

Western Electric Company, Inc.,
Equipment Engineering Branch, Hawthorne.

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(1 Page) Page #1.
Appendix 5.
Issue 1 - BT-502492.
July 18, 1923. (*)

This Appendix was prepared from Issue 20 of T-502492.

METHOD OF OPERATION
PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District
Selector Circuit and Line Finder Circuit - Arranged for Coin Box Lines - With
or Without Message Register - Panel Machine Switching System.

Cancel circuit requirements on page 24 to 36 included.

Cancel Circuit requirements in appendix 1.

Cancel Circuit requirements in appendix 2.

Cancel all of appendix 3.

Cancel all of appendix 4.

ENG. B.F.M.
7/20/23.
MH

CHECKED BY: -J.I.

APPROVED: -H.L. MOYNES.
E.R.C.

Western Electric Company, Inc.,
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New York.

736309
(1 Page) Page #1
Appendix 4
Issue 1 - BE-502492
February 27, 1923.

METHOD OF OPERATION
PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District
Selector Circuit and Line Finder Circuit - Arranged for Coin Box Lines - With or
Without Message Register - Full Mechanical Power Driven System.

This appendix was prepared from issue 18 of drawing T-502492.

The Circuit Requirements for the F10 relay shall be changed to read as
follows:

After operating on .047 amp., must remain operated when circuit is opened
for a minimum period of 0.1 second and release on open circuit within a time in-
terval of maximum 0.35 second.

ENG.-TPI-KX.
3-7-23.

CHK'D-WCD-CWP

APPROVED-J. L. DOW-GML

METHOD OF OPERATION
PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District Selector Circuit and Line Finder Circuit - Arranged For Coin Box Lines - With or Without Message Register - Full Mechanical Power Driven System.

The requirements for E901 and E1187 relays shall be changed to read as follows:-

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E901 (L)	Special requirements to meet testing conditions Armature travel .020" Contact pressure 20 grams.		
	Requirements with relay cover off.		
	Readj. .018 amp.		Readj. .0052 amp.
	Test .019 amp.		Test .0049 amp.
	Requirements with relay cover on.		
	Test .019 amp.		Test .0046 amp.
E1187 (CO)	Special requirements to meet testing conditions. Armature travel .015" Contact pressure 20 grams.		
Wdgs. in series	Requirements with relay cover off.		
	Readj. .011 amp.	Readj. .0074 amp.	
	Test .017 amp.	Test .007 amp.	
Inner Wdg. (100 ohms)	Test .078 amp.	Test .039 amp.	
Wdgs. in series	Requirements with relay cover on.		
	Test .017 amp.	Test .0066 amp.	
Inner wdg. (100 ohms)	Test .078 amp.	Test .037 amp.	

ENG.--TPI-MM.
12/29/22.

CHK'D.--LBS-CWP.

APPROVED: J.L. DOW, G.M.L.

METHOD OF OPERATION
PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District Selector Circuit and Line Finder Circuit - Arranged for Coin Box Lines - With or Without Message Register - Full Mechanical Power Driven System.

Page 16

Paragraph 40 shall be changed to read as follows:

POSITION 7 TO 10.

40. Should the receiver be replaced on the switchhook while the district switch is in any of these positions, the line finder circuit is restored to normal as previously described in paragraph 30. Trunk hunting and selection beyond will take place in the same manner previously described and the advance of the sender circuit advances the switch to position 10. After selection beyond, the calling subscriber controls disconnection. In position 10 the release of the D relay advances the switch to position 16. In position 16 ground on the armature of the SL relay advances the switch to position 17 and ground on the break contact of cam D, advances the switch to position 18. From this point on the district selector and switch are restored to normal as described in paragraph 31.

Page 23.

Paragraph 59 shall be changed to read as follows:

TELL-TALE DISTRICT SELECTOR:

59. Should the selector travel to the tell tale position during brush selection, it will stop in position 8, since the sender does not furnish the 500 ohm ground over the (SC) lead to operate the (CH) relay. If the district selector goes to tell tale in group selection, the district will stick in position 9, since the sender does not furnish the 500 ohm ground to operate the (CH) relay under this condition. In either position the district will be held with its sender.

UNDER CIRCUIT REQUIREMENTS

The hold requirements for the E461 (A), should be removed and should be shown as being associated with the E461 (B). The circuit requirements were duplicated in the master copy. The second set of requirements should be cancelled.

ENG.-TPI-KX.
12/16/22.

CHK'D.-WCD-GWP.

APPROVED - C. L. SIUYTER, G.M.L.

Western Electric Co., Incorporated,
Engineering Department,
New York.

(1 Page) Page #1.
Appendix 2.
Issue 1 - BT-502492.
July 31, 1922.

METHOD OF OPERATION

PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District Selector and Line Finder Circuit - Arranged for Coin Box Lines - With or Without Message Register - Full Mechanical Power Driven System.

Page 7, Paragraphs 11.1 and 11.2 shall be added as follows:-

11.1 If either the STA or the STB relay remains operated, due to the failure of the TR or TR-1 relay in the trip circuit to be shunted out and released, the KF relay operates as soon as the interrupter contacts I, III and V close, and locks under control of the STA or STB relay in the starting circuit. If it remains locked for two seconds, interrupter contacts II and IV close from ground through either the TR or TR-1 relay in the trip circuit, (depending upon whether the call is through the A or B sub-group), releasing the TR or TR-1 relay. When ground is removed by the opening of the interrupter contacts II or IV, the STA or the STB relay releases, releasing the KF relay and restoring the circuit to normal.

11.2 The closure of the interrupter contact VI, which occurs at the same time contact II and IV are closed, while the KF relay is operated, operates the KA relay. The KA relay operated, (a) locks under control of a key at the trouble desk, (b) lights a lamp at the trouble desk, individual to the line finder frame and (c) operates an alarm. The operation of the key releases the KA relay, extinguishing the lamp and silencing the alarm.

The requirements for the E725 and E1626 relays shall be added as follows:-

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E725 (KF)	Readj. .017 amp. Test .019 amp.		Readj. .002 amp. Test .001 amp.
E1626 (KA)	Readj. .010 amp. Test .016 amp.		Readj. .001 amp. Test .0005 amp.

ENG.--WLK-BH.
12/16/22.

CHK'D.--ASP-CWP.

APPROVED - J. L. DOW, G.M.L.

METHOD OF OPERATION

PANEL LINE FINDER

Line Circuit - Trip Circuit - Start Circuit - Time Alarm Circuit - District Selector Circuit And Line Finder Circuit - Arranged For Coin Box Lines - With Or Without Message Register - Full Mechanical Power Driven System.

GENERAL DESCRIPTION

1. This common panel line finder and district selector circuit is used for passing calls originated by a dial subscriber on an individual message rate or coin box lines in a full mechanical office. It consists of six functionally connected circuits, as follows:-

1.1 The LINE circuit consists of a line relay (L), cut-off relay (CO), and a message register, one line circuit for each subscriber's line. When the receiver at a calling station is removed from the switchhook, battery is connected to the hunting (H) lead of the calling line and the associated apparatus functions and starts a line finder selector hunting for the battery on the hunting lead. When the calling line is found, battery and ground from the line circuit is disconnected from the tip and ring of the line, which awaits the closure of talking battery from the associated sender circuit. The trip circuit is also released, thus permitting another call to start in that half of the group.

1.2 A TRIP circuit is provided for each bank group of 20 lines, thus making 15 trip circuits on a panel line finder frame of 300 lines. Each trip circuit is divided into two units, trip unit A, having access to the first 10 lines in a bank, and trip unit B, having access to the last 10 lines in a bank. The trip circuit mechanically trips the selector brushes of the particular bank in which the terminals of its associated lines appear and connects to a starting circuit. Each trip circuit is equipped with an emergency plug and jack, by means of which a defective trip circuit may be immediately replaced by an emergency circuit.

