

SHORT-CIRCUITING RELAY PROTECTORS

TESTING

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1. GENERAL

1.01 This section outlines the maintenance procedure for ac-type short-circuiting relay protectors which are used on open wire telephone circuits exposed to low-frequency induction. It also describes the use of the D-98961 Test Set for testing and adjusting the relays.

1.02 This section replaces Section 638-550-500 which is cancelled.

1.03 Information regarding the description, use, and operating characteristics of the multigrounding and unit type short-circuiting relay protectors is contained in Engineering Practice AB63.228.

1.04 Although primarily intended for use in testing multigrounding relay protectors the D-98961 Test Set may also be used to check the operation of the KS-7677 unit type short-circuiting relay protector. Because of the rugged design of the KS-7677 Relay, however, such applications are expected to be infrequent.

1.05 It is suggested that a pushbutton switch be installed in each box equipped with a D-157081 Master Relay to permit operation of the dc relays without the necessity of removing the cover and manually operating the master relay. It has been found that manual operation of the relay has a tendency to change its operating characteristics to such an extent that it may fail to meet test requirements. The pushbutton switch may be installed and connected as shown in Fig. 1. The contacts of the switch are in parallel with the contacts of the master relay so the operation of the pushbutton will provide the same results as manual relay operation, ie, the simultaneous closing of all the dc relays. The switch may be mounted in a convenient location in the relay box, with a stenciled warning not to operate the pushbutton before pulling out the disconnect switches.

1.06 While the operate and release requirements of both the multigrounding and unit type protectors given in this section are specifically for 60 Hz operation, such protectors when meeting these 60 Hz requirements will also give satisfactory performance on installations involving fundamental frequencies down to 25 Hz.

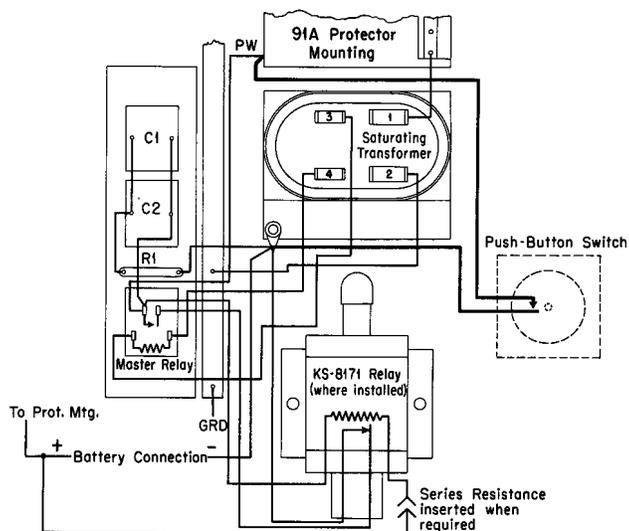


Fig. 1—Short-Circuiting Relay Protector (Method of Connecting Pushbutton Switch)

2. MAINTENANCE OF RELAY PROTECTORS

A. INITIAL INSPECTION

2.01 Before placing short-circuiting relay installations in service an inspection will be required to determine whether the equipment will function properly.

2.02 Check the batteries to determine whether they are properly connected and whether sufficient voltage is available to ensure the proper operation of the short-circuiting relays. A commercial type voltmeter will be satisfactory for voltage measurements. Table A shows the battery voltages for various numbers of protector groups and the minimum allowable terminal battery voltage when measured under load, ie, with the short-circuiting relays operated. This can be done by operating the pushbutton switch, where one is provided.

TABLE A		
NO. OF 10-WIRE GROUPS	REQUIRED VOLTAGE	MINIMUM ALLOWABLE TERMINAL VOLTAGE UNDER LOAD
1	4.0	2.8
2	5.0	3.5
3	7.5	5.3
4	10.0	7.0
5	12.5	8.8
6	15.0	10.5
7	17.5	12.5

2.03 Check all relays in the protector equipment to ensure that they have the correct mechanical adjustments to meet the requirements given in Part 5. Readjust those relays not meeting requirements.

