# CROSSED NUMBER GROUP CONNECTOR
# NF LEADS
# NO. 1 CROSSBAR OFFICES

## 1. GENERAL

1.01 This section covers methods to be followed in connection with analyzing and locating troubles due to crossed number group connector NF leads.

## 2. INDICATIONS OF TROUBLE CONDITION

2.01 Terminating trouble indicator displays.

## 3. REACTIONS DUE TO TROUBLE

3.01 During busy-hour periods this trouble causes a backup of terminating traffic.

3.02 Terminating traffic through the equipment affected by the trouble condition may not be completed. In some cases all calls to a particular number group may be affected and in others a percentage of calls to any number group may not be affected depending upon the location of the cross.

## 4. IMMEDIATE PROCEDURE TO FOLLOW

4.01 A sufficient number of terminating trouble indications should be recorded in as short an interval as possible so that an analysis of the trouble may be made.

4.02 When a particular terminating marker appears to be the cause of a trouble condition make it busy.

4.03 It may be desirable to place make-busy plugs in all terminating marker TR0 jacks as soon as a sufficient number of trouble indications have been recorded to permit analyzing the trouble condition. If this action is taken the call carrying capacity of the terminating markers should be increased by effecting a reduction in the marker holding time. Before plugging into the TR0 jacks the terminating trouble indicator may be used to assist in analyzing the trouble. The plugs should be removed from the TR0 jacks when the trouble condition is cleared.

4.04 Make tests and observations to locate and clear the cause of the trouble as indicated by an analysis of the terminating trouble indicator record.

## 5. ANALYSIS OF TROUBLE

5.01 The extent of the effect of crossed NF leads on terminating traffic may vary somewhat depending upon the location of a particular trouble. This section treats trouble conditions due to crossed NF leads under five headings shown below, and illustrated in Figs. 1 to 5. The trouble indicator lamps used to illustrate the various trouble conditions covered in this section represent false information introduced by the trouble conditions when bracketed (√).

(a) Crossed NF Leads—Two Individual Contacts on TB Relay.

(b) Crossed NF Leads—Two Individual Contacts on MCB Relay.

(c) Crossed NF Leads—Individual and Common Contact on TB Relay.

(d) Crossed NF Leads—Individual and Common Contact MCB Relay.

(e) Crossed NF Leads—Two Common Contacts on TB or MCB Relay.

### Trouble (a)—Crossed NF Leads—Two Individual Contacts on TB Relay

5.02 A cross between two individual contacts associated with NF leads, on a number group connector TB relay, may cause terminating trouble indications similar to those shown in Table A.

TABLE A

Trouble Indications

| | DR | Line No. | L | NGC | LCF | HF | RF | TF | X |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 0029 | 9 | 0 | 0 | | √ | (√) | XF |
| 2. | 1 | 0039 | 19 | 0 | 0 | | √ | (√) | XF |
| 3. | 2 | 0140 | 0 | 0 | 0 | | √ | (√) | XF |
| 4. | 0 | 0159 | 19 | 0 | 0 | | (√) | √ | XF |
| 5. | 1 | 0141 | 1 | 0 | 0 | | (√) | √ | XF |
| 6. | 2 | 0289 | 9 | 0 | 0 | | (√) | √ | XF |
| 7. | 2 | 0443 | 3 | 0 | 0 | | √ | (√) | XF |
| 8. | 1 | 0299 | 19 | 0 | 0 | | √ | (√) | XF |
| 9. | 1 | 0020 | 0 | 0 | 0 | | √ | (√) | XF |
| 10. | 0 | 0440 | 0 | 0 | 0 | | (√) | √ | XF |

5.03 Analysis of indications shows:

(a) Any marker (DR- lamp) fails on calls to any line number (L- lamp) in a particular number group (NGC- lamp) which indicates that this **number group is in trouble** (number group 0 in this case).

(b) The same line choice (LCF- lamp) and type of line lamps (HF, RF or TF) appear in all indications. This indicates that **two individual TB relay contacts** or **NF punchings** are crossed.

5.04 The two line choice fields involved in a trouble condition may be differently numbered, as RF0 and RF1; in which case trouble indications will be attended by lamps LCF0-1, and RF; or may be differently numbered line choice and type of line fields as RF0 and TF1, in which case the lamps attending trouble indications will be LCF0-1 and RF, TF; or, as illustrated in the trouble indications in Table A, may involve the same LCF- lamp and two of the type of line lamps. If it is assumed that individual contacts 40 (NF0) and 41 (NF1) are crossed on the number group connector TB relay serving line numbers 0020 to 0039, illustrated in Fig. 1, a call to **any number** in the number group served by **one of the line choice fields associated with either 0020 or 0021** will block and a terminating trouble indication will be received (see trouble indication 9 above).