1.3 The STARTING circuit controls the routing of calls to the respective line finder selectors and starts an idle selector hunting over the line terminals for the calling line. It also, at the same time, releases a trip relay in the associated trip unit, thus permitting another call to start in any other group. There is one starting circuit for each frame of 300 lines. The circuit consists of three 200 type distributing selectors, one of which permits the distributing of this circuit so as to give each line equal preference. The other two distributing selectors distribute the calls uniformly to the respective line finder selectors. Each regular starting circuit is provided with means for testing any line finder circuit and is equipped with an emergency plug and jack for immediately replacing the regular circuit with an emergency circuit at any time.

1.4 The LINE FINDER circuit is arranged to find the calling subscriber's line and connect it with the various switching apparatus necessary to complete a call. Each line finder circuit is permanently connected to a district selector circuit and consists of a power driven selector having 15 sets of contact brushes wired in multiple, one set of brushes associated with each line bank. At the same time the line finder selector starts upward hunting for the calling line, the associated district circuit functions and selects an idle sender. This circuit also includes a MAKE BUSY jack and a TEST jack.

1.5 The DISTRICT SELECTOR circuit, which is the other end of the line finder selector, is provided with a magnet driven selector switch, by means of which an idle sender is selected and associated with the district until all selections have been completed, when the sender is discharged. The district circuit is selector ended and selects and connects to the proper outgoing trunk, under the control of a sender, for the completion of an originating call. It also supplies talking battery to the calling station, connects battery for the operation of the message register in the line circuit on a charged call, and connects the busy tone to the calling station if required.

1.6 The LINE FINDER TIME ALARM circuit is for the purpose of giving visual and audible signals to the attendant when an originating call is not connected to a line finder in a specified time period.

PANEL LINE FINDER FRAME:

2. A panel line finder frame consists of 15 banks (at times known as panels) of line terminals, each bank consisting of 20 sets of multiple line terminals, making a total capacity of 300 lines. The multiple terminals appear on both sides of the bank and each set consists of four terminals, namely: tip (T), ring (R), sleeve (S) and hunting (H). Each frame and bank has a capacity of 60 line finder selectors, 30 selectors mounted on the front of the frame and the other 30 selectors mounted on the rear of the frame. This number of selectors for each 300 lines may be reduced to 40 or 28 selectors. The arrangement of the selectors may be accomplished by splitting the line multiple banks of a frame in the following manner:-

2.1 Each 60 selector bank on a frame is split in the center and arranged for a cross connecting cable, so that the first or bottom line on one side of the split will connect to and appear at the last or top line on the other half of the bank. This practice is used where 60 line finder selectors are required for each 300 lines.

2.2 Each 60 selector bank on a frame is split into three sections of 20 selectors each, two of these sections to be arranged for cross connecting to each other, the other section to be cross connected to a corresponding bank section on another frame. This practice is used where 40 selectors are required for each 300 lines thus permitting 900 lines to be accommodated on two frames.

2.3 A 56 selector bank split into four sections of 15 selectors each, the first and second sections to be arranged for cross connecting to each other and the third and fourth sections arranged for cross connecting to each other. This practice is used where 28 selectors are required for each 300 lines, thus permitting 600 lines to be accommodated on the one frame.

3. Each group of selectors for each 300 lines is divided into two sub-groups, "A" and "B". The "A" sub-group of selectors is on one side of the transposition split and the "B" sub-group is on the other side of the transposition split. By this method, a call originating in a group of 20 lines causes a selector in the "A" or "B" sub-group to start hunting, the sub-group depending upon the calling line being in the first or last 10 lines of the group. Should two calls in the same group originate at the same time, one

being in the first 10 lines and the other being in the last 10 lines, two selectors will start, one selector in sub-group "A", the other in sub-group "B". Should all line finders in a sub-group be busy, a call originating within the corresponding 10 lines will start a selector in the adjacent sub-group.

4. When both sub-groups of selectors for 300 lines are on the same frame, two TRIP magnets are used, one magnet on the front and the other magnet on the rear of the frame. When both sub-groups of selectors are on separate frames, four TRIP magnets are used, one on the front and one on the rear of each frame.

DETAILED DESCRIPTION

ORIGINATING CALL

5. The operation for a call originating in the first 10 lines of a group is as follows:- When the receiver at the calling station is removed from the switchhook, the L relay in the line circuit operates over the subscriber's loop, in turn connecting battery to the H terminal of the line at the finder multiple bank and operating the BA relay. The BA relay operated, operates the TR relay in a circuit from ground on the armature of the BA relay break contact of the K relay, 700 ohm outer winding of the TR relay, break contacts of the A, ST-A and ST-B relays, to battery on the armature of the STP-G magnet. The TR relay operated, (a) operates the TRIP magnets, (b) opens the locking series circuit through the TR relays in the other bank groups, as hereinafter described, (c) locks in a circuit from ground through its 600 ohm inner winding and make contact, terminal 1 and brush of the G group distributor selector, break contacts of the C, CA and SB relays to battery through the 18 BH resistance in parallel with the winding of the ST-A relay, which operates. Each TRIP magnet operates its trip rod, thus tripping the corresponding group brushes of the associated selectors on its respective side of the frame. The ST-A relay operated, (a) operates the STP-G magnet, which remains operated until the ST-A relay releases, (b) short circuits the 500 ohm winding of the CA relay, preventing it from operating and starting a line finder in sub-group "B" while a call is going through, as described in paragraph 41 under "ALL SELECTORS IN ONE SUB-GROUP BUSY", (c) operates the K relay over a circuit from battery through the winding of the K relay, make contact of the TR relay to ground on the armature of the ST-A relay, (d) closes a circuit operating the LF relay in the line finder circuit. This circuit is traced from ground on the right outer armature and inner make contact of the ST-A relay, through the break contacts of the CA and C relays, the A-1 bridging brush and terminal of the A selector, over lead ST, break contact of MB relay in the line finder circuit, break springs of the TEST jack, to battery through the 1000 ohm inner winding of the LF relay. The K relay operated, (a) locks to ground on the armature of the BA relay through its make contact and the break contact of the O relay (b) opens the circuit through the 700 ohm winding of the TR relay, thus preventing another line finder selector from being started by this call, (c) closes a circuit from ground on its make contact through the 1500 ohm winding of the O relay, but the O relay does not operate at this time on account of insufficient current through the winding. The LF relay operated, (a) locks through its make contact and both windings in series, to ground on the break contact and armature of the H relay, (b) closes a circuit operating the GA relay in the starting circuit from ground

April 20, 1922.

and connects ground to the RT lead, causing the L relay to operate and lock through its inner winding over the tip of the fundamental circuit previously described. The L relay operated, advances the switch for talking selection. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit through the outer contacts of cam E, holding the L relay operated, but successively short circuiting and permitting the re-operation of the stepping relay in the sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the L relay. The L relay released, opens the circuit through the R magnet, stopping the switch in position 11, 12, or 14, depending upon the class of call. As the switch leaves position 10, the holding circuit of the CI relay is transferred from the secondary to the primary winding. This circuit is traced from ground through the upper outer and lower inner contacts of cam E, make contact of the L relay upper outer and lower inner contacts of cam V make contact of the CI-1 relay, inner contacts of cam U make contact of the E relay to battery through the primary winding of the CI relay. The release of the L relay opens the holding circuit through the CI relay, releasing CI and CI-1 relays and disconnecting the sender from the district circuit.

