

**NOISE ENGINEERING**  
**CONTROL OF CENTRAL OFFICE NOISE**  
**LOCALIZATION OF CONTACT NOISE IN**  
**PANEL DIAL OFFICES**

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as a convenient means of determining the effectiveness of such measures before they are applied generally to the office equipment.

**1.04** The testing methods consist of measuring partial channels of overall intraoffice connections and subdivisions of these "part channels" where possible. Since the panel unit can readily be divided between originating and terminating equipment, this subdivision is made first. Noise measurements of the originating equipment thus include line finder, district frames, and office frames where these are involved. Included in tests of the terminating equipment are the incoming and final frames. Following this, the office and final frames can be tested alone. Then the results can be compared with those obtained in the respective "part channel" measurements.

**1. GENERAL**

**1.01** This section covers methods of measuring contact noise on portions ("part channels") of intraoffice panel dial connections. The procedures which are suggested should be helpful in locating the major sources of contact noise in those cases where contact noise measurements or other evidence indicate that the usual cleaning procedures are not effective in reducing the contact noise to a satisfactory level.

**1.02** This section has been reissued to renumber it into the 870 division of the Plant Series, to expand the title, and to replace manufacture discontinued (MD) apparatus codes.

**1.03** In addition to locating the outstanding contact noise sources, tests on the various component circuits of the intraoffice connections before and after applying remedial measures can also be used

**1.05** In measurements of the originating half of the equipment, the calls are terminated on a terminal of a spare trunk group by dialing a special code. Where such a terminal is not available in the same district bank involved in intraoffice calls, it will be satisfactory to choose a terminal in a different bank, provided it meets the test requirements. In these cases it will be necessary in determining the effectiveness of a remedial measure to treat the terminals and brushes of both multiple banks on the various frames involved so that the effectiveness of the remedial measure can be observed on the "part channel" as well as on an overall channel basis.

**1.06** A comparison of the results of this testing procedure will give an indication as to whether the major source of noise is in the originating or terminating equipment, confined to particular types of frames, or is generally distributed throughout the various frames.

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**1.07** The testing work can be carried out in either of two ways, as follows:

(a) By using the equipment involved in the general overall contact noise survey. In cases where the effectiveness of the remedial measures is known, immediate service benefits can be realized by first treating the particular types of frames which are outstanding noise contributors.

(b) By establishing new channels which include a smaller group of frames than involved in the general overall contact noise survey. The smaller test channels are the more desirable to use when checking the effectiveness of remedial measures since this will permit completing the work in a shorter period of time on account of the lesser amount of equipment involved. In view of the restricted equipment sample in these cases, it is possible that a defective brush or terminal may unduly influence the results, and it is therefore desirable to select two such channels so that the results in one may be checked with the results in the other. Usually, if the four-point average as obtained from the cumulative distribution curve of one of the small channels is within about  $\pm 2$  dB of the results obtained in the other, it is an indication that comparable results should be expected from tests involving a much larger proportion of equipment. However, if the results from these channels are very much out of line with each other, the reason for this should either be investigated or consideration should be given to the selection of new lines and the tests repeated.

**1.08** The small channels may be chosen in such a manner that intraoffice calls can be established on an overall basis from line finder to final terminals, including the equipment which was tested on the "part channel" basis. In these cases where overall channel tests are made, the measurements should include tests to different final terminals from one calling line instead of to the same final terminal from different calling lines, as used in the general overall noise survey. This procedure permits a greater distribution of the calls than the latter method.

**1.09** Having isolated the contact noise to specific types of frames, it is not practicable to actually locate the offending contacts on a sampling

basis in view of the random variable nature of contact noise. The most practicable procedure from this point on is the application of remedial measures successively applied to the multiple bank terminals and brushes, sequence switches and commutators with each measure followed by a noise test. The before and after test results will give an indication as to the effectiveness of the measures applied. Where large noise reductions are obtained after the treatment of a specific type of contact, information will be available as to the major noise source.

**1.10** Where two channels have been chosen for the study of a remedial measure, it is desirable that the application as discussed above be confined to only one channel and the second channel be reserved for the application of the particular remedial measure that is found to be most effective in reducing the noise. If the desired results are obtained in the second channel, application of the same remedial measure to the remaining equipment in the office should produce comparable results.

**1.11** If no change in the contact noise is noted from the above, a visual inspection may reveal some contacts, which in view of their relative inaccessibility, may not have been given a thorough application of the remedial measure and therefore require further treatment. Some of these contacts, for example, are the lower and upper terminals in the multiple bank.

**1.12** If after the application of remedial measures it is desired to obtain a rough indication of the offending contacts, this may be done by holding any noisy connections and proceeding as outlined later in this section. Where it is found that none of the treatments are effective in reducing the contact noise to the desired level it may be necessary to consider such other factors as excessive frame vibration, alignment of equipment, and contact spring tensions.

**1.13** The following detailed tests are outlined for line finder offices and are also applicable to line switch type offices.

## 2. TEST SAMPLE

**2.01** The test sample should include ten originating lines and ten final terminals. Two hundred calls will usually be sufficient if these are spread

throughout the daytime traffic periods. If it is desirable to limit the testing time to a few hours each day, the busy rather than the light load traffic hours should be employed since the additional office and equipment activity at these times may have a direct influence upon the contact noise.