### Trouble (b)—Crossed NF Leads—Two Individual Contacts on MCB Relay

5.05 A cross between two individual contacts associated with NF leads, on any number group connector MCB relay associated with a particular terminating marker, may cause terminating trouble indications similar to those shown in Table B.

TABLE B

Trouble Indications

| | DR | Line No. | L | NGC | LCF | HF | RF | TF | X |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 0020 | 0 | 0 | 0 | | √ | (√) | XF |
| 2. | 0 | 0021 | 1 | 0 | 0 | | (√) | √ | XF |
| 3. | 0 | 0039 | 19 | 0 | 0 | | √ | (√) | XF |
| 4. | 0 | 0780 | 0 | 0 | (1)– 2 | √ | (√) | | XF |
| 5. | 0 | 0781 | 1 | 0 | 1 –(2) | (√) | √ | | XF |
| 6. | 0 | 0799 | 19 | 0 | 1 –(2) | (√) | √ | | XF |
| 7. | 0 | 8440 | 0 | 9 | (2)– 4 | | √ | | XF |
| 8. | 0 | 8441 | 1 | 9 | 2 –(4) | | √ | | XF |
| 9. | 0 | 8459 | 19 | 9 | (2)– 4 | | √ | | XF |

5.06 Analysis of indications shows:

(a) One marker (DR- lamp) fails in various number groups (NGC- lamp) which indicates that **this marker is in trouble.**

(b) Different line choice lamps (LCF-) and type of line lamps (HF, RF or TF) associated with different line numbers (L- lamp) indicate that **two marker NF leads are crossed on a number group connector MCB relay.**