2.04 Check the operation of the master relay and the short-circuiting relays, using the test set and following the methods described in Part 4, and make any adjustments necessary to obtain proper operation.

B. ROUTINE INSPECTION

2.05 Routine inspections of short-circuiting relay protector installations should be made monthly for the first three months after installation and thereafter at four-month intervals unless local instructions provide otherwise.

2.06 Measure battery voltage under load; ie, with the short-circuiting relays operated manually or by operating the pushbutton switch, where one is provided. Replace batteries if voltages are below the values given in Table A.

2.07 Check the operation of the master relay and check the contact resistance of the short-circuiting relays using the methods described in Part 4. Those relays not meeting test requirements should be adjusted.

2.08 Measure the resistance of any made grounds. Suitable methods for measuring resistance of grounds are described in a section of the AB Series of the Bell System Practices. The use of the ground megger is usually satisfactory. The resistances of the grounds, as measured, should be reported in accordance with local instructions.

3. TEST SETUP

3.01 The connections of the test set, the procedure for making the specified tests and the operating requirements of the protector circuit are given in the following paragraphs.

3.02 Before using the test set a KS-6542 Dry Cell or its equivalent should be installed. This is done by lifting the instrument panel and inserting the battery in the container provided. Connection to the battery is made by leads attached to the terminal strip at the side of the box, the polarity of these leads being marked on the terminal strip. The battery is held in place by a bracket attached to the under side of the instrument panel. Before

making tests with the test set, check the condition of the dry cell by connecting test terminals 2 and 3 together and operating the test key. If the indication on the dc ammeter is less than 0.6 ampere, replace the dry cell.

3.03 The initial arrangements when setting up the apparatus for tests at a SCR protector installation, and the precautions to be taken are:

- (1) Suitably locate the test set so the test leads will be within reach of all the test connections to be made on the protector.
- (2) Suspend the battery cable between the test set and storage battery and support it so the strain of its weight will not be borne by the plug connection to the test set. The storage battery should be fully charged before making these tests.
- (3) Check the operation of the dynamotor by operating the switch to *on*, and then to *off* after it is observed that the machine has started. To conserve the capacity of the storage battery the dynamotor should be operated, as far as practicable, only during the actual interval of the tests to be made.

4. MULTIGROUNDING TYPE PROTECTORS—TESTING

4.01 The steps to be taken in testing multigrounding type protectors are as follows:

- (1) Disconnect the relay protector from the line by pulling out the disconnect switches on all of the 91A Protector Mountings.
- (2) Check the type of master relay in the protector. When testing protectors using the D-157081 Master Relay, the toggle switch (associated with the step-up transformer) should be thrown to Pos. 1. For tests involving the D-94456 Master Relay, this switch should be in Pos. 2.
- (3) Connect the three test leads to the three terminals of the test set, and connect Terminal 1 test lead to the ground terminal of the relay protector, the position it occupies in all the tests.

4.02 Tests (A) to (D) below on the multigrounding protector are presented in the sequence in

which they will usually be performed, and the procedures given for each test will follow initial arrangements listed in 3.03.

A. OPERATION OF MASTER RELAY

4.03 Check the operation of the master relay as follows:

- (1) Connect Terminal 2 test lead to the common ground strip of a 91A Protector Mounting.
- (2) Set the rheostat to the minimum current position. Close the battery switch and operate the test key. Slowly turn the rheostat to increase the current. The master relay should operate without appreciable vibration of its contacts before the current as shown on the ac ammeter exceeds 1.3 amperes (Test Requirement) and its operation should result in the functioning of all the short-circuiting relays.
- (3) Make several tests of the operation of this relay by restoring the key to normal and reoperating it to determine whether the protector is prompt and positive in its operation. If adjustments are to be made, the test key may be operated to the locking position, holding the master relay operated and leaving both hands free for other work. If the test requirements are not met the relay should be adjusted to operate before the current reaches 1.0 ampere (Readjust Requirement).