**2.02** Where it is decided to use two test channels, it is preferable that the initial tests be made on each channel at about the same time in order to minimize any influence from such factors as traffic load, etc., which might have an effect upon the results. To do this a group of five tests calls should be measured in one channel and then a similar number in the other channel until the required 200 calls have been made in each test channel.

**2.03** It is desirable to include as many different combinations of contacts in the test sample as possible. In tests of the originating "part channel," this condition is taken care of by automatic rotation of the line finder selectors through the allotter or link circuits associated with the various line finder groups.

**2.04** The tests of the terminating equipment from the outgoing trunk testboard to final terminals connected to the call-through test set should be made to include as many different incoming selectors and frames as possible.

**2.05** In cases of a particular type of selector equipment (e.g., office or final frames), as many different selectors and frames as possible should be included in the test sample.

#### **Channel Arrangement for Large Equipment Sample**

**2.06** Where tests are to be made on a large equipment sample, the calling lines and final terminals involved in the overall contact noise survey can usually be employed so that no further arranging of equipment is required than that which was necessary in the contact noise survey on the overall channel basis.

#### **Channel Arrangement for Small Equipment Sample**

**2.07** When a small equipment sample is used a different set of calling lines and final terminals from those employed in the overall contact noise survey will be required. The calling lines and

final terminals of each test channel can usually be confined to two line finder and two final frames. The calling lines should be distributed between the A and B line finder subgroups associated with the two line finder frames. The final terminals should be distributed between two final multiple banks each of which appears in a different final frame. In cases where the test calls in the two channels might be routed through the same incoming frame, it is desirable that the final terminals in each test channel be selected in such a manner that a different incoming bank will be used. With this arrangement the only equipment common to the two channels would be the incoming commutators and sequence switches.

### **3. NOISE MEASURING APPARATUS**

**3.01** The 3-type noise measuring set will normally be used in the general noise survey.

**3.02** In addition to the above, it will be necessary to simulate the overall channel battery supply combinations in order that the "background" noise will be a constant factor when "part channel" measurements are made.

**3.03** When testing the originating "part channel" or office selectors, the equivalent of the incoming repeating coil circuit should be supplied. When testing the terminating "part channel" the equivalent of the district repeating coil circuit should be supplied. When testing final selectors both the district and incoming repeating coil circuit should be supplied. The details of these circuits are covered more specifically later.

### **4. LINE FINDER - DISTRICT OR OFFICE SELECTOR CIRCUIT TESTS**

**4.01** The testing procedure is the same whether tests are made from line finders to district or to office frames. The discussion as far as "part channel" measurements are concerned will be confined to tests from line finder to districts since this is the more common case.

**4.02** These tests are made by calling from originating lines connected to a call through test set to a terminal in a spare trunk group in the district or office multiple to which the termination and the noise measuring apparatus are connected.

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**4.03** In order to direct the district or office selectors to the particular trunk group chosen for the test, a special code should be used.

### Preparation

**4.04** Preparation for these tests will require the central office forces to make the necessary decoder route relay cross-connections, so as to provide a talking condition with the district repeating coil in the circuit in the same manner as on an intraoffice call. In offices having translator type senders, the proper cross-connections should be made to obtain a similar circuit condition. It may be possible to reduce the preparation work by using temporarily one of the special test codes already established.

**4.05** Since the actual district or office frame multiple bank terminals used in the overall channel tests cannot conveniently be used in the "part channel" measurements, it is desirable to select terminals which are in about the same condition from a noise standpoint for the measurements. The condition can be roughly approximated by choosing a spare trunk group which precedes working trunk groups.

**4.06** Having decided upon a trunk group, proper cross-connections may be made at the trunk distributing frame from one of the terminals in this group to the circuit of Fig. 1. Other working terminals in this group should be made busy in the approved manner.

**4.07** The terminal chosen may be cross-connected to a test and make-busy jack at the outgoing trunk switchboard for the purpose of making this terminal busy when not in use.

**4.08** In these tests the equivalent of the repeating coil circuit as furnished by the incoming selector in intraoffice dial connections should be provided. The equivalent of this circuit is shown on Fig. 1. The noise measuring apparatus is connected to the side of the repeating coil which would normally be connected to the incoming selector if the coil were involved in a working circuit.

**4.09** The relay in the battery supply circuit on the trunk side of this repeating coil is wired to a lamp and reversing key which should preferably be located in front of the tester for the purpose of informing him when trunk closure has taken place. The purpose of the key in this circuit is for reversing the trunk battery after trunk closure has taken place.

**4.10** Figure 2 shows the test connections together with a schematic diagram of the transmission circuit.

### Contacts Involved

**4.11** The following contacts are involved in this test:

- (1) Line finder multiple bank and multiple brush
- (2) Line finder commutator
- (3) "D" relay
- (4) District sequence switch talking cams
- (5) District commutator
- (6) District multiple bank and brush.