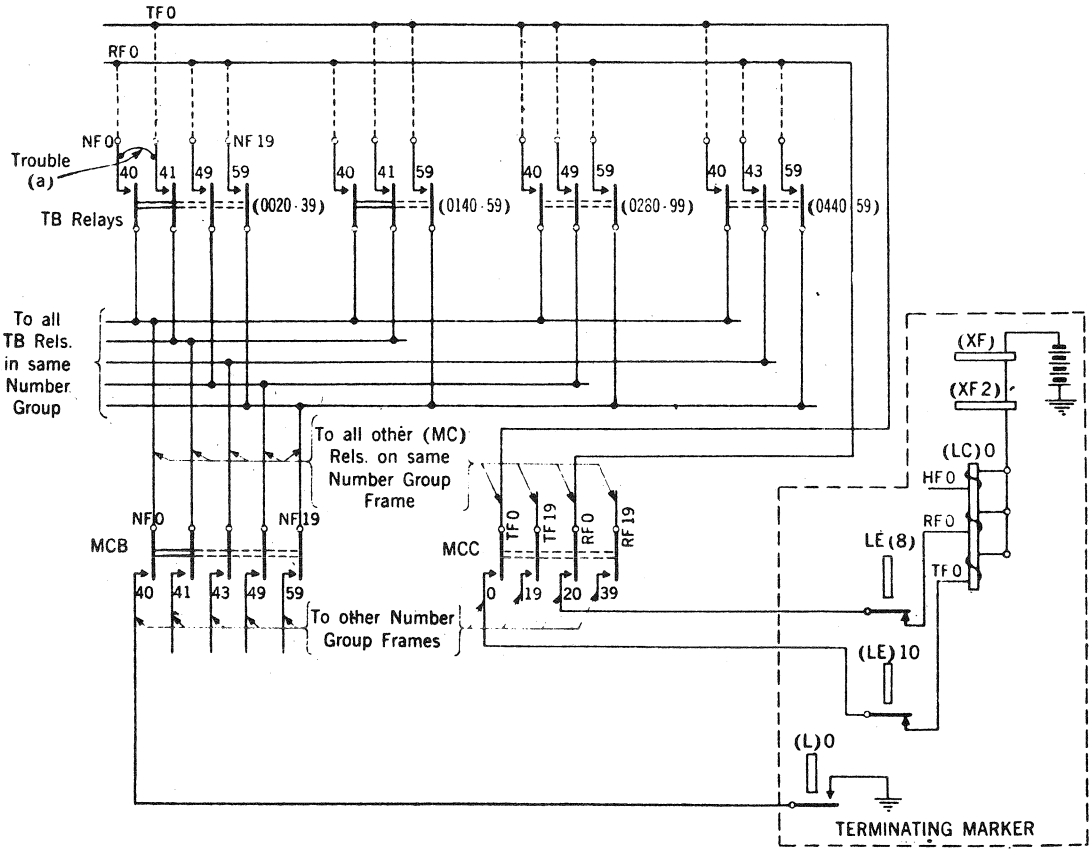


Fig. 1

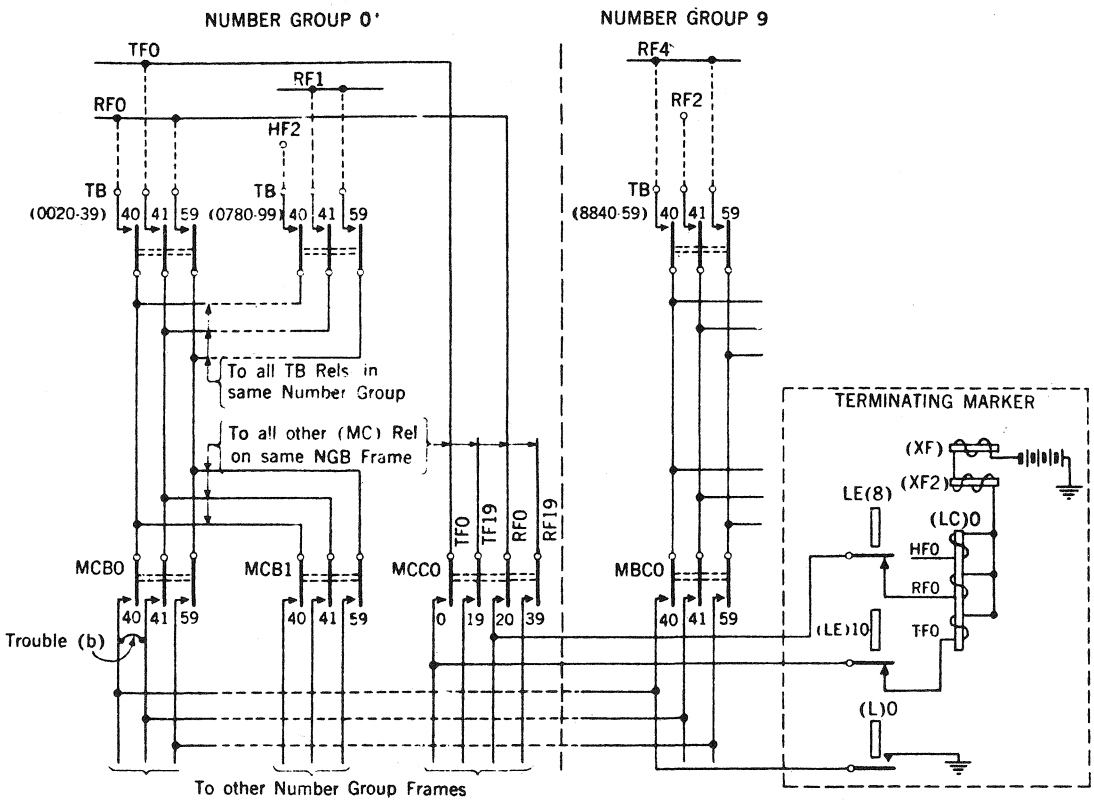


**Fig. 2**

(c) In offices served by four or more line choices analysis of a multiplicity of indications may reveal two predominating L lamps which indicate the marker NF leads in trouble. In offices served by less than four line choices two particular L lamps may not predominate and the determination of the crossed NF leads must be done by testing. In any event the analysis should be checked by a test.

5.07 The line choice lamps (LCF-) and type of line lamps (HF, RF, TF) attending the trouble indications may appear in combinations as described in 5.04. If it is assumed that individual contacts 40 (NF0) and 41 (NF1) on the MCB relay in number group 0, associated with terminating marker 0, are crossed and line number 0020 and 0021 are cross-connected to line choice fields RF0 and TF0 respectively, as shown in Fig. 2, a call to 0020, served by terminating marker 0 will result in line choice fields RF0 and TF0 being grounded (due to the cross) and a terminating trouble indication of XF attended by lamps LCF0, RF and TF will be received. It may be noted by referring to Fig. 2 that calls to line numbers served by a particular TB relay and the terminating marker involved in the trouble condition, will block and a terminating trouble indication will be received attended by the XF lamp and various combinations of lamps LCF-, HF, RF, and TF, provided the line numbers associated with the crossed NF leads are cross-connected to **different line choice fields** and the called number is cross-connected to **either one of them.**

**Trouble (c)—Crossed NF Leads—Individual and Common Contact TB Relay**

5.08 A cross between an individual and common contact, associated with an NF lead, on a number group connector TB relay may cause terminating trouble indications similar to those shown in Table C.