CALLED PARTY ANSWERS

22. When the receiver at the called station is removed from the switch-hook, with the switch in position 11 or 12, reversed battery and ground from the incoming circuit operates the CS relay. The CS relay operated, closes a circuit from ground on the upper outer contact of cam H, through the make contact of the CS relay, outer contacts of cam N, winding of the I relay, to battery through the III contact of the 149-J interrupter. When the interrupter contact closes, the I relay operates and locks to the same ground through its make contact. When the IV contact of the interrupter closes, ground on the interrupter contact, operates the CH relay. The CH relay operated, locks through its 600 ohm winding and the outer contacts of cam O, to ground on its make contact and armature.

23. The 149-J interrupter is so connected in the circuit that the operation of the CH relay is delayed for at least two seconds after the CS relay operates. This is to prevent the false operation of the CH relay should the CS relay operate momentarily before the called party answers due to any line disturbances.

OPERATOR ANSWERS

24. The switch advances to position 13 as described above, and when the operator inserts the plug of an answering cord in the answering jack of the trunk, the CS relay operates on reversed battery and ground over the trunk. The CS relay operated, closes a circuit from the same ground on cam H, through the upper outer and lower inner contacts of cam R, to battery through the outer winding of the L relay, which operates and advances the switch to position 14. With the switch in position 14, the repeating coil and battery are disconnected and the T and R leads are connected directly to the T and R brushes of the selector through cams P and Q, respectively. As the switch enters position 13-1/2 the L relay locks to ground over lead S of the selected

trunk, and in position 13 $\frac{3}{4}$ the locking circuit through the inner winding of the D relay is transferred from the contacts of the DC relay to the upper contacts of cam J. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, inner contacts of cam E, make contact of the L relay, upper contacts of cam V, lower contacts of cam Y, 2 m.f. condenser, lower outer and upper inner contacts of cam X, the S brush and terminal at the line finder bank, to ground through the winding of the CO relay for number checking.

DISCONNECTION - REGULAR CALL

25. When the receiver at the calling station is replaced on the switch-hook, the DC relay releases, in turn releasing the D relay. The D relay released, closes a circuit advancing the switch to position 16.

MESSAGE REGISTERING

26. On M. R. or coin district circuits, the CI relay operates while the switch is passing through positions 14 $\frac{3}{4}$ to 15 $\frac{1}{2}$ and another sender is selected in a manner similar to that described in paragraphs 5 and 6 except that the CI relay operates in a circuit traced from battery through its inner winding the make contact of the E relay to ground on cam I. The ground to hold the test terminal of the sender busy after the release of the CI relay, is connected until the switch advances from position 16-1/2. In position 15 $\frac{1}{2}$ the CI relay locks to ground on the Test lead if the test brush of the sender is resting on the terminals of a busy sender. If the call has been completed the CH relay will have operated in position 11 or 12, and as the switch enters position 16, a circuit is closed to the Selector Time Alarm Circuit, thus giving a visual and audible alarm if a sender is not selected in a reasonable length of time.

27. When an idle sender has been selected the CI relay releases, since there is no ground on the test lead. The CI relay released, operates the L relay. This circuit is traced from battery through the outer winding of the L relay, the lower contacts of cam R, the break contact of the CI relay the make contact of the E relay, to ground through the inner contacts of cam I.

28. The D relay operates in position 16 and advances the switch to position 17 from ground on its make contact, inner contacts of cam M, the make contact of the L relay, the lower outer contact of cam B to battery through the R magnet.

29. In position 17, a circuit is closed from battery on the make contact of the SL relay, outer contacts of cam T, through the three 13-AH resistances in parallel, make contact of the CH relay, the H brush and terminal at the line finder bank, over lead H, through the break contact of the L relay, to ground through the message register (MR) operating the message register. During the message registering period, another line finder selector hunting over the line terminals in the same group will not stop its brushes on the multiple terminals of this line at this time for the reason that its H relay is shunted by the 5 ohm message register while the H brush of the hunting selector is passing over the H terminal of this line.

30. In position 17 the CI relay operates from battery through its inner winding, make contact of the E relay, to ground on the lower outer contact of cam I. The CI relay operated, operates the CI-1 relay. The CI-1 relay operated, closes a circuit from ground over the SC lead, lower contacts of cam V, make contact of the CI-1 relay lower inner and upper outer contacts of cam U, to battery through the outer winding of the D relay, which releases differentially. The D relay released, advances the switch to position 18. As the switch advances to position 18, the circuits through the D, SL, CH, and L relays are opened, releasing the relays and the battery for operating the message register is disconnected from lead H. The release of the SL relay disconnects battery from lead S, releasing the CO relay, thus restoring the line circuit to normal. As the switch enters position 18, a circuit is closed, operating the DS relay in the line finder circuit. This circuit is traced from ground on the M commutator brush and segment, through the 350 ohm winding of the DS relay, inner contacts of cam N break contact of the D relay, to battery on the break contacts of the DS relay. The DS relay operated, (a) locks through its make contact and 350 ohm winding to the same battery, (b) closes a circuit through the outer winding of the F relay, to hold this relay operated until both the line finder selector and the district selector have returned to normal, (c) operates the line finder DOWN magnet from ground on its armature, which restores the line finder selector to normal. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the E, DS, and LB relays.

31. In position 18 the L relay released connects ground through the upper contacts of cam D to the district DOWN magnet, which operates and restores the district selector to normal. As the district selector returns to normal, a circuit is closed from ground on the Y commutator brush and segment, upper inner contact of cam B, to battery through the R magnet, advancing the switch to position 1 or normal. As the switch leaves position 18, the circuit through the DOWN magnet is opened.

32. Should the calling subscriber fail to replace the receiver on the switchhook after the called subscriber has disconnected, the release of the CS relay, due to the incoming trunk functioning operates the selector time alarm circuit from ground through the upper outer contact of cam H over the circuit previously described, thereby notifying the switchman of the existing condition.

DISCONNECTION - TALKING TO OPERATOR

33. With the plug of the cord in the trunk jack at the incoming end, ground is connected to the sleeve terminal of the trunk to hold the district L relay operated. If the plug of the cord is removed from the trunk jack before the receiver at the calling station is replaced on the switchhook, the line relay in the trunk circuit operates, thereby holding the ground on the sleeve terminal of the trunk. When the receiver at the calling station is replaced on the switchhook and the plug of the answering cord is removed from the trunk jack at the incoming end, the DC relay releases, and ground is disconnected from the sleeve of the trunk releasing the L relay, thus advancing the switch

to position 15. As the switch advances from position 14-1/4, the locking circuit through the inner winding of the D relay is opened at cam J, releasing the relay. The D relay released, (a) opens the circuit through the SL relay, which releases, (b) closes a circuit advancing the district switch to position 16. In position 16 ground on the armature of the SL relay through the lower contacts of cam D advances the switch to position 17 and ground on the break contact of the D relay advances it to position 18. In position 18, the CH relay being normal, battery is not connected over lead H to operate the message register in the line circuit, as the call is not chargeable. From this point on, the line finder and district selectors are restored to normal as described under "Disconnection - Regular Call". Paragraph 31.

COLLECTING OR RETURNING THE COIN

34. If the call is from a coin box line, another sender is selected as described in paragraph 26 and in position 17, the CI relay operates in the same manner as previously described. The CI relay operated, operates the CI-1 relay. When the switch stopped in position 11 or 12 for talking, the CS relay operated when the receiver was removed from the switchhook at the called station and in turn closed a circuit operating the CH relay. The CH relay operated, locks and remains locked until the switch leaves position 17 1/4. With the CH relay operated and the switch in position 17, ground is connected to the FR lead, causing the sender to function and connect the coin collect battery to the T and R leads of the sender circuit, inner contacts of cams P and Q over the T and R leads to the subscriber's station, collecting the coin.