### Test Procedure

**4.12** The test procedure is as follows:

- (1) Operate TLK key of the Call Through Test Set. This will provide dial tone in the tester's receiver.
- (2) Dial the special two or three digit code as the case may be.
- (3) With the key of the auxiliary circuit (Fig. 1) normal (Battery on Tip) wait for the lamp of the auxiliary circuit or click in receiver of Call Through Test Set. This indicates trunk closure and the key should then be operated to place ground on the tip side of the circuit.
- (4) At the Call Through Test Set operate TLK key to HLD, and connect the noise measuring set in the circuit.
- (5) Measure the noise.
- (6) Remove the noise measuring set from the circuit and restore to normal the TLK key of the Call Through Test Set.
- (7) Repeat the above for the remaining originating lines from which tests are to be made.

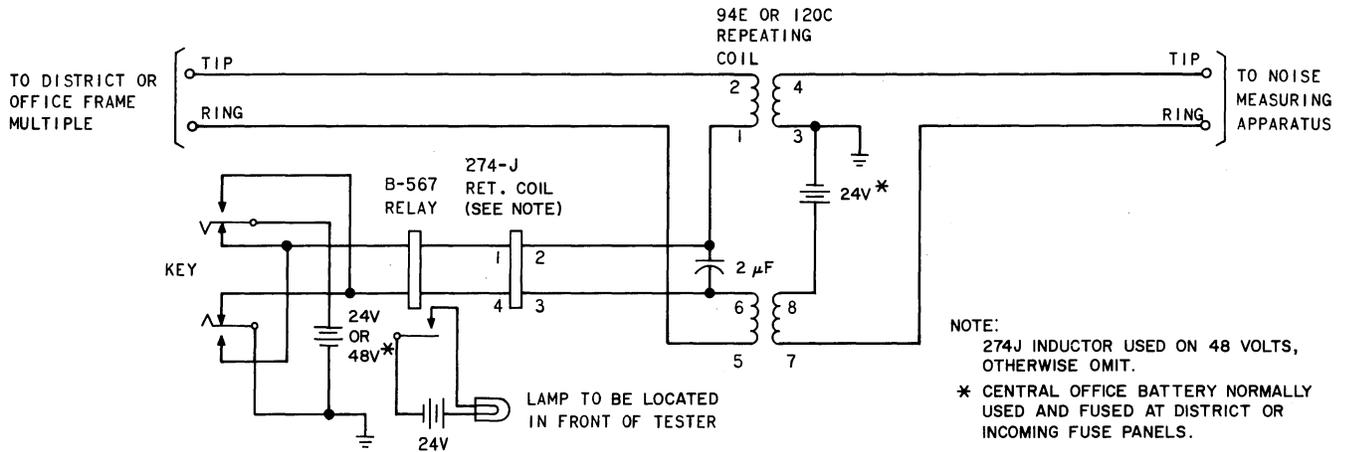


Fig. 1—Repeating Coil Circuit Equivalent to the Incoming Selector in Intraoffice Dial Connections

