay (H1) which operates relay (G2) thru (T1) and (T2) released. The operation of (G2) locks (G2), operates (T2) and releases contactor (C2) cutting in resistor (R2) or CEMF cells (GR2) and reducing the output voltage.

Reoperation of (VR1) on its high contact gives alarms as above.

7. ALARMS (FIGS. 1B, 7, 11, 12 & 16)

This circuit includes alarms to indicate trouble conditions with individual lamps for different alarms and cut-off keys to silence audible alarms and bring in guard lamps until troubles are cleared.

A high-low voltage alarm, Fig. 1B, will indicate load voltage limits in excess of 125-135 volts. A float voltage alarm, Fig. 1B, will indicate 66 cell battery limits in excess of 139-146 volts or 70 cell battery limits in excess of 148-156 volts. This latter alarm contains a cut-off key as described in the preceding paragraph. Voltage alarms may be caused by power failure, rectifier failure, blown charge fuses or battery circuit open.

Alarm type fuses will indicate trouble due to blown fuses and will be indicated by lamp FA, Figs. 7 or 12. A rectifier alarm will be indicated by lamp RECT. FAIL. whenever failure of a rectifier shown on the charge circuit connects ground over lead D in Fig. 16 to operate relay (RCT). Operation of the RCT ACO keys cuts-off the audible alarm and locks up relay (RC) to bring up a guard lamp. After the trouble has been cleared unlocking relay (RC) the circuit returns to normal extinguishing the guard lamp.

An unbalance alarm per Fig. 11 provided for plants of both positive and negative polarities will indicate

an unbalance between the voltages of the two polarities in excess of 5 volts. Operation of the VOLT ACO key will silence the alarm and bring in a guard lamp which will be extinguished when the circuit returns to normal.

8. LOAD DISTRIBUTION

Figure 8 covers the load distribution for plate supply with filtering to permit common plate and positive telegraph or signaling supply. Two capacities of filters are provided with multiple fuses as required. Figures 9 and 10 cover load and fuse distribution for positive and negative telegraph. Figures 13 and 14 provide circuit connections for watthour meters when specified.

9. ADJUSTMENTS

Circuits per Figs. 1F, 17 or 21 are equipped with switches which permit the discharge lead to be connected thru and to remove battery from the resistors or CEMF cells per Fig. 23. This permits safe changing of resistor taps without interrupting the discharge circuit. The float voltage should be manually reduced to keep the load voltage within limits of 125-135 volts while a CEMF group is shorted out.

The switches in Figs. 17 & 21 also disconnect battery from the contactors to facilitate maintenance but with Fig.1 the contactors remain at 125-150 volt potential to ground.

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DEPT. 5740-WJM-JMD-Z2