35. If the receiver was not removed from the switchhook at the called station, the CH relay does not operate, therefore ground is not connected to the FR lead of the sender, but the sender functions and connects "coin return" battery over the T and R leads of the sender, to the subscriber's station, returning the coin. With the switch in position 17, the D relay releases differentially due to a circuit being closed from battery through its outer winding, upper outer and lower inner contacts of cam U, make contact of the CI-1 relay, lower contacts of cam V, to ground in the sender circuit over the SC lead.

36. When the switch stops in position 13 or 14 for talking selection, the CH relay does not operate, since the call is to an operator, and therefore the coin is returned in the same manner as previously described.

37. When the coin has been returned or collected, the sender circuit advances and connects ground to SC lead causing the D relay to release. The D relay released, advances the switch to position 18. As the switch enters position 18, a circuit is closed through the DOWN magnet, from ground on the break contact of the D relay, upper contacts of cam D to battery, causing the district selector to return to normal. With the switch in position 18, another circuit is closed from ground on the M commutator, outer winding of the DS relay, inner contacts of cam N, break contact of the D relay, to battery on the break contact of the DS relay, operating the DS relay. The DS relay operated, locks directly to the same battery through its make contact and closes a circuit energizing the line finder selector DOWN magnet, restoring the line finder selector to normal. As the switch advances from position 17, battery is disconnected from the S lead of the line allowing the CO relay to release and as the switch advances from

position 17 1/2, the SL relay releases. The CO relay released, again connects battery and ground to the tip and ring of the line through the L relay. The DS relay operated also closes a circuit operating the F relay. When the selector returns to normal, the circuit through the H commutator segment is opened, releasing the E, DS, MB, and F relays, restoring the circuit to normal. When the district selector returns to normal, a circuit is closed from ground on its Y commutator to battery through the R magnet, advancing the switch to position 1 or normal.

DISCONNECTION ON ABANDONED CALLS

(a) DISCONNECTION BEFORE LINE FINDER SELECTOR FINDS LINE

38. Should the calling subscriber replace the receiver on the switchhook before a hunting selector finds the line, the L relay in the line circuit releases, disconnecting battery from the H terminal at the multiple bank. Assuming the calling line to be in sub-group A, the release of the L relay releases the BA relay. The TR relay having operated, locks and operates the STA relay, which operates the IF relay in the line finder circuit and the selector is started hunting, as described under "Originating Call" paragraph 5. The selector therefore travels to the top of the bank and the H brush of the selector makes contact with the terminal of the H comb at the top of the multiple bank. The H relay operates from ground on the break contact and armature of the DS relay, winding of the H relay, outer contacts of cam W, H brush of the selector to battery on the terminal of the H comb, supplied through the 1,000 ohm non-inductive winding of the BA-1 relay and the break contacts of the BA-1 and BA relays. The H relay operated, releases the IF relay, which in turn releases the F relay and opens the circuit through the UP magnet, stopping the selector. The H commutator segment is opened with the selector brush resting on the H comb terminal to prevent the district switch from advancing from normal when the F relay is released by the release of the IF relay. When the F relay releases, the DS relay operates through its 1,000 ohm winding from ground on the X commutator brush and segment. The DS relay operated, operates the DOWN magnet, restoring the selector to normal.

POSITION 2 to 6

39. If the receiver is replaced on the switchhook at the calling station while the district switch is in position 2 to 6, the dialing circuit is opened at the calling station, causing the sender circuit to function and connect a direct ground to the SC lead, causing the D relay to release on account of the increased current flowing through the outer winding of the relay. The D relay is connected differentially, but does not release when its inner winding is connected directly to ground and its outer winding connected to ground in series with sufficient resistance. The D relay released, operates the DS relay, which restores the line finder selector to normal, as described in paragraph 30. The D relay released, also opens the circuit through the SL relay, which releases. The SL relay released, disconnects battery from lead S, releasing the CO relay in the line circuit, and advances the district switch to position 6 from ground on the N commutator and break contacts of the F and SL relays through the lower contacts of cam D. With the district switch in position 6, a circuit is closed from the same ground through the lower inner and upper outer contacts of cam D,

to battery through the DOWN magnet, operating the district DOWN magnet restoring the selector to normal. When the selector reaches normal, ground on the Y commutator brush and segment advances the switch to normal.

POSITIONS 7 to 10

40. Should the receiver be replaced on the switchhook while the district switch is in any of these positions, the line finder circuit is restored to normal, as previously described in paragraph 30. Trunk hunting and selection beyond will take place in the same manner previously described and the advance of the sender circuit advances the switch to position 11. In position 11 the release of the D relay advances the switch to position 16. In position 16, ground on the armature of the SL relay advances the switch to position 17, and ground on the break contact of the D relay through the upper inner and lower outer contact of cam D, advances the switch to position 18. From this point on the district selector and switch are restored to normal as described in paragraph 31.

ALL SELECTIONS IN ONE SUB-GROUP BUSY

41. If all the selectors in sub-group "A", for example, are busy, the CA relay operates over a circuit from ground on the armature of the MB relay in the line finder circuit, through the make contacts of all the other operated MB relays in sub-group "A" over lead CH to the starting circuit, 500 ohm winding of the CA relay, to battery through the 600 ohm resistance (C). The CA relay operated, transfers the circuit through the 600 ohm winding of the TR relay in the trip circuit from the winding of the STA relay, to battery through the winding of the SA relay and the break contact of the SB relay. When a call is now received, the SA relay operates in series with the 600 ohm winding of the TR relay, in turn operating the STB relay. This circuit is traced from battery through the winding of the STB relay, make contact of the SA relay, 600 ohm resistance (B), to ground on the armature of the CB relay. The STB relay operated, operates the E relay, starts a selector in the "B" sub-group hunting for the calling line and closes a locking circuit through the 1000 ohm winding and make contact of the CA relay. This is to prevent the release of the CA relay should a selector become available in the "A" sub-group while a call is going through the "B" sub-group. If all selectors in sub-group "B" are busy, the operation is similar except that the CB, SB, and ST-A relays now operate. The ST-A relay operated, starts a selector in the "A" sub-group hunting, as explained before.

ALL SELECTORS IN BOTH SUB-GROUPS BUSY

42. If all selectors in both sub-groups are busy both the CA and CB relays are operated. Should a call be received in either sub-group under these conditions, the corresponding SA or SB relay operates, but neither the STB nor STA relay operates, as the circuits to ground on the armature of the CA and CB relays are open. When a call is received in the "A" or "B" sub-group while all selectors are busy, the special message register (MR) in the starting circuit operates through the make contact of the SA relay to ground on the armature of the CB relay, if the call is in sub-group "A", or through the make contact of the SB relay to ground on the armature of the CA relay, if the call

is in sub-group "B". The message register thus indicates the number of calls which were originated while all the line finder selectors were busy.

LINE FINDER TIME ALARM

43. If a line finder does not find the subscriber's line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner: When the receiver at the calling station is removed from the switchhook, the line L relay operates, operating the BA relay. The BA relay operated, connects battery to the contact of the 152-D interrupter in the time alarm circuit over a circuit from battery through the outer non-inductive winding and make contact of the BA relay, lead B winding of the B (frame) relay in the time alarm circuit, brush and terminal 1 of the start arc of the time alarm selector, break contact of the A frame relay, to the interrupter contact. When the interrupter contact closes, the B relay operates. The A (frame) relay does not operate, however, due to its windings being short circuited by ground on the interrupter. When the interrupter contact opens, the short circuit is removed from the winding of the A relay, which now operates in series with the winding and make contact of the B relay, to ground on the armature of the B relay, thus holding both relays operated. The next closure of the interrupter operates the STP magnet, over a circuit from ground on the make contact of the interrupter, make contact of the A relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the STP magnet. When the interrupter contact opens, the STP magnet releases and steps its brushes one step on its back stroke. The selector brushes thus advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the BA-1 lamp in the trip circuit lights over a circuit from battery on the armature of the A (frame) relay, terminal 5 and brush of the LAMP arc of the selector, lead A, through the make contact of the BA relay, BA-1 lamp, lead C, to ground through the winding of the B (aisle) relay in the time alarm circuit, which operates. The B relay operated, operates the A (aisle) relay. The A relay operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm circuits. When the source of trouble is removed and the BA relay in the trip circuit has released, the circuits over leads A and B are opened, in turn releasing both the frame and aisle A and B relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the B (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector, to battery through the break contact and winding of the STP magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next closure of lead B.