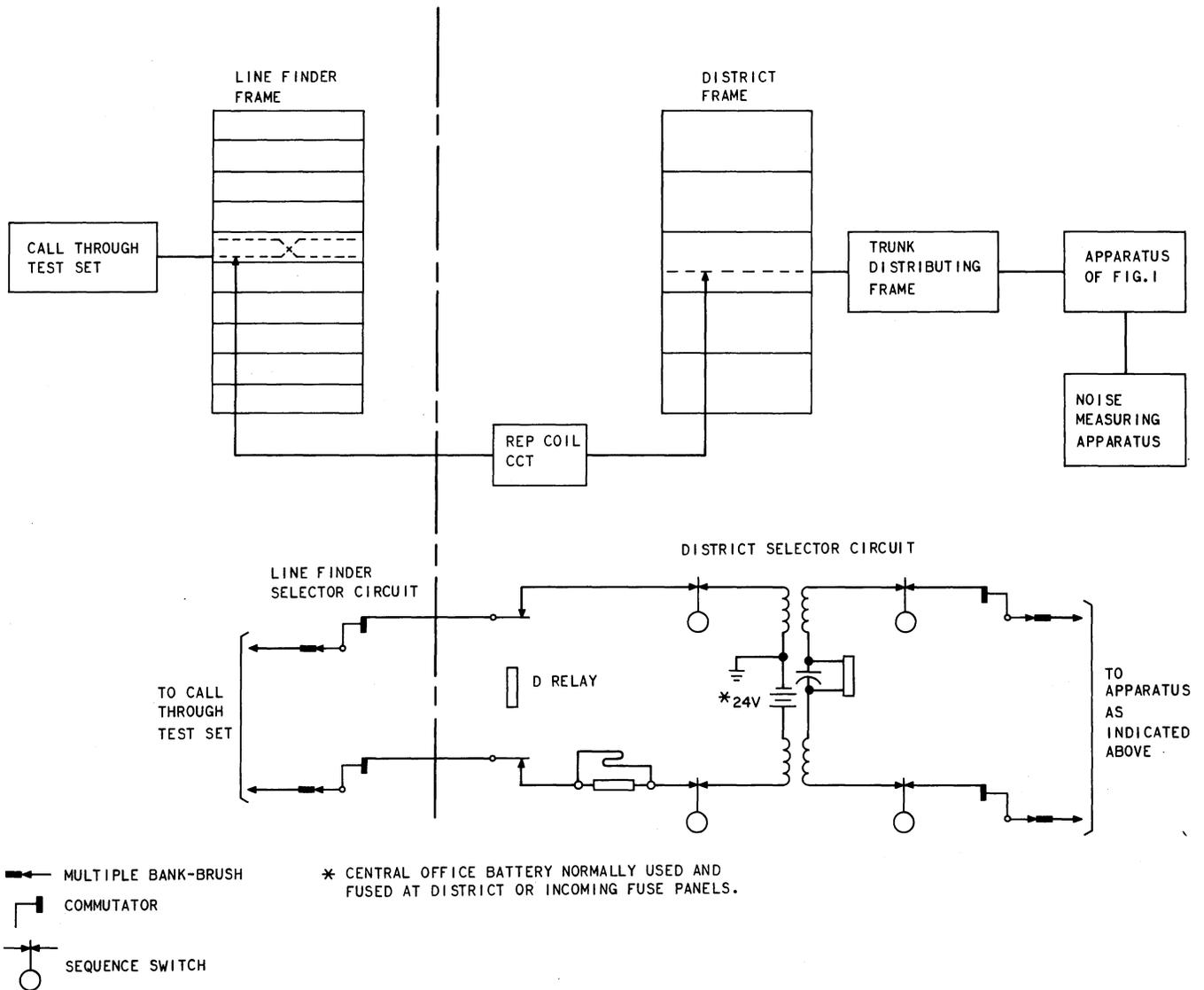


Fig. 2—Connections for Testing Line Finder—District/Office Selector Circuits

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### 5. OFFICE SELECTOR CIRCUIT TESTS

**5.01** The office selector circuits may be tested at the various office frames from the selector test jacks to terminals in the same spare trunk group of the office frame which was used in the tests between line finder and office frames.

#### Preparation

**5.02** A talking connection should be established between the noise testers and the office frames to facilitate the testing work.

**5.03** An office selector test set (wagon type) and the terminating circuit of Fig. 1 will be required. An additional terminating circuit will be necessary as a holding bridge after the selections have been established from the test jacks by means of the office selector test set. This circuit should be the equivalent of the district repeating coil circuit. The side of this repeating coil, which would normally provide battery to the originating subscriber in a working circuit, should preferably be terminated in 200 ohms.

**5.04** Figure 3 shows this termination connected to jacks and a key which will be found convenient for this test. In addition the test connections and transmission circuit of the office selector are shown.

#### Contacts Involved

**5.05** The following contacts are involved in this test:

- (1) Office sequence switch talking cams
- (2) Office commutator
- (3) Office multiple bank and brush.

#### Test Procedure

**5.06** The test procedure is as follows:

- (1) Patch the B-GRD jack of the office selector test set to the A jack (B-GRD) of the office selector frame involved.
- (2) Patch the TST jack of the office selector test set to Jack No. 1 of the terminating circuit.

- (3) Patch Jack No. 2 of the terminating circuit to the test jack of the selector to be tested.

**Caution:** To avoid releasing a service connection do not connect to the test jack if the associated selector is off normal.

- (4) On the office selector test set operate the OFF (office) key and the proper compensating resistance and class keys.
- (5) Set up the proper brush and group selection on the numerical keys of the office selector test set to direct the selector to the test terminal in the office multiple.
- (6) Momentarily operate the ST (start) key of the office selector test set.
- (7) When the office selector reaches the test terminal, operate the key of the terminating circuit and advise the noise tester that the circuit is ready for measurement.
- (8) Measure the noise.
- (9) Restore the key of the terminating circuit to normal.
- (10) At the office selector test set momentarily operate the DISC key and remove the plug of the cord from the selector test jack.
- (11) Repeat the above from other selector test jacks.

### 6. INCOMING-FINAL SELECTOR CIRCUIT TESTS

**6.01** These tests are made from the outgoing trunk testboard to final terminals which have been connected to the Call Through Test Set.

#### Preparation

**6.02** A talking connection should be established between the noise testers and the OGT board as it will be necessary to communicate between these two points to facilitate the testing work.

**6.03** The regular test cord and key equipments of the OGT board are required in establishing the calls and a combination of three multiplied jacks are employed as a means of providing a termination