B. RELEASE OF MASTER RELAY

4.04 This test needs to be made only on those protectors equipped with D-157081 Master Relays. Where the protector is also provided with a KS-8171 Lock-up Prevention Relay, the lead from the positive battery terminal to the KS-8171 Relay should be disconnected for this test.

- (1) Connect Terminal 2 test lead to one of the contact springs on the protector mounting side of the disconnect switches on the 91A Protector Mounting.
- (2) Set the rheostat to a position corresponding to a current in excess of the operate current of the relay (no current indication will be shown on the ac ammeter at this point as the test circuit will be open).

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- (3) Operate the test key to the locking position.
- (4) Cause the dc relays to close by manually operating the master relay, or preferably by means of the pushbutton switch discussed in 1.05. The use of this switch will prevent any change of the master relay operating characteristics which might be caused by manual operation. This should result in the operation of all the short-circuiting relays which, together with the master relay, should remain operated. Release the pushbutton switch. The ac ammeter should then indicate the current delivered by the test set.
- (5) Slowly decrease the current, noting from the ac ammeter the value at which the master relay and the short-circuiting relays release. (This release will open the test circuit and the current will drop to zero.) The D-157081 Relay should release before the current decreases below 0.6 ampere (Test Requirement). If the test requirements are not met, the relay should be adjusted to release before the current decreases below 0.8 ampere (Readjust Requirement).
- (6) Replace the battery lead to the KS-8171 Relay.

C. OPERATION OF LOCK-UP PREVENTION RELAY (KS-8171)

4.05 Where a KS-8171 Relay is provided to prevent permanent lock-up of the master relay, the following check should be made:

- (1) Connect the test set as in test (B), (1) to (3).
- (2) Manually operate the master relay, or operate pushbutton switch.
- (3) Using a timepiece, or by an approximate count of seconds, from the moment of operation of the master relay, the KS-8171 Relay should operate to release the short-circuiting relays and the master relay in not less than 13 seconds nor more than 20 seconds. If the relay does not meet this requirement, it should be replaced.
- (4) Immediate manual reoperation of the master relay should cause operation of the short-circuiting relays for another interval of

approximately 15 seconds before again being released by the KS-8171 Relay.

D. CHECK OF CONTACT RESISTANCE

4.06 Check the resistance of contacts of the short-circuiting relays as follows:

- (1) Connect Terminal 2 test lead to the common ground strip of a 91A Protector Mounting as in test (A).
- (2) Connect Terminal 3 test lead to the contact spring on the protector mounting side of the disconnect switch corresponding to the short-circuiting relay contact to be tested.
- (3) Operate the pushbutton switch or, if one is not installed, operate the test key on the set to the locking position and adjust the rheostat to a position corresponding to an operate current value for the master relay.
- (4) The current shown on the dc ammeter should not be less than 0.4 ampere.
- (5) Repeat for each short-circuiting relay contact.

5. MULTIGROUNDING TYPE PROTECTORS—RELAY ADJUSTMENTS

5.01 In case the test requirements in Part 4 are not met during the initial or any routine inspection, the relays in the protector should be checked to ensure that they have the proper mechanical adjustments. Requirements for the types of relays used in the multigrounding protectors are given in the following paragraphs.

5.02 D-157081 Relay (J Type)

- (a) This relay shall operate with 0.100 ampere, 60-Hz ac flowing through its winding, with the winding disconnected from the saturating transformer and connected in series with a 110-volt, 60-Hz source, a variable resistance and an ac ammeter. "Operate" shall then be interpreted to mean that the D-157081 Relay contacts shall close and hold the short-circuiting relays firmly in their operated condition. Under this condition, however, the D-157081 Relay contacts may chatter slightly.

- (b) This relay shall have a minimum armature travel of 0.020 inch.
- (c) The contact separation shall be minimum 0.008 inch.
- (d) The contact follow shall be minimum 0.005 inch.
- (e) The armature tension shall be minimum 10 grams measured with the armature in the unoperated position.