5.09 Analysis of indications shows:

(a) All markers (DR- lamp) fail in one number group (NGC- lamp) which indicates **that the number group is in trouble.**

(b) The same line choice field (LCF- lamp) and type of line (HF, RF or TF- lamp) appear in all indications which indicates that

TABLE C

Trouble Indications

| | DR | Line No. | L | NGC | LCF | HF | RF | TF | X |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 0847 | 7 | 1 | (2)– 4 | | √ | | XF |
| 2. | 1 | 0869 | 9 | 1 | 4 | | √ | (√) | XF |
| 3. | 2 | 0904 | 4 | 1 | (0)– 4 | | √ | | XF |
| 4. | 1 | 0842 | 2 | 1 | 2 –(4) | | √ | | XF |
| 5. | 2 | 0862 | 2 | 1 | 4 | | (√) | √ | XF |
| 6. | 2 | 0902 | 2 | 1 | 0 –(4) | | √ | | XF |
| 7. | 0 | 1022 | 2 | 1 | 3 –(4) | √ | (√) | | XF |
| 8. | 2 | 1039 | 19 | 1 | (3)– 4 | (√) | √ | | XF |
| 9. | 0 | 1482 | 2 | 1 | 3 –(4) | | √ | | XF |
| 10. | 0 | 1499 | 19 | 1 | (3)– 4 | | √ | | XF |
| 11. | 1 | 1502 | 2 | 1 | 0 –(4) | | √ | | XF |
| 12. | 1 | 1503 | 3 | 1 | (0)– 4 | | √ | | XF |
| 13. | 0 | 1582 | 2 | 1 | 4 | √ | (√) | | XF |
| 14. | 0 | 1590 | 10 | 1 | 4 | (√) | √ | | XF |

this lead (LCF4, RF in this case) is grounded (in which case consult Section 216-667-301) or that an individual and common contact of a TB relay is crossed. Test the particular HF, RF, or TF lead for false ground. If it is not grounded, note a trouble indication in which this LCF lamp **appears as a false indication** (indications 4, 5, 6, 7, 9, 11 and 13 in this case). The L lamp of this indication **denotes the NF lead in trouble** (L2 lamp, NF2 lead in this case).

5.10 In offices maintaining a line number NF punching assignment record the particular pair of crossed contacts may be partially determined by analysis. Scan each twenty blocks of assignments in a number group observing the line numbers corresponding to the NF lead in trouble. (In this case with the NF2 in trouble observe line numbers ending in 02, 22, 42, 62 and 82.) When a line is assigned to the line choice field (LCF) that is indicated in the trouble (RF4 in this case) note the particular line number. After checking all numbers in the number group open the cross-connections at the NF punching of each line noted. As each NF cross-connection is opened test for a cross between it and the HF, RF or TF lead in trouble. When the cross-connection associated with the contacts in trouble is opened, the cross condition will clear. Reclose all opened cross-connections except the one in trouble and inspect the TB relay contacts associated with this line for a trouble.

5.11 In offices having no records, cross-connections may be traced to determine assignments. This is done by observing the NF punchings of line numbers associated with the NF lead