44. Should the BA relay release before the fifth terminal is reached by the selector, the A and B (frame) relays release. The B relay released, causes the selector to advance to the next normal position, awaiting closure of lead B, as previously described. The operation of the 188-A key steps the selector brushes to the next normal position by way of the STEP bridging brush and 5, 10, 15, or 20 terminal, as the case may be. If the selector had been at normal position 6, 11, or 16 when the BA relay operated, the operation would have been the same as described for position 1.

WIRING OF GROUP DISTRIBUTOR BANK

45. The wiring of the two group distributor arcs of the regular G distributing selector bank, shown on the regular starting circuit, and of the emergency G distributor selector bank, is shown in detail in the circuit associated with the series circuit through the emergency jack and the contacts of the TR and TR-1 relays for the 15 groups of a panel line finder frame. For a complete frame of 300 lines, the wiring of the terminals for both arcs of each G distributor selector is shown in a table on the drawing. As a trip circuit is divided into two units, A and B, calls originating in the first 10 lines of a group of 20 lines are connected through trip unit A and a terminal and brush of the G arc normally having access to the line finders in sub-group "A". Calls originating in the last 10 lines of a group are connected through trip unit B and a corresponding terminal and brush of the other arc normally having access to the line finders in sub-group "B". This arrangement permits the distributing of the 30 trip circuit A and B units to sub-groups "A" and "B", respectively, in the starting circuit, so as to give each group an equal preference, thus preventing any one group from having a permanent preference over the other groups. This is accomplished by the G selector being advanced one step to the next group after each call. The series circuit through the contacts of the TR and TR-1 relays permits the passing of a call through a number of idle groups with the same speed as though the call originated on a line within the group having the preference at that time. Should two or more calls start in two or more groups at the same time, the group nearest the one having the preference at that time will be completed first, because of the series locking arrangement of the TR or TR-1 relay holding the relay of this group locked and releasing the other relays.

46. The TR relay in any group locks from ground through its 600 ohm winding and make contact, jack 10, terminal and brush of the associated arc of the G selector, to battery in the starting circuit through jack 15. The TR-1 relay locks through its 600 ohm winding and make contact, jack 12, corresponding terminal and brush of the associated G arc, to the starting circuit through jack 16. Jacks 10 and 12 of each group circuit wire to the selector arc terminals and jacks 9 and 11 loop to the next group circuit, so that the selector may be giving preference to one group, this group being idle, and a call originates in some other group, a circuit is closed back through the intervening jacks and break contacts of the intervening relays of each group until the terminal which the distributor brush is resting on is reached. Assume a call originates in group 15 and is passing through trip unit A and the brushes of the G distributor selector are resting on the first group terminal which is terminal 1. The locking circuit for the TR relay will be as follows: Through the 600 ohm winding and make contact of the TR relay and jack 10 of group 15, jack 11, break contacts of the TR-1 and TR relays, and jack 10 of group 14 (not shown) through all other groups in the same manner to jack 10 of group 1, terminal 1 and brush of the selector, to jack 15 of the starting circuit. It will be seen that if two calls start at the same time in two different groups causing the TR relays in the two groups to operate together, the call originating in the group nearest the one having the preference of the starting circuit will be completed first. For example, if a call started in group 10, trip unit A, and another in group 15, trip unit A, the operation of the TR relay in the former group would release the TR relay in the latter circuit, but remain locked itself. The magnet of the G selector is operated by ground on the armature of the ST-A or ST-B relay and the brushes advance

53. When the 184 plug (shown on the line finder circuit) is inserted in the TEST jack of the line finder under test, the ST and ST-1 leads are connected together. The 1000 ohm winding of the LF relay is disconnected from the break contact of the MB relay and connected to the make contact of the C relay in the starting circuit through the strapped ring and sleeve of the TEST plug. When the plug of the test box cord is inserted in either 159 test jack, the A relay operates from ground on the sleeve of the test box cord. The A relay operated, opens the circuit through the 700 ohm winding of the TR and TR-1 relays in the trip circuit and connects ground to the winding of the B relay, which operates. This circuit is traced from ground on the right inner armature of the A relay, winding and break contact of the B relay, break contacts of the STA and STB relays, to battery on the armature of the STP-G magnet when the previous step of the G distributor selector has been completed. The B relay is slow in operating to prevent a call which has just reached the STA or STB relay from being interrupted and to prevent there being the possibility of two selectors arriving on the test line. The B relay operated, (a) locks to battery on its make contact, (b) operates the C and CI relays from ground on its armature, through the break contact of the E relay, (c) closes the ring side of a loop through the test box, which operates the L relay associated with the test line. The C relay operated, (a) transfers the circuit for operating the STA relay in the starting circuit from the G distributor selector bank, (b) opens the normal ST lead, (c) closes the circuit through the LF relay and TEST jack to the make contact of the ST-A relay, as hereinafter described, (d) opens the operating circuit for the ST-B relay, which would otherwise operate and lock on a call within the last 10 lines in the group. The CI relay operated, (a) closes a circuit for operating the TR relay in the trip circuit from battery on the armature of the STP-G magnet, (b) connects the K lead of sub-group "A" with the K lead of sub-group "B", thus connecting the K commutator segments of all the selectors of both sub-groups together, (c) connects the Y lead of sub-group "A" with the Y lead of sub-group "B", so the GA relay will be operated by a selector in either sub-group.

54. The L relay of the test line operated, in turn operates the BA relay. The BA relay operated, operates the TR relay through its 700 ohm winding over the same circuit as described under "ORIGINATING CALL" paragraph 5, except this time through the make contact of the CI relay, the A relay being operated. The TR relay operated, functions as previously described and locks in a circuit traced from ground through its 600 ohm winding and break contact of the C relay, break contacts of the CA and SB relays to battery through the winding of the STA relay, which operates. The STA relay, operated, functions as described under "ORIGINATING CALL" paragraph 5 and in addition closes a circuit operating the D relay. The circuit for operating the LF relay of the line finder circuit under test is traced from ground on the armature and inner make contact of the STA relay, through the break contact of the GA relay, make contact of the C relay, sleeve and ring of the TEST jack and plug in the line finder circuit, to battery through the 1000 ohm winding of the LF relay. The LF relay operated, starts the selector hunting for the battery on the H terminal of the test line, as in the case of a regular call. With the exceptions already stated, the line, trip, starting, line finder, and district circuits function as for a regular call.

55. With the STA relay operated, the circuit for operating the D relay is traced from ground on the armature and outer make contact of the STA relay, break contact and winding of the D relay, to battery on the armature of the B relay. The D relay operated, locks to ground on the armature of the A relay. When the STA relay releases, the E relay operates from ground on the left inner armature of the STA relay, make contact of the D relay, to battery through the break contact and winding of the E relay. The E relay operated, (a) locks to ground on the armature of the A relay, (b) releases the C and CI relays, thereby restoring the starting circuit to normal, (c) closes the circuit from battery on the armature of the STP-C magnet, which was opened by the operation of the A relay and later closed by the operation of the CI relay, through to the 700 ohm winding of the TR and TR-1 relays. When the plug of the test box cord is removed from the test jack, the A relay is released, releasing the B, D, and E relays, thereby restoring the test circuit to normal.