5.03 D-94456 Relay (J Type)

- (a) This relay shall operate with a 0.32 ampere, 60-Hz ac flowing through its winding, with the relay disconnected from the saturating transformer.
- (b) In the unoperated position this relay shall have a minimum armature air-gap of 0.020 inch.
- (c) The separation between contacts with the relay in its unoperated position shall be minimum 0.010 inch.
- (d) The contact follow shall be minimum 0.005 inch, maximum 0.008 inch.
- (e) The contact pressure with the armature held against the core shall be minimum 15 grams.
- (f) The armature in its unoperated position shall have a back tension of 10 grams minimum, measured at the contact end of the armature.

5.04 D-94486 Relay (R Type)

- (a) The armature travel, measured between the armature stop pins and the core with the armature against its back stop nut, shall be 0.020 inch (± 0.0025 inch).
- (b) The contact separation shall be maximum 0.018 inch, minimum 0.014 inch. (Attempts should be made to adjust the springs so that both pairs of contacts close simultaneously when the relay is operated electrically.)
- (c) The contact pressure with the relay in its operated position shall be minimum 35 grams.

- (d) The back tension of each traveling spring shall be minimum 7 grams, maximum 12 grams.

5.05 If necessary to file the contacts to reduce their resistance, a fine file (such as a KS-2663 File) should be used. Sandpaper or emery cloth should not be used. After a file has been used, the contact separation and contact pressure (5.04 (b) and (c)) should be rechecked.

6. KS-7677 UNIT TYPE PROTECTORS—TESTING

6.01 The method of testing the KS-7677 unit type protector with the D-98961 Test Set and the mechanical adjustment to be made if the relay operating requirements are not met are given in the following paragraphs:

6.02 Check the operation of the KS-7677 unit type short-circuiting relay protector as follows:

- (1) Connect the storage battery to the test set. Operate the toggle switch to Pos. 2. Connect Terminal 1 of the set to the ground lug of the relay and Terminal 2 of the set to the armature back stop of other metal part of the core structure.
- (2) Set the rheostat to the minimum current position. Close the battery switch and operate the test key.
- (3) Slowly turn the rheostat to increase the current. The relay should operate before the current, as shown on the ac ammeter, exceeds 1.5 amperes.
- (4) Slowly turn the rheostat to decrease the current. The relay should release when the current falls to a value that is 0.2 ampere less than the minimum operate current determined in 6.02(3). Thus, if the minimum operate current is 1.3 amperes, the relay should release when the current is reduced to not less than 1.1 amperes. (The relay should also release on about 0.45 ampere dc. An external rheostat and the dc circuit of the test set may be used to check this if desired.)
- (5) A satisfactory check of the contact resistance of this relay cannot be made with the low

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value of voltage available. This test should therefore be omitted.

7. KS-7677 UNIT TYPE PROTECTORS—RELAY ADJUSTMENTS

7.01 In case the test requirement in 6.02 is not met, the relay in the KS-7677 unit should be checked to ensure that it has the proper mechanical adjustments as given in the following paragraphs:

- (a) The contact clearance with the armature in its unoperated position should be approximately 0.030 inch.
- (b) The contact follow should be approximately 0.005 inch.

7.02 It is sufficient that the above two requirements be gauged by eye. However, the contact follow will be considered satisfactory if the contacts make with a 0.005-inch thickness gauge placed between the armature and the core and do not make with a 0.010-inch gauge similarly applied. In

operating the relay manually for these tests, pressure should be applied at the center of the strip connecting the two traveling contacts.

7.03 Methods of making adjustments on the KS-7677 Relay are as follows:

- (1) Bending the stationary contact springs with a pair of long-nose pliers applied near the base of the spring supports.
- (2) Changing the armature travel by means of the screw located on the armature backstop near the base of the relay.
- (3) Changing the armature back tension by bending the support carrying the coil spring. This should be changed only if the relay fails to meet operating and release current requirements.

7.04 If pitting or burning of the contacts is noticeable, the contacts should be burnished with a fine file (such as a KS-2663 File). Sandpaper or emery cloth should not be used.