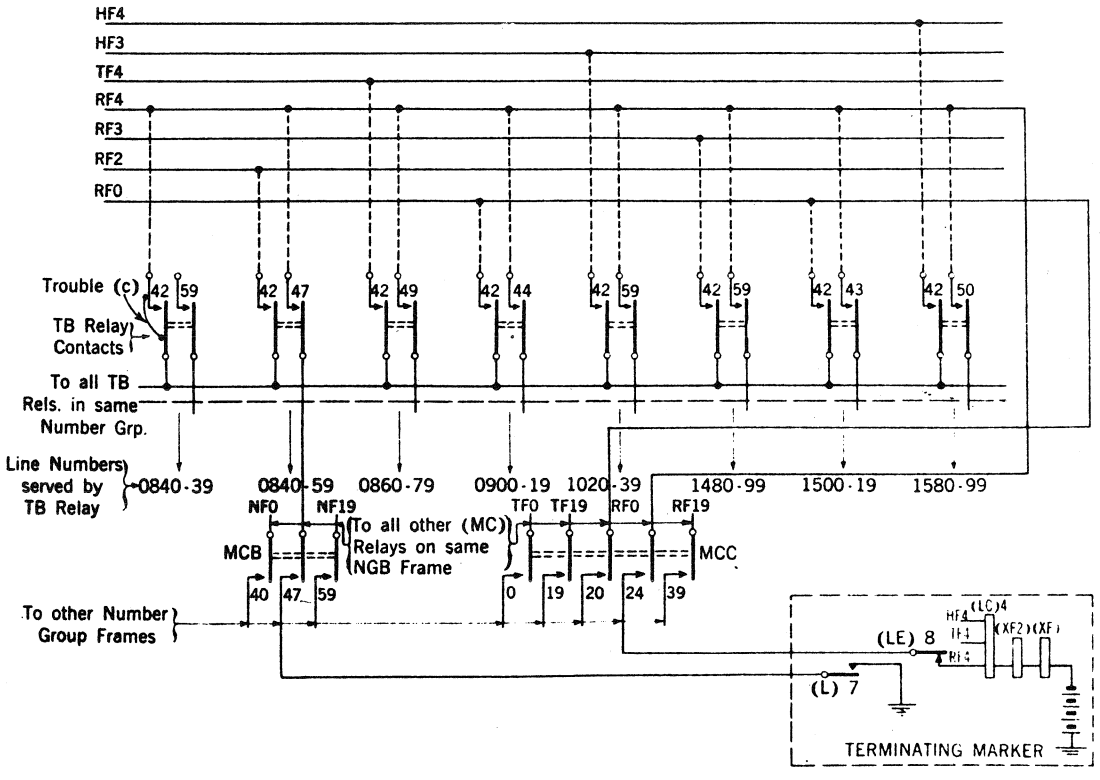


Fig. 3

in trouble and noting whether or not it is cross-connected to the HF, RF or TF in trouble.

5.12 In offices having one to three line choices it may be easier to isolate the cross to one hundred block of HF, RF or TF punchings before opening the NF cross-connections by opening the HF, RF or TF leads between hundreds.

5.13 The effect of a cross on a number group connector TB relay, between a common and individual contact associated with an NF lead, is illustrated by trouble indications in Table C and Fig. 3. It may be noted, by referring to these illustrations, that terminating trouble indications are received on calls to line numbers associated with the NF lead in trouble, provided they are cross-connected to a line choice field different from the one associated with the line number involved in the cross (trouble indications 4, 5, 6, 7, 9, 11 and 13). Calls to line numbers associated with various NF leads will also cause terminating trouble indications provided the line choice field serving the called number corresponds to the one associated with the line number involved in the cross (trouble indications 1, 2, 3, 8, 10, 12 and 14).

**Trouble (d)—Crossed NF Leads—Individual and Common Contact MCB Relay**

5.14 A cross between an individual and common contact, associated with an NF lead, on a number group connector MCB relay may cause terminating trouble indications similar to those shown in Table D.

**TABLE D**

**Trouble Indications**

| | DR | Line No. | L | NGC | LCF | HF | RF | TF | X |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 1 | 0121 | 1 | 0 | (0)– 3 | | √ | | XF |
| 2. | 0 | 1059 | 19 | 1 | 0 | | (√) | √ | XF |
| 3. | 2 | 0700 | 1 | 0 | 1 | (√) | √ | | XF |
| 4. | 0 | 1049 | 9 | 1 | (0)– 2 | | √ | | XF |
| 5. | 0 | 9583 | 3 | 12 | (0)– 1 | | | √ | XF |
| 6. | 0 | 9919 | 19 | 12 | (0)– 2 | | √ | | XF |
| 7. | 3 | 0139 | 19 | 0 | 0 | | (√) | √ | XF |
| 8. | 2 | 0719 | 19 | 0 | 1 | (√) | | √ | XF |
| 9. | 0 | 9599 | 19 | 12 | (0)– 2 | | | √ | XF |
| 10. | 0 | 1375 | 15 | 1 | 2 –(4) | | √ | | XF |

5.15 Analysis of indications shows:

(a) All markers except one fail in a particular number group **which is the number group in trouble** (number group 0 in this case).