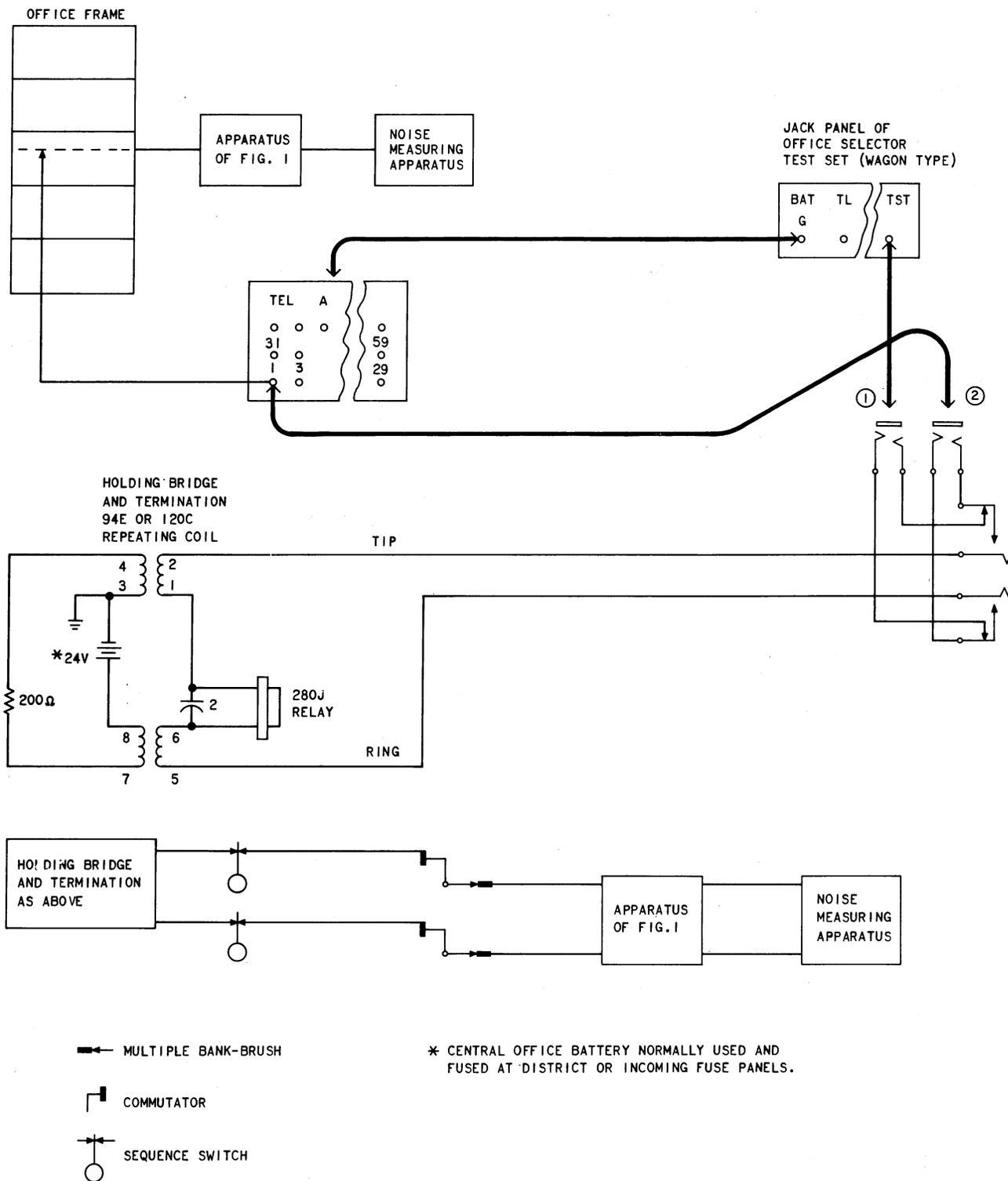


Fig. 3—Arrangement for Testing Office Selector Circuits

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and holding bridge when the circuits have been established for test.

**6.04** The holding bridge should simulate the repeating coil circuit as normally provided in the district selector circuit. A 200-ohm termination should be provided on the side of the coil which would normally provide battery to the originating subscriber in a working circuit.

**6.05** Figure 4 shows this holding bridge together with the circuit arrangements involved in the test and a schematic of the transmission circuit.

### Contacts Involved

**6.06** The following contacts are involved in this circuit:

- (1) Incoming sequence switch talking cams
- (2) Incoming commutator
- (3) Incoming multiple bank and brush
- (4) Final sequence switch talking cams
- (5) Final commutator
- (6) Final multiple bank and brush.

### Test Procedure

**6.07** The test procedure is as follows:

- (1) At the OGT board insert a trunk test cord in Jack No. 1 (three multiplied jacks).
- (2) Insert one plug of patching cord in Jack No. 2 (three multiplied jacks) and the other plug in the test jack of the trunk associated with the incoming selector to be tested.
- (3) Operate the class key designated DM or the key used for panel dial incoming selectors.
- (4) Set up the test call number (number of one of final terminals) on the numerical recording key set.

(5) Operate the proper compensating resistance key in the recording key set. In three-wired incomings also operate the NT (no test) key.

(6) Depress the ST (start) key. If a red lamp associated with the trunk test cord lights it is an indication that the trunk is busy and another trunk should be selected for test purposes.

(7) If the trunk is not busy a green lamp associated with the trunk test cord will flash until the selections are completed when a white supervisory lamp will light indicating ringing of the called number.

(8) Insert the plug of the holding bridge in Jack No. 3 (three multiplied jacks).

(9) Insert an MB plug in the MB jack of the trunk under test and remove the trunk test cord from Jack No. 1. (three multiple jacks).

**Note:** At this point the tester should be advised to proceed with the noise measurement.

(10) When the measurements are completed, the tester should remove the noise measuring equipment from the circuit and advise the OGT board.

(11) At the OGT board the circuit may be released by removing the holding bridge from Jack No. 3 (three multiplied jacks) and the MB plug in the case of three-wire incomings.

**Note:** If more test calls are required from the same incoming selector to the same or other final terminal numbers, do not remove the MB plug from the trunk MB jack in the case of two-wire incomings. In the case of three-wire incomings remove the MB plug momentarily, and proceed as outlined below.