TELL TALE - LINE FINDER SELECTOR

56. Should the selector travel to the tell tale position while hunting, due to the multiple brush not being tripped, the F relay remains operated through its outer winding. Ground on the X commutator brush and segment is thereby connected to the lead "To Tell Tale Circuit", giving a visual signal to the attendant. As the N commutator segment is open at tell-tale, the district is prevented from advancing from its normal position. The selector in this case is restored to normal manually by the attendant.

57. Should the selector travel to the tell-tale position while hunting, with the multiple brush tripped, a circuit is closed from battery in the trip circuit through the 500 ohm winding of the O relay in parallel with the 500 ohm resistance, make contact of the BA relay, terminal of the H comb at the top of the multiple bank, H multiple brush of the line finder selector, outer contacts of cam W, winding of the H relay, to ground on the armature of the DS relay, operating the O and H relays. The O relay operated, functions as previously described in paragraph 10 and the H relay operated, releases the IF relay which in turn releases the F relay and the UP magnet. The F relay released, opens the circuit through the tell-tale alarm and connects ground through the X commutator brush and segment to battery through the 1000 ohm winding of the DS relay, which operates, in turn operating the DOWN magnet, restoring the selector to normal.

58. The receiver at the calling station being still removed from the switchhook, the L and BA relays are still operated and the call again goes through as described under "ORIGINATING CALL".

TELL -TALE DISTRICT SELECTOR

59. Should the selector travel to the tell tale position during selection, ground on the X commutator brush and segment is connected through the lower inner contact of cam B, to battery through the R magnet, advancing the switch to position 18. In position 18, the DOWN magnet operates and restores the selector to normal. When the selector returns to normal, ground on the Y commutator brush and segment advances the switch to position 1.

OVERFLOW

60. If all the trunks in the group are busy, the district selector, while trunk hunting in position 7, travels to the top of the group and rests on the overflow terminals. As the sleeve terminal at overflow is open, the L relay releases, in turn advancing the switch to position 8. In position 8, the L relay re-operates from ground on the armature of the CH relay, advancing the switch to position 9. In position 9, a circuit is closed from ground on the Z commutator brush and segment, through the upper contacts of cam K, to battery through the R magnet, advancing the switch to position 10. In position 10, a circuit is closed from ground on the Z commutator brush and segment, through the upper outer contact of cam K, lower inner contact of cam L, to battery through the 1200 ohm winding of the L relay, operating the L relay. The L relay operated, locks through its 1200 ohm winding and make contact to the same ground, through the upper outer contact of cam L, advancing the switch to position 14 from ground on cam M. As the switch advances from position 13, the L relay releases, and in position 14 advances the switch to position 15. The release of the L relay also releases the CI relay, disconnecting the sender from the district circuit. With the switch in position 15, a circuit is closed from the "Miscellaneous Tone Circuit" over lead C, 2 M.F. condenser, upper contacts of cam G, winding of the repeating coil, 2 M.F. condenser, lower contacts of cam Y, upper contacts of cam V, lower outer and upper inner contacts of cam J make contact of D relay, to ground. A tone is therefore induced in the other winding of the repeating coil, thus causing the "All Trunks Busy" tone to be sent back to the calling subscriber. When the receiver at the calling station is replaced on the switchhook, the DC relay releases, opening the locking circuit through the D relay, which releases. From this point on, the switch is advanced to position 1 as described under "Disconnection - Talking to Operator" paragraph.

"O" COMMUTATOR

61. The function of the "O" commutator segment is to maintain an idle condition on the multiple overflow terminals, so that more than one selector may stop an overflow at one time; otherwise, the first selector reaching overflow would make the sleeve multiple terminals busy, thus causing succeeding selectors to continue upward into the next group of trunks. The "O" commutator segment is open at overflow, but the S bar is continuous. Both the "O" and "S" commutator brushes are permanently strapped together and wired to the multiple sleeve brush. When the selector is at overflow, the "O" commutator brush is resting on an open (dead) segment, and as the busy ground is fed through the "O" commutator bar only, this arrangement maintains a non-busy condition on the sleeve terminals. When necessary to combine two or more groups of trunks, the multiple sleeve overflow terminals between the combined groups are made permanently busy by being connected to ground. As the "S" commutator bar is closed at overflow, the L relay is held operated at this time, and the selector therefore SKIPS past the "MADE BUSY" terminals into the next group.

TERMINATING CALL

62. When a final selector connects to the tip, ring and sleeve terminals of an idle line at the final multiple, battery through a resistance in the

final circuit is connected over the sleeve lead S, to ground through the both windings of the CO relay on individual lines and the last line of a group of consecutive lines; or through the 100 ohm winding of the CO relay on an intermediate line of a group of consecutive lines. The CO relay operated, disconnects the L relay battery bridge from across the tip and ring of the line circuit. When the final selector returns to normal, the circuit through the windings of the CO relay is opened, releasing the relay and restoring the circuit to normal.

(30 Pages) - 1932
1932-1 - 1932-1
1932-1 - 1932-1

Final circuit is connected over the above line to the group of
windings of the 30 relay on individual lines and the last line of a group of
consecutive lines; or through the 100 line winding of the 30 relay on an in-
mediate line of a group of consecutive lines. The 30 relay operates discon-
nects the 100 line winding from across the line and ring of the line cir-
cuit. When the final detector returns to normal, the circuit through the
windings of the 30 relay is opened, releasing the relay and restoring the cir-
cuit to normal.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
178-AK (L) Inner Wdg.	Special requirements to insure slow release. Readj. .014 amp. Test .047 amp.	All normally made contacts to be tensioned to minimum 15 grams.	Readj. .004 amp. Test .0038 amp.
Outer Wdg.	Test .046 amp.		

MECHANICAL REQUIREMENTS

- 203-A
(CS)
- (a) Armature travel .015" to .020".
 - (b) Armature must move freely in bearings.
 - (c) There must be follow in the contact springs.
 - (d) There shall be .005" air gap between the hard rubber bridge and the swinging spring.

When trunk loop does not exceed 3560 ohms. Resistance
Readj. .0024 amp. On open circuit.
Test .004 amp.

When the trunk loop is more than 3560 ohms but does not exceed
5000 ohms resistance.
Readj. .0024 amp. On open circuit.
Test .0032 amp.

When the trunk loop exceeds 5000 ohms resistance.
Readj. .0024 amp. On open circuit.
Test .0026 amp.

NOTE: TRUNK LOOP includes the resistance of the trunk conductors,
relays and repeating coils, in the District and connecting
circuits.

MECHANICAL REQUIREMENTS

- 206-L
(CS)
- (a) Total contact travel shall be .004".
 - (b) The biasing spring shall be tensioned against
the armature with sufficient force to meet the
release requirement.

Special requirements to insure fast operation.
After a soak of
.045 amp. in the
direction opposite
to the operating
current.

On open circuit.
After a soak of
.045 amp. in same
direction as oper-
ating current.

April 20, 1922.