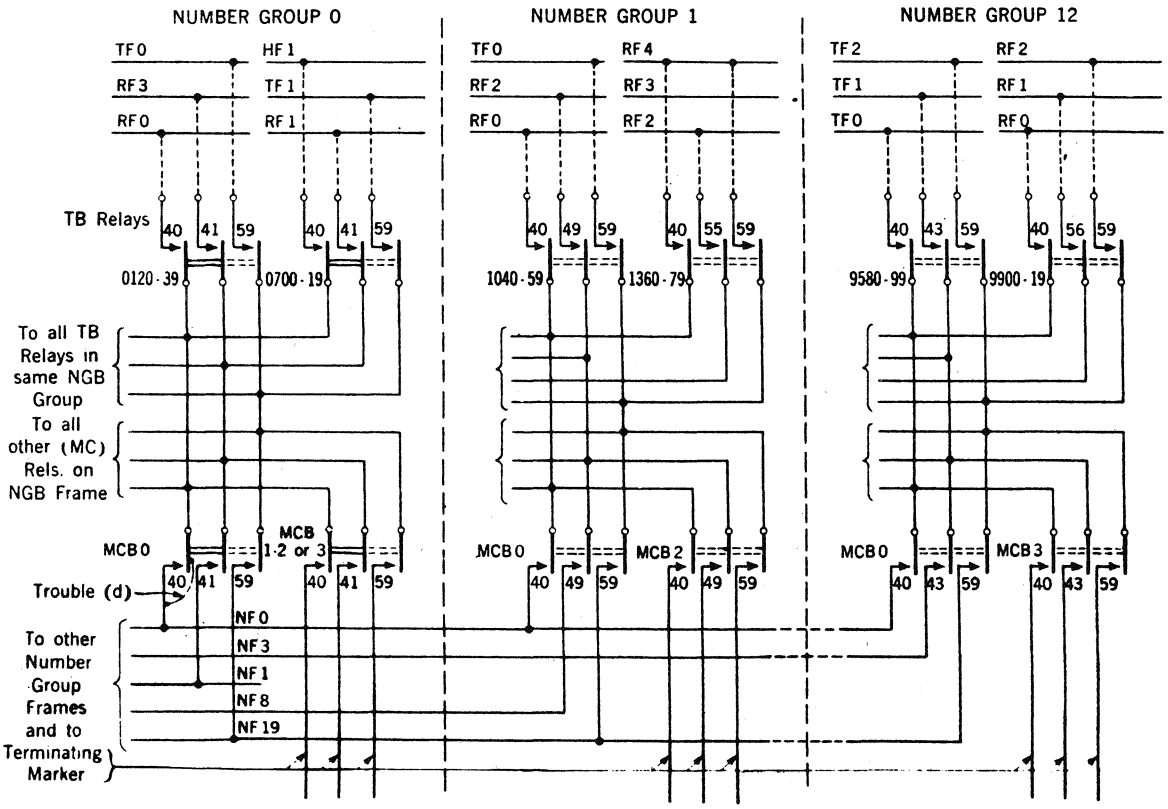


Fig. 4

(b) One marker fails in all number groups, except the one in trouble. **This is the marker in trouble** (marker 0 in this case).

(c) The trouble indicated is a cross between an individual and common contact on an MCB relay. **The MCB relay is associated with the marker in trouble and is located on the number group connector in trouble.**

5.16 The terminating trouble indications received, due to this type trouble condition, occur only when the terminating marker involved in the trouble is serving a call to any number roup, **except the one associated with the relay in trouble,** and a simultaneous call is being handled by **any other terminating marker** to a line number served by the number group associated with the relay in trouble.

5.17 The NF lead in trouble may be determined through a process of elimination by separately analyzing a number of indications. Referring to the indications in Table D:

(a) Indication 1 (marker not in trouble in number group in trouble) shows false RF0 when the TB relay associated with 0120-0139 is operated. Inspection of assignments shows RF0 assigned to NF 1020 (Fig. 4). Therefore the NF0 lead of number group 0 is indicated to be in trouble. However, there may be other lines in the same twenty block assigned to RF0. All such cases should be noted.

(b) Indication 2 (marker in trouble in number group not in trouble) shows false RF0 when the TB relay associated with 1040-1059 is operated. Inspection of assignments shows RF0 assigned to NF 1040 (Fig. 4). Therefore the NF0 lead of marker 0 is indicated to be in trouble.

(c) Indication 3 (marker not in trouble in number group in trouble) shows false HF1 when the TB relay associated with 0700-0719 is operated. Inspection of assignments shows HF1 assigned to NF 0700 (Fig. 4). Therefore the NF0 lead of number group 0 is indicated to be in trouble.

(d) Indication 5 (marker in trouble in number group not in trouble) shows false TF0 when the TB relay associated with 9580-9599 is operated. Inspection of assignments shows TF0 assigned to NF 9580 (Fig. 4). Therefore the NF0 of marker 0 is indicated to be in trouble.

5.18 From the foregoing analysis of four indications number group 0, NF lead 0 is crossed with marker 0, NF lead 0 at the MCB0 relay of number group 0.