(12) In the case of two-wire and three-wire incomings, operate the NT (no test) key associated with the trunk test cord and insert the trunk test cord in Jack No. 1 (three multiplied jacks) and proceed as outlined above starting with Item 3, noting that in Item 6 no red lamp should be obtained.

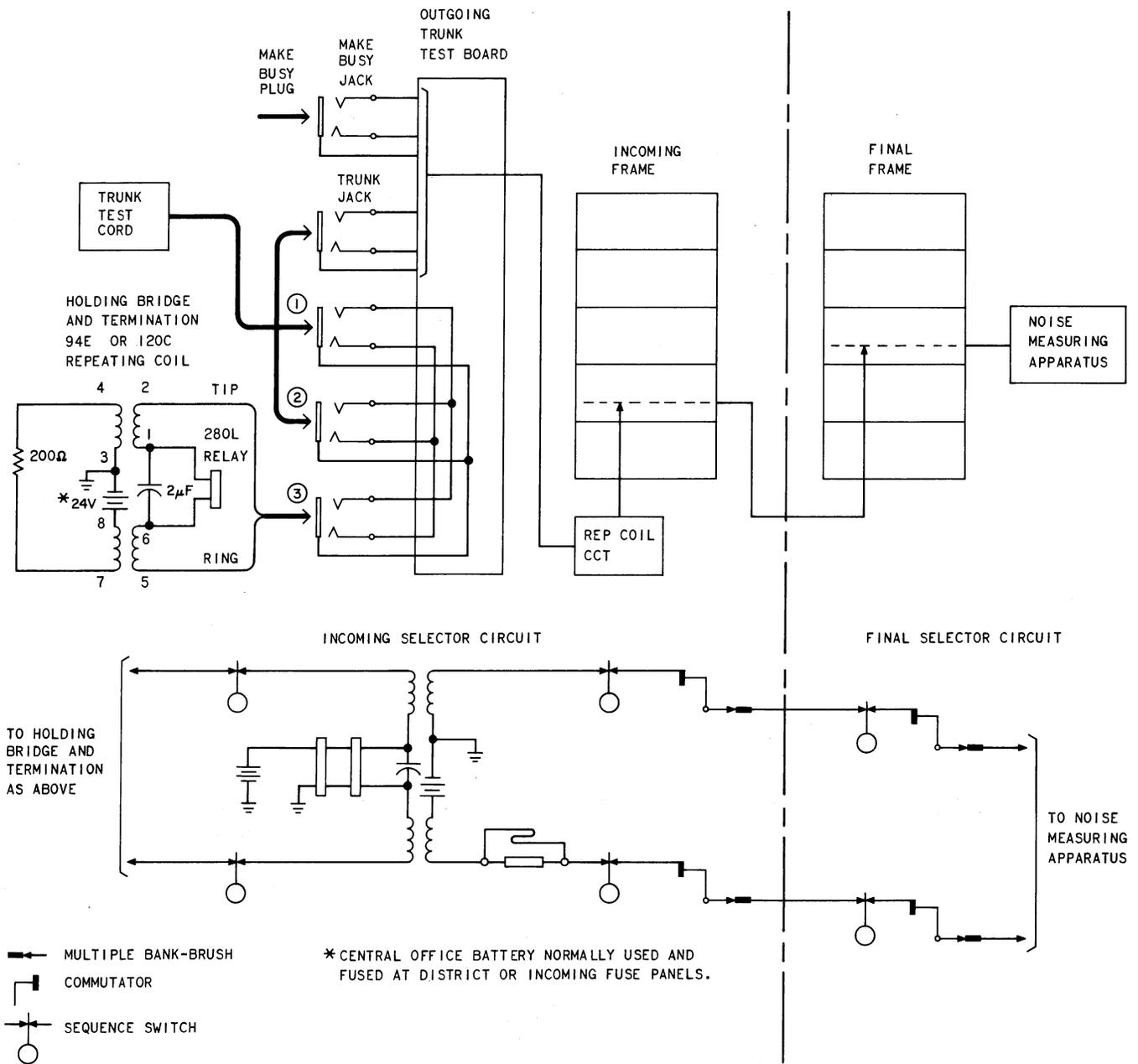


Fig. 4—Arrangement for Testing Incoming—Final Selector Circuits

**7. FINAL SELECTOR CIRCUIT TESTS**

**7.01** The final selector circuits may be tested at the various final frames from the selector test jacks to the same final terminals used in the Incoming-Final Selector Tests. The frames involved in the test depend upon the numbers of the particular final terminals.

**Preparation**

**7.02** A talking connection should be established between the noise testers and the final frames to facilitate the testing work.

**7.03** An Incoming-Final Selector Test Set (wagon type) and a terminating circuit will be

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required. This circuit should consist of the equivalent repeating coil circuits of the district and incoming selectors.

**7.04** Figure 5 shows this termination connected to jacks and a key which will be found convenient for this test. In addition, the test connections and transmission circuit of the final selector are shown.

### Contacts Involved

**7.05** The following contacts are involved in this test:

- (1) Final multiple bank and brush
- (2) Final commutator
- (3) Final sequence switch talking cams.