CIRCUIT REQUIREMENTSTHE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
206-L (CS) Cont'd.	Readj. .003 amp. Test .0032 amp.		
B1 (DC)	When used with loops having a maximum resistance of 750 ohms. After a soak of approximately .3 amp. Readj. .015 amp. Test .021 amp.		After a soak of approximately .3 amp. Readj. .005 amp. Test .0037 amp.
	When used with loops having a maximum resistance of 900 ohms; After a soak of approximately .3 amp. Readj. .015 amp. Test .019 amp.		After a soak of approximately .3 amp. Readj. .005 amp. Test .0037 amp.
B9 (B)	After a soak of approximately .3 amp. Readj. .054 amp. Test .062 amp.		After a soak of approximately .3 amp. Readj. .006 amp. Test .0057 amp.
E106 (SA, SB)	Readj. .030 amp. Test .034 amp.	Readj. .015 amp. Test .014 amp.	
E499 (D)	Readj. .013 amp. Test .028 amp.		Readj. .002 amp. Test .0019 amp.
	NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E428	Through relay winding; Readj. .016 amp. Through parallel combination with E568 relay. Readj. .034 amp. Test .040 amp.	Through relay winding; Readj. .010 amp. Through parallel combination with E568 relay. Readj. .021 amp. Test .020 amp.	
E461 (A)	Readj. .012 amp. Test .015 amp.	Readj. .008 amp. Test .0076 amp.	Hold: Readj. .0096 amp. Test .012 amp.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E461 (B)	Special requirements to insure Hold. Readj. .012 amp. Test .015 amp.	Readj. .008 amp. Test .0076 amp.	
E533 (L) Inner Wdg. (1200 ohms)	Special requirements to insure fast operation. Readj. .017 amp. Test .0178 amp.	Readj. .012 amp. Test .0114 amp.	
Outer Wdg. (800 ohms)	Test .045 amp.		
	NOTE: Relay to be equipped with special armature stop (piece part P-163914) unless an E1 relay cover is furnished.		
E542 (CH) Inner Wdg. (600 ohms)	Readj. .022 amp. Test .0235 amp.	Readj. .015 amp. Test .014 amp.	
Outer Wdg. (275 ohms)	Not used.		
	NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E555 (CI-1, I and A)	Readj. .009 amp. Test .012 amp.		Readj. .0013 amp. Test .0006 amp.
E568 (C-1)	Through relay winding; Readj. .015 amp. Through parallel combination with E428 relay (C). Readj. .032 amp. Test .038 amp.	Through relay winding; Readj. .009 amp. Through parallel combination with E428 relay (C). Readj. .019 amp. Test .018 amp.	

(38 Pages) Page #27.
Issue 1 - BT-502492.
April 20, 1922.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E598 (SL)	Readj. .017 amp. Test .030 amp.	Readj. .010 amp. Test .0095 amp.	
E632 (TR, TR-1) Outer Wdg. (700 ohms)	Special requirements to insure fast operation and to meet hold circuit condition. Readj. .045 amp. Readj. .022 amp. Test .048 amp. Test .020 amp.		
Inner Wdg. (600 ohms)		Hold: Readj. .032 amp. Test .034 amp.	
E637 (CA, CB) Inner Wdg. (500 ohms)	Test requirement of inner winding is proportional to test of outer winding. Readj. .025 amp. Readj. .015 amp. Test .027 amp. Test .014 amp.		
Outer Wdg. (1000 ohms)	Hold: Readj. .037 amp. Test .040 amp.		
E638 (STB)	Special requirements to insure fast operation. Through relay winding; Readj. .025 amp. Through relay winding; Through parallel combination with 18 BH resistance. Readj. .039 amp. Readj. .004 amp. Test .042 amp. Test .0062 amp. Test .0059 amp.		
E748 (LF) Inner Wdg. (1000 ohms).	Special requirements to insure fast operation. Readj. .025 amp. Readj. .016 amp. Hold: Test .027 amp. Test .015 amp. Readj. .017 amp. Test .018 amp.		
E750 (MB, Inner Wdg. (1000 ohms).	Test requirement of inner winding is proportional to test requirement of outer winding; Readj. .028 amp. Readj. .014 amp. Test .030 amp. Test .013 amp.		

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E750 Cont'd. Outer Wdg. (1000 ohms)		Hold: Readj. .040 amp. Test .043 amp.	
E895 (E)	Readj. .016 amp. Test .030 amp.		Readj. .003 amp. Test .0028 amp.
	NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E896 (B)	Readj. .047 amp. Test .050 amp.		Readj. .007 amp. Test .0065 amp.
	NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E897 (A)	Readj. .013 amp. Test .028 amp.	Readj. .0075 amp. Test .007 amp.	
E899 (STA)	Special requirements to insure fast operation. Through relay winding; Readj. .026 amp. Through parallel combination with 18 BH resistance. Readj. .041 amp. Test .044 amp.		Through relay winding; Readj. .005 amp. Through parallel combination with 18 BH resistance. Readj. .0077 amp. Test .0073 amp.
E901 (L)	Readj. .018 amp. Test .019 amp.		Readj. .0052 amp. Test .0049 amp.
E904 (E)	Readj. .031 amp. Test .037 amp.		Readj. .003 amp. Test .0028 amp.
E908 (F) Inner wdg. (1000 ohms)	Special requirements to meet hold circuit condition. Hold: Readj. .031 amp. Test .037 amp.	All normally closed contacts shall be tensioned to a min- imum of 15 grams.	

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
Outer Wdg. (300 ohms)	Readj. .040 amp. Test .047 amp.		
E938 (CI) Inner Wdg. (800 ohms)	Readj. .045 amp. Test .050 amp.	Readj. .024 amp. Test .022 amp.	
Outer Wdg. (800 ohms)	Test .050 amp.		
E996 (DS) Pri. Wdg. (1000 ohms).	Test requirements of secondary and tertiary windings in series is proportional to test of primary winding. Readj. .040 amp. Test .042 amp.		Readj. .007 amp. Test .0066 amp.
Sec. and Ter. wds. in parallel (350 ohms).	Test .091 amp.		

NOTE: To prevent chattering, the "make-before-break"
 spring combination of this relay shall be so
 adjusted that the spring, which normally makes
 on the back contact, will give the greatest
 possible contact pressure against the back contact.

E1148 (BA, BA-1) Inner Wdg. (1000 ohms)	Readj. .022 amp. Test .033 amp.	Readj. .012 amp. Test .011 amp.
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MECHANICAL REQUIREMENTS

E1149 (C, C-1)	(a) Armature travel .015" \pm .0025". (b) There shall be a perceptible follow of the bent spring when the relay operates, but it will not be necessary to have a visible stud-gap.
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ELECTRICAL REQUIREMENTS

E1149 (C, C-1) Inner Wdg. (500 ohms)	Special requirements due to circuit conditions and to obtain speed. Through relay winding. Readj. .015 amp.	Through relay winding: Readj. .010 amp.
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CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
El149 Cont'd.	Through parallel combination with 500 ohm non-inductive resistance. Readj. .032 amp. Test .034 amp.	Through parallel combination with 500 ohm non-inductive resistance. Readj. .021 amp. Test .020 amp.	
Outer wdg. (1500 ohms)	Hold: Readj. .027 amp. Test .0285 amp.		
El187 (CO) Wdg. in series aiding.	Special requirements to meet testing conditions. Readj. .011 amp. Test .017 amp.	Readj. .0074 amp. Test .007 amp.	
Inner Wdg. (100 ohms)	Test .078 amp. Armature Travel .015" \pm .0025". Contact Pressures - Minimum 15 grams.	Test .039 amp.	

MECHANICAL REQUIREMENTS

- (a) The front spring shall be tensioned against the spool head to a minimum of 30 grams.
- (b) Minimum contact follow .008".
- (c) Armature travel minimum .020" maximum .023".

