

STEP BY STEP SYSTEMS
NO. 1, 350A, 355A, 356A OR 360A
CABLE PROTECTIVE DEVICE ALARM
CABLE INSULATION ALARM AND
PERMANENT SIGNAL ALARM CIRCUIT
ARRANGED TO OPERATE ON A SPECIFIED
NUMBER OF PERMANENT SIGNALS
PSB AND PSL BATTERY SUPPLY

CHANGES

- C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE CAUSED BY
CHANGES IN APPARATUS
- C.1 Adjustment information for D relay added to Circuit
Requirements table.
- D. DESCRIPTION OF CHANGES
- D.1 "C" lead added to Fig. 1.
- D.2 Title revised to show "Cable Protective Device Alarm" on
all sheets. This phrase was also capitalized in title.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2363-RJA-FCK

CIRCUIT DESCRIPTION

CD-31912-01
Issue 7-D
Appendix 1-D
Dwg. Issue 21-D

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CIRCUIT INSULATION ALARM AND
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CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The rating of this circuit for 356A offices is changed to A&M Only since it is expected that there will be no further demand for new 356A dial offices.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2336-JPD-RCD-F5

STEP BY STEP SYSTEMS
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CHANGES

B. CHANGES IN APPARATUS

B.1 Added

Fig. 9
1 - UA103 Relay (CA)
2 - 18AC Resistances
1 - 177E Network

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 Fig. 9 is added to receive alarms from cable protective devices.
- D.2 Circuit Notes 103 and 106 reflect the addition of Fig. 9.
- D.3 Circuit Note 108, table of network values is added.
- D.4 Information Notes 301, 302, 303 and 304 are added.
- D.5 Fuse (C) is added to circuit Note 101.
- D.6 Title was previously:

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A, 356A OR 360A
CABLE INSULATION ALARM CIRCUIT
PERMANENT SIGNAL ALARM CIRCUIT
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PSB AND PSL BATTERY SUPPLY

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

- 1.1 Fig. 2 in combination with Fig. 1 is used to give an alarm when a specified number of permanent signals occur simultaneously.
- 1.2 Fig. 3 in combination with Fig. 1 is used to give an alarm for indicating an impending cable failure where the breakdown of the insulation occurs more or less gradually. Complete service interruption may thus be forestalled when the alarm is transmitted sufficiently in advance of complete breakdown.

1.3 Fig. 4 provides facility for the use of both a permanent signal alarm and cable insulation alarms in the same office or for a number of cable insulation alarm circuits in the same office.

1.4 Figs. 5, 6 and 7 provide means for applying the CI relay to the cable conductors at approximately 20-minute intervals in No. 1, 350A or 355A Offices.

1.5 Figs. 5 and 7 provide means for applying the CI relay to the cable conductors at intervals of 2 to 4 minutes in the 356A Offices.

1.6 Provides means to give an alarm indication from cable protective devices.

2. WORKING LIMITS

2.1 Adjustable for operation on any number of simultaneous permanent signals from 2 to 41, inclusive.

2.2 Provision is made for four conditions of cable insulation failure as given in Working Limits Table.

2.3 Relay (CA) UA103

Max. Ext. Ckt. Loop - 3513 (45-52V)
Min. Ins. Res. - 20,000 Ins. Resistance

3. FUNCTIONS

3.1 For Figs. 1 and 2.

3.11 To indicate when a specified number of permanent signals occur simultaneously.

3.12 Provides for operating on permanent signals from first selectors, subscribers line circuit arranged for lockout or a combination of both.

3.13 Provides for giving a permanent signal alarm in the same or distant office.

3.14 Provides means for discontinuing audible and visual alarm.

3.15 Provides means for restoring the sensitrol relay to normal under control of a miscellaneous alarm and register circuit or alarm checking circuit.

3.16 Provides for optional means of restoring the sensitrol relay.

3.2 For Figs. 1 and 3.

3.21 To indicate if the combined insulation of a group of cable pairs falls below a specified insulation resistance.

3.22 To indicate the particular group of cable pairs in which failure occurs.

3.23 Provides for giving the alarm in the same or distant office, this alarm being the same as given for permanent signals.

3.24 Provides means for discontinuing audible and visual alarm.

3.25 Provides means for indicating the amount of cable insulation at all times.

3.26 Provides means for varying the current in the sensitrol relay to adapt it to any one of four cable insulation conditions.

3.27 Provides means for restoring the sensitrol relays to normal under control of a miscellaneous alarm and register circuit, alarm circuit or alarm checking circuit.

3.28 Provides for optional means of restoring the sensitrol relay.

3.3 For Fig. 4 in combination with Figs. 2 and 3.

3.31 Provides means for opening the 50-ohm sensitrol relay windings separately when more than one alarm circuit is installed.

3.4 Figs. 5, 6, 7 and 8.

3.41 In the No. 1, 350A, 360A and 355A Offices Figs. 5, 6, 7 and 8 provide means for applying the CI relay to the cable conductors at intervals of approximately 20 minutes to minimize the possibility of false alarms due to lightning discharges. For the 356A Offices the interval is changed to a period of 2 to 4 minutes.