### Test Procedure

**7.06** The test procedure is as follows:

- (1) Patch the B-GRD jack of the final selector test set to the A jack (B-GRD) of the final selector frame involved.
- (2) Patch the TST jack of the final selector test set to Jack No. 1 of the terminating circuit.
- (3) Patch Jack No. 2 of the terminating circuit to the test jack of the selector to be tested. Where separate test and make-busy jacks are provided, insert an MB plug in the make-busy jack.

**Caution:** *To avoid releasing a service connection do not connect to the test jack if the associated selector is off normal.*

- (4) On the test set operate the FIN (final) key and the proper compensating resistance and class keys.
- (5) Set up the number of the final terminal to be called on the numerical keys of the test set.
- (6) Momentarily operate the ST (start) key of the test set.

(7) When the final selector reaches the number called, operate the key of the terminating circuit and advise the noise tester that the circuit is ready for measurement.

(8) Measure the noise.

(9) When the noise measurement has been completed remove the measuring set from the circuit and advise the assistant at the final frames who should restore the key of the terminating circuit to normal.

(10) At the test set momentarily operate the DISC key and remove the plug of the cord from the selector test jack and the MB plug from the make-busy jack if one is used.

## 8. SPECIFIC TYPES OF CONTACTS

**8.01** The following outlines two procedures which may be used to determine if specific types of contacts are major noise contributors. These methods are usually tedious and only give very rough indications since a sufficiently large sample of calls can not be handled in a reasonably short period of time.

**8.02** The first method involves placing calls on a "part channel" or frame basis as the case may be until a noisy connection is obtained. This connection is then held by the tester who observes the magnitude of the noise while an assistant, who is in telephone communication with the tester, exerts a very slight amount of pressure on the various brushes and springs with an orangewood stick or similar implement. If a change in noise is accompanied by the assistant's efforts on a particular contact, this contact may be assumed to be the major offender and steps should be taken to remove the noise without losing the connection. If the same experience is observed on repeated test connections, it usually is an indication that this particular type of contact is the outstanding noise source. In order to avoid losing the connection while the above work is going on, it is desirable that the proper relays, etc., be blocked in the operated position.

**8.03** The second test method also involves placing calls on a "part channel" or frame basis as the case may be until the noisy connection is obtained. This connection is then held operated