5.19 A trouble condition can usually be located more quickly by testing than by the analysis method outlined above. However, for intermittent trouble conditions the analysis method is more positive. Even though many assignments agree with the false information attending indications (RF0 in indication 1), by a process of elimination it will be fairly certain after the fourth or fifth indication has been analyzed which leads are crossed.

### Trouble (e)—Crossed NF Leads—Two Common Contacts on TB or MCB Relay

5.20 A cross between two common contacts associated with NF leads, on a number group connector TB or MCB relay, may cause terminating trouble indications similar to those shown in Table E.

**TABLE E**

**Trouble Indications**

| | DR | Line No. | L | NGC | LCF | HF | RF | TF | X |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 0120 | 0 | 0 | 0 –(1) | | √ | | XF |
| 2. | 1 | 0121 | 1 | 0 | (0)– 1 | | √ | | XF |
| 3. | 2 | 0133 | 13 | 0 | 0 –(1) | | √ | | XF |
| 4. | 0 | 0134 | 14 | 0 | (0)– 1 | | √ | | XF |
| 5. | 0 | 0139 | 19 | 0 | 0 –(1) | | √ | | XF |
| 6. | 2 | 0780 | 0 | 0 | 0 –(1) | √ | (√) | | XF |
| 7. | 1 | 0781 | 1 | 0 | (0)– 1 | (√) | √ | | XF |
| 8. | 1 | 0793 | 13 | 0 | (0)– 1 | (√) | √ | | XF |
| 9. | 2 | 0799 | 19 | 0 | 0 –(1) | √ | (√) | | XF |

5.21 Analysis of indications shows:

(a) All markers (DR- lamp) fail in a particular number group (NGC- lamp) **which is the number group in trouble** (number group 0 in this case).

(b) Various L lamps with various HF, RF or TF and LCF lamps **indicate that two common NF leads of the number group are crossed** (NF0 and NF1 in this case).

(c) In large offices the two NF leads will be revealed by a preponderance of associated L lamps. (If the NF2 and NF12 leads are crossed the L2 or the L12 lamp will attend most of the indications.)

(d) In small offices it will be necessary to analyze each indication to determine the crossed NF leads as illustrated below. Reference should be made to the indications in Table E and Fig. 5.

(1) Indication 1 shows true RF0 with false RF1 when NF0 (L0) is used—TB 0120-0139. This indicates possible cross between NF0 and 1 (possible), NF1 and 13 (improbable), NF13 and 14 (possible) or NF14 and 19 (improbable).

(2) Indications 2, 3, 4 and 5 show same possibilities of crosses with different L lamps.