3.5 Fig. 9

3.51 Provides means for providing an alarm indication from cable protective devices.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet, the connecting information thereon is to be followed.

4.01 Subscriber Line Circuit Arranged for Permanent Signal Lockout - SD-31777-01.*

4.02 Switch Trouble Alarm Circuits - SD-31515-01 and SD-31583-01.*

4.03 Miscellaneous Alarm and Register Circuit - SD-31798-01.*

4.04 Alarm Checking Terminal Circuit - SD-31835-01.

4.05 Pilot Lamp Circuit - SD-31548-01.*

4.06 Pilot Lamp and Power Alarm Lamp Circuit - SD-31573-01.

4.07 Audible and Visual Alarm Circuit - SD-96188-01.

4.08 Miscellaneous Alarm Circuit for Aisle Pilots - SD-31970-01.*

4.09 Miscellaneous Alarm Circuit for Alarm Control - SD-31980-01.*

4.10 Cable Insulation Alarm Circuit - SD-96348-01.

4.11 Common Timing Ckt. - SD-31310-01 No. 350A Dial Office, SD-31558-01 No. 1 Office.*

4.12 Permanent Signal Timing Ckt. - SD-31844-01 No. 355A Office.

4.13 Alarm Circuit - SD-32145-01 No. 356A Office.

4.14 Misc. Alarm Circuit - SD-31209-01 360A Office.

4.15 Cable Protective Devices Arranged to Extend Alarms to Central Offices - Cathodic Protection Rectifiers, Gas Reservoir Contactors, Manhole High Water Level Indicator, etc.

*Typical Circuit

DESCRIPTION OF OPERATION

5. GENERAL

5.1 Permanent Signal Alarm Circuit

The sensitrol relay (SR) and test resistance network in Fig. 2 are permanently connected as a part of the PSB battery supply to the first selector circuit 800-ohm (B) relays and as a part of the PSL battery supply to 1000-ohm relay windings of subscriber lines arranged

for lock-out. When a first selector is seized and before it cuts through, the (B) relay remains energized and other first selectors as they are seized connect additional (B) relays to the PSB battery supply. Similarly a subscribers line circuit when locked out connects ground through a 1000-ohm relay winding to the PSL battery supply. As the number of selectors or subscribers lines or a combination of both in a permanent signal condition is increased, the current drain is increased and proportionately more current flows through the 50-ohm winding of the sensitrol relay (SR) until it operates and gives an alarm.

5.2 Cable Insulation Alarm Circuit

The sensitrol relay (CI) and test resistance network in Fig. 3 are connected from 48-volt battery to the ring conductors of several vacant cable pair of an exchange cable, the tip conductors being grounded. The normal variation in the total insulation of these cable conductors remain too high for the sensitrol relay needle to reach the end of its indicating scale. If, however, the insulation for some reason is lowered the relay needle will swing to the end of its 125 ma scale and stick and give an alarm.

6. RESISTANCE NETWORKS

6.1 Permanent Signal Circuit

The 50-ohm winding of the sensitrol relay (SR) is connected in the resistance network of Fig. 2 in such a way that only a very small part of the current drain from the PSB BAT and PSL BAT bus bars flows through its winding. By cutting different combinations of the straps that are provided, the amount of current in the (SR) winding can be controlled and the relay therefore made to operate on any desired number of permanents.

6.2 Cable Insulation Network

6.21 Fig. B

This network comprises a series shunt wiring arrangement in which the 50-ohm winding of the sensitrol relay (CI) is connected in shunt with the battery path that supplies battery to the (R) conductors of the vacant cable pairs, ground being connected to the tip conductors. Through the use of "B", "E" and "F" strapping it will readily be seen that any one of four different series shunt conditions are set up for the sensitrol relay winding, thereby providing for different insulation resistance values on which the relay will operate. Whatever the condition, it will be observed that the 50-ohm winding of the (CI) relay is always included in the shunt path so that when the relay operates, only the shunt path is opened, leaving battery always connected to the cable. This minimizes the

effect on the relay when the winding is again restored to the cable battery supply. The series shunting effect on the relay winding also minimizes any crossfire due to ringing voltage that from time to time are impressed on the working pairs of the cable.

If as assumed in the case of condition 1, the total insulation of the cable connected to the network does not fall below 86,000 ohms, the relay will not receive enough current for the relay needle to reach the end of its indicating scale and it will continue under this condition of nonoperation indefinitely or until the total cable insulation of the connected pairs falls below 68,000 ohms. At 50,000 ohms the relay receives enough current to operate even under the most severe conditions: The accuracy of each indicating relay in a particular network may readily be determined so that when required, the indicating scale of the relay may be so translated into ohms representing total cable insulation.

6.22 Fig. A

Prior to Issue 5-D of this circuit the network was according to Fig. A and the test conditions were governed by the use of "K", "M", "N" and "Q" wiring. Otherwise the description in Item 6.21 applies to this figure also.