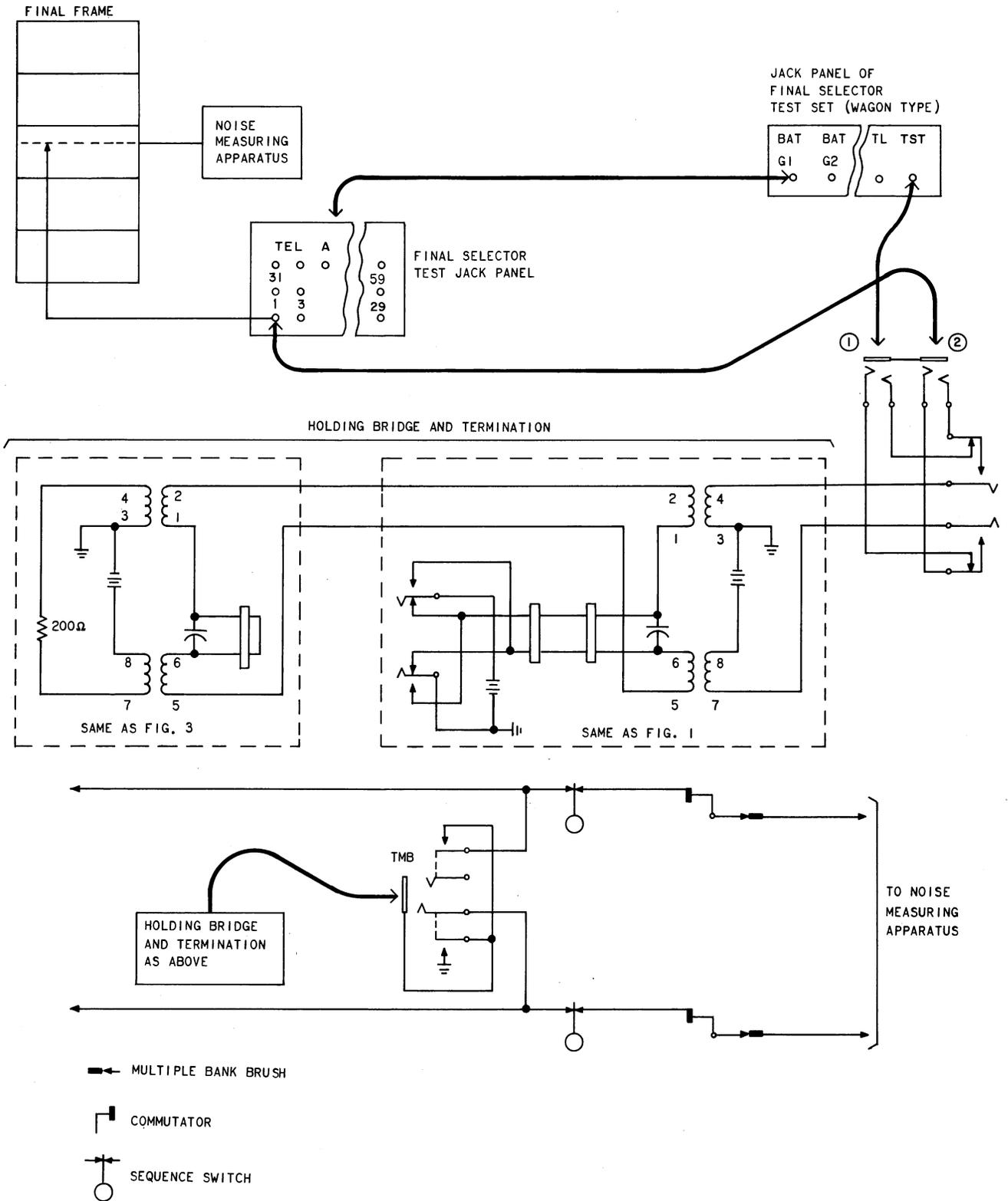


Fig. 5—Arrangement for Testing Final Selector Circuits

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while the tester or an assistant bridges the suspected noisy contacts with a telephone receiver in series with a condenser. The noisy contact will produce the same character of noise in the receiver. The same precautions regarding losing the connection should be observed as above by blocking the proper relay, etc., in the operated position. Several methods of attack in connection with this method may be employed. For example, several contacts might be bridged at one time and then eliminated one at a time until the noise has been isolated to one type of contact. This scheme, like the one involving the use of the noise measuring set, is slow and has the added disadvantage that a slight disturbance of a contact during the process of applying the receiver to the proper terminals for test is likely to eliminate or create additional contact noise before the tester has had a chance to listen in the receiver.

**8.04** Some of the locations which may be used in connection with this type of test are outlined below. It should be noted that the details apply to only one side of the circuit and must be repeated on the other side. Some of the bridging points are relatively inaccessible; for example, some of the commutator bars and the soldering lugs of sequence switch springs.

**8.05** With a little experience the tester will become familiar with the most likely sources of noise after having listened across several contacts in the test connections. The order of importance of the contacts from a noise standpoint are generally:

- (1) Multiple bank and brush
- (2) Sequence switch
- (3) Commutator.

**LINE FINDER FRAME**

TYPE OF CONTACT	BRIDGING POINTS
Multiple bank — brush and commutator	Soldering lug on multiple bank terminal to cabling block on line finder frame.

Multiple bank — brush	Soldering lug of multiple bank terminal to corresponding spring of another brush on the same selector rod as the brush involved in the test.
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Commutator	Multiple brush spring as above to cabling block on line finder frame.
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**LINE SWITCHES**

TYPE OF CONTACT	BRIDGING POINTS
Line Switch Feeder and Brush Springs	Line terminal block to district cabling block at line switches.

**DISTRICT FRAME**

(Side towards trunk)

TYPE OF CONTACT	BRIDGING POINTS
Multiple bank — brush commutator, sequence switch	Soldering lug of multiple bank terminal to cam of sequence switch (for one contact only)

To include both sequence contacts connect between soldering lug of multiple bank terminal to soldering lug of sequence switch spring towards the district repeating coil.

Multiple bank — brush	Soldering lug of multiple bank terminal to corresponding spring of another brush on the same selector rod as the brush involved in the test.
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Commutator and sequence switch, (one contact)	From cam of sequence switch to brush spring as above.
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Commutator Multiple brush spring as above to soldering lug of commutator bar.

Sequence switch, (both contacts) Soldering lug of commutator bar to selector cabling block.  
 Sequence switch, (one contact) Soldering lug of commutator bar to sequence switch cam.

**DISTRICT FRAME**

(Side towards line finder)

TYPE OF CONTACT BRIDGING POINTS

*Note:* In line switch offices the first two items may be disregarded.

Sequence switch and relay contacts Soldering lug of sequence switch spring towards repeating coil to selector cabling block on district frame.

Relay Across relay contacts or from selector cabling block to soldering lug of sequence switch spring.

Sequence switch Soldering lug of sequence switch spring to cam.

**OFFICE FRAME**

TYPE OF CONTACT BRIDGING POINTS

Multiple bank—brush, commutator and sequence switch, (both contacts) Soldering lug on multiple bank terminal to selector cabling block.

Multiple bank—brush Soldering lug on multiple bank to corresponding spring of another brush on the same selector rod as the brush involved in the test.

Commutator Multiple brush spring as above to soldering lug of commutator bar.

**INCOMING FRAME**

(Side towards finals)

TYPE OF CONTACT BRIDGING POINTS

Multiple bank—brush, commutator and sequence switch Soldering lug of multiple bank terminal to soldering lug of sequence switch spring towards repeating coil.

*Note:* Other contacts may be bridged as outlined for District Frame, (trunk side).

**INCOMING FRAME**

(Side towards trunk)

TYPE OF CONTACT BRIDGING POINTS

Sequence switch, (both contacts) Selector cabling block to soldering lug of sequence switch spring towards repeating coil.

Sequence switch, (one contact) Selector cabling block to sequence switch cam.

**FINAL FRAME**

TYPE OF CONTACT BRIDGING POINTS

Multiple bank—brush, commutator and sequence switch Soldering lug of multiple bank terminal to selector cabling block.

*Note:* Other contacts may be bridged as outlined for Office Frame.