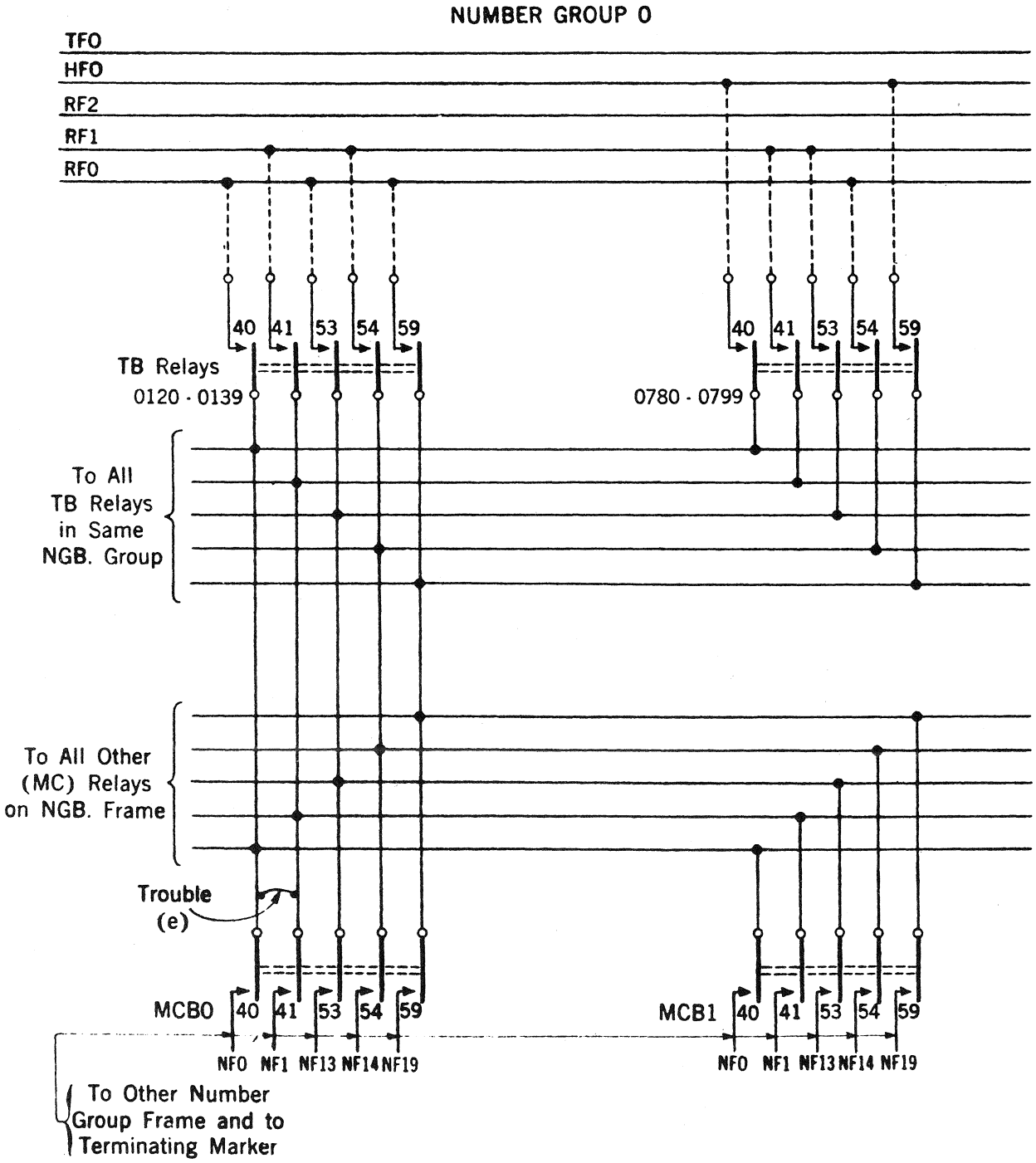
NUMBER GROUP 0
TFO
HFO
RF2
RF1
RF0
40 41 53 54 59
TB Relays
0120 - 0139
40 41 53 54 59
0780 - 0799
To All
TB Relays
in Same
NGB. Group
To All Other
(MC) Relays
on NGB. Frame
Trouble
(e)
MCB0 40 41 53 54 59
NF0 NF1 NF13 NF14 NF19
MCB1 40 41 53 54 59
NF0 NF1 NF13 NF14 NF19
To Other Number
Group Frame and to
Terminating Marker

Fig. 5

(3) Indication 6 shows true HF0 with false RF1 when NF0 (L0) is used—TB 0780-0799. This indicates possible cross between NF0 and 1 (possible), NF0 and 13 (improbable), or NF13 and 19 (improbable).

(4) Indications 7, 8 and 9 show the same possibilities with different L lamps.

## 6. SUGGESTED PROCEDURE FOR LOCATING AND CLEARING TROUBLE

6.01 In general the terminating trouble indication received due to crosses involving NF leads may be considered under one of two classifications, one involving a particular marker and the other a particular number group.

6.02 When analysis of the terminating trouble indication received involves a particular marker make it busy. By means of tests and inspections locate and clear the trouble. A terminating marker involved in a trouble condition as described in 5.14 to 5.19 will continue to bring in trouble indications, after the marker is made busy. In this case the leads involved in the trouble may be determined by observing the LC relays that operate in the terminating marker while it is made busy.

6.03 When a particular number group is involved determine whether any cross-connecting work was performed at the associated block relay frame coincident with the appearance of the trouble condition. Make an inspection at all locations where work was performed for a possible cause of the trouble.

6.04 Make an inspection for the cause of the trouble condition at all locations involved in the multiple wiring as indicated by an analysis of the trouble indicator displays. In connection with trouble conditions it may be desirable to attempt to isolate the trouble condition by opening the multiple wiring at the test terminal strips provided with each horizontal row of associated multi-contact relays. As the wires are removed from the test terminal strips tests should be made to determine if the trouble condition locates within that row. When it is found the multiple wiring for that row tests clear replace the wires and repeat the above method on the remaining rows of multi-contact relays until the row in which the trouble locates is determined. When an inspection of the multiple wiring on the row in which the trouble locates does not reveal the cause of the trouble conditions, it may be necessary to isolate the trouble further by removing wires from the multi-contact relays until the particular location of the trouble condition is determined.

## 7. TROUBLE CONDITIONS CAUSING REACTIONS MAY BE LISTED BELOW

7.01 Intermittent cross between leads NF2 and NF12 on the multiple wiring of the TB (twenty block) relays.