6.23 Where it is required to provide for alarms on more than one group of cable pairs, Fig. 4 is provided. In this case when any one of the (CI) relays operates, relay (E) of Fig. 4 will operate and open the operating windings of all the sensitrol relays. Fig. 4 will also be provided in offices where both permanent signal alarm and cable insulation alarm circuits are required.

7. CABLE INSULATION TIMING CIRCUIT FIGS. 5, 6 and 7

7.1 Relay CP, Fig. 5 is operated through its P winding from Figs. 6, 7 or 8. When operated, it connects the CI sensitrol relay to the cable pairs. This intermittent connection is to reduce the likelihood of false operation of the alarms due to transient conditions in the outside plant, such as may occur during thunderstorms.

7.2 Timing Relays - Fig. 6 - No. 1 and 350A Office

The common timing circuit connects ground over lead A2 for six seconds every 22 minutes for operation of CP2. CP2 operates CP, Fig. 5 and releases slow release relays CP3 and CP4 in succession. The release of CP4 releases CP, which thus remained operated for approximately 6/10 to one second.

7.3 Timing Relays, Fig. 7 - No. 355A and 356A Office

Ground from lead ST1 operates the 20-second timer in No. 355A offices and in 356A offices using Alarm Circuit SD-32145-01, Issue 3-D or later, or the 2-4 minute timer in No. 356A offices using SD-32145-01, Issue 1 or 2-D. The timer in turn operates CP1 Fig. 7, every 20-30 minutes or in earlier No. 356A offices, every 2-4 minutes.

7.4 Timing Relays - Fig. 8 - No. 360A Office

Relay CP3 operates in 20-30 minutes through the back contact of relay CP2, and when operated, operates CP1, and in turn CP Fig. 5 and slow operate relay CP2, Fig. 8. CP2 opens the circuit for CP3, which releases in 1/2 sec. max., but as CP2 was slow to operate, CP1 received sufficient soak to release slowly. Thus CP, Fig. 5, remains operated long enough to allow CI to operate if low cable insulation exists.

8. ALARM OPERATION

8.1 When the sensitrol relay (SR) or (CI) contacts close they are prevented from opening again normally by the pull exerted by a small bar magnet on a piece of iron connected to the pointer or moving contact. The contacts closed connect ground either directly to relay (A) of Fig. 1 or first to the (E) relay of Fig. 4 then to the winding of relay (A) which operates, in turn operating relays (B) and (C). Relay (E) or relay (A) of Fig. 1 operated opens the circuit to the 50-ohm sensitrol operating windings to protect them against excessive current and lead "SR" is transferred from the winding of relay (D) to the 900-ohm sensitrol restoring solenoid windings. Relay (C) operated lights red alarm lamp (MP) and connects ground to various leads for lighting aisle pilot lamps and sending an alarm to the operator office or test desk or giving an audible alarm signal.

8.2 When connection is made to the alarm checking terminal to determine whether the alarm condition is still present, ground is connected to lead "SR" energizing the sensitrol restoring solenoids, and operating relay CP through its S winding to keep relay CI connected to the cable conductors. The sensitrol contacts are forced apart releasing relay (E) if used and relay (A). Relay (A) released opens the circuit to relay (B), closes the sensitrol operating windings and operates relay (D). Relay (D) operated

locks to ground on lead "SR" and opens the circuit to the sensitrol restoring solenoids. Relay (A) is slow releasing so the (SR) relay contacts will be restored to normal before relay (D) operates and opens the restoring circuit. Relay (B) releases in turn releasing relay (C) which removes ground from the alarm leads and extinguishes lamp (MP). When the operator disconnects from the alarm checking terminal ground is removed from lead "SR" releasing relays (D), CP and restoring the circuit to normal.

If when relay (A) releases after the sensitrol is restored to normal a cable alarm condition still exists or a sufficient number of permanent signals are still present to operate the sensitrol, it reoperates in turn reoperating relays (A), (B) and (C). Relays (B) and (C) are slow releasing so when this condition occurs relay (C) will not be released before the circuit is re-energized and ground will stay on the various lamp signal and alarm leads.

8.3 With "ZA" Wiring and Apparatus

The nonlocking switch (AL) and relay (AL) provides for cutting off the audible alarm and pilot lamp signals. The lock-off in this case continues however, only as long as relay (C) of Fig. 1 remains operated.

This wiring and apparatus also provides a nonlocking switch (RS) which may be operated by the maintenance force for determining whether the alarm condition is still present. The operation of this switch has the same effect as grounding lead "SR" described in Item 8.2 above.

8.4 With "ZC" Wiring and Apparatus

A nonlocking switch (RS) is provided in order that the maintenance force may use it to determine whether an alarm condition is still present. The operation of this switch has the same effect as a ground on the lead "SR" as described in Item 8.2 and is used in the 356A offices only.

9. ALARM TRUNK RELAY FOR CABLE PROTECTION ALARM TRUNK FIG. 9

9.1 When a cable protective device operates it extends the alarm to the central office by closing the loop and operating relay (CA). Ground on lead C operates relay (A) of Fig. 1 to start the alarm signal circuit, as covered in Par. 8.1.

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