ELECTRICAL REQUIREMENTS

El325 (H)	Special requirements to insure fast operation. Readj. .009 amp. Test .0095 amp.	Readj. .0068 amp. Test .0064 amp.
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MECHANICAL REQUIREMENTS

EC000 (CA) (CB)	Armature travel .035" \pm .0025".
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Special requirements to insure fast operation.
 Readj. .018 amp. The contact pressure of the normally closed contacts shall be minimum 20 grams. The contact pressure of all other contacts shall be minimum 15 grams.
 Test .019 amp.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E428 (C)	Through relay winding; Readj. .016 amp. Through parallel combination with E568 relay. Readj. .034 amp. Test .040 amp.	Through relay winding; Readj. .010 amp. Through parallel combination with E568 relay. Readj. .021 amp. Test .020 amp.	
E461 (A)	Readj. .012 amp. Test .015 amp.	Readj. .008 amp. Test .0076 amp.	Hold: Readj. .0096 amp. Test .012 amp.
E461 (B)	Special requirements to insure Hold. Readj. .012 amp. Test .015 amp.	Readj. .008 amp. Test .0076 amp.	
E535 (L) Inner Wdg. (1200 ohms)	Special requirements to insure fast operation. Readj. .017 amp. Test .0178 amp.	Readj. .012 amp. Test .0114 amp.	
Outer Wdg. (800 ohms)	Test .045 amp. NOTE: Relay to be equipped with special armature stop (piece part P168914) unless an E1 relay cover is furnished.		
E542 (CH) Inner Wdg. (600 ohms)	Readj. .022 amp. Test .0235 amp.	Readj. .015 amp. Test .014 amp.	
Outer Wdg. (275 ohms)	Not used.		
	NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E555 (CI-1, I and A)	Readj. .009 amp. Test .012 amp.		Readj. .0013 amp. Test .0006 amp.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E168 (C-1)	Through relay winding. Readj. .015 amp.	Through relay winding. Readj. .009 amp.	
	Through parallel combination with E428 relay (C). Readj. .032 amp. Test .038 amp.	Through parallel combination with E428 relay (C). Readj. .019 amp. Test .018 amp.	
E598 (SL)	Readj. .017 amp. Test .030 amp.	Readj. .010 amp. Test .0095 amp.	
E632 (TR, TR-1) Outer wdg. (700 ohms)	Special requirements to insure fast operation and to meet hold circuit condition. Readj. .045 amp. Test .048 amp.	Readj. .022 amp. Test .020 amp.	
Inner wdg. (600 ohms)		Hold: Readj. .032 amp. Test .034 amp.	
E637 (CA, CB) Inner wdg. (500 ohms)	Test requirement of inner winding is proportional to test of outer winding: Readj. .025 amp. Test .027 amp.	Readj. .015 amp. Test .014 amp.	
Outer wdg. (1000 ohms).	Hold: Readj. .037 amp. Test .040 amp.		
E628 (STB)	Special requirements to insure fast operation. Through relay winding: Readj. .025 amp. Through parallel combination with 18 BH resistance. Readj. .039 amp. Test .042 amp.	Through relay winding: Readj. .004 amp. Through parallel combination with 18 BH resistance. Readj. .0062 amp. Test .0059 amp.	

April 20, 1922.

CIRCUIT REQUIREMENTSTHE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E748 (LF) Inner wdg. (1000 ohms)	Special requirements to insure fast operation. Readj. .025 amp. Test .027 amp.	Readj. .016 amp. Test .015 amp.	Hold: Readj. .017 amp. Test .018 amp.
E750 (MB) Inner wdg. (1000 ohms).	Test requirement of inner winding is proportional to test requirement of outer winding. Readj. .028 amp. Test .030 amp.	Readj. .014 amp. Test .013 amp.	
Outer wdg. (1000 ohms)			Hold: Readj. .040 amp. Test .043 amp.
E895 (E)	Readj. .016 amp. Test .030 amp.		Readj. .003 amp. Test .0028 amp.
	NOTE: To prevent chattering the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.		
E896 (B)	Readj. .047 amp. Test .050 amp.		Readj. .007 amp. Test .0065 amp.
	NOTE: To prevent chattering the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact will give the greatest possible contact pressure against the back contact.		
E897 (A)	Readj. .013 amp. Test .028 amp.	Readj. .0075 amp. Test .007 amp.	
E899 (STA)	Special requirements to insure fast operation. Through relay winding. Readj. .026 amp. Through parallel combination with 18 BH resistance. Readj. .041 amp. Test .044 amp.	Through relay winding. Readj. .005 amp. Through parallel combination with 18 BH resistance. Readj. .0077 amp. Test .0073 amp.	

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E901 (L)	Readj. .018 amp. Test .019 amp.		Readj. .0052 amp. Test .0049 amp.
E904 (E)	Readj. .031 amp. Test .037 amp.		Readj. .003 amp. Test .0028 amp.
E908 (F) Inner wdg. (1000 ohms)	Special requirements to meet hold circuit condition. Hold: Readj. .031 amp. Test .037 amp.	All normally closed contacts shall be tensioned to a minimum of 15 grams.	
Outer Wdg. (800 ohms)	Readj. .040 amp. Test .047 amp.		
E938 (CI) Inner wdg. (800 ohms)	Readj. .045 amp. Test .050 amp.	Readj. .024 amp. Test .022 amp.	
Outer Wdg. (800 ohms)	Test .050 amp.		
E996 (DS) Primary wdg. (1000 ohms)	Test requirements of Secondary and Tertiary windings in series is proportional to test of Primary winding. Readj. .040 amp. Test .042 amp.		Readj. .007 amp. Test .006 amp.
Secondary and Tertiary wdgs. in parallel (350 ohms)	Test .091 amp.		
NOTE: To prevent chattering, the "make-before-break" spring combination of this relay shall be so adjusted that the spring, which normally makes on the back contact, will give the greatest possible contact pressure against the back contact.			
E1148 (BA, BA-1) Inner Wdg. (1000 ohms)	Readj. .022 amp. Test .033 amp.	Readj. .012 amp. Test .011 amp.	

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

OPERATE

NON-OPERATE

RELEASE

MECHANICAL REQUIREMENTS

- El149 (a) Armature Travel .015" \pm .0025".
(0,0-1) (b) There shall be a perceptible follow of the bent spring when the relay operates, but it will not be necessary to have a visible stud-gap.

ELECTRICAL REQUIREMENTS

El149 Special requirements due to circuit conditions and to
(0,0-1) obtain speed.

Inner	Through relay	Through relay
Wdg.	winding:	winding:
(500	Readj. .015 amp.	Readj. .010 amp.
ohms)	Through parallel	Through parallel
	combination with	combination with
	500 ohm non-in-	500 ohm non-in-
	ductive resistance.	ductive resistance.
	Readj. .032 amp.	Readj. .021 amp.
	Test .034 amp.	Test .020 amp.

Outer Hold:
wdg. Readj. .027 amp.
(1500 Test .0235 amp.
ohms).

El187	(Special requirements to meet testing conditions)
(00)	Readj. .011 amp. Readj. .0074 amp.
Wdgs.	Test .017 amp. Test .007 amp.
series	
aiding.	

Inner	Test .078 amp.	Test .039 amp.
Wdg.		
(100 ohms)		

Armature travel .015 \pm .0025".
Contact pressures - Minimum 15 grams.

MECHANICAL REQUIREMENTS

- El1325 (a) The front spring shall be tensioned against the spool head
(H) to a minimum of 30 grams.
(b) Minimum contact follow .008".
(c) Armature travel minimum .020" maximum .023".

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

OPERATE

NON-OPERATE

RELEASE

ELECTRICAL REQUIREMENTS

Special requirements to insure fast operation.

Readj. .009 amp. Readj. .0068 amp.

Test .0095 amp. Test .0064 amp.

MECHANICAL REQUIREMENTS

Armature travel .035" \pm .0025".

B6000
(GA)
(GB)

ELECTRICAL REQUIREMENTS

Special requirements to insure fast operation.

Readj. .018 amp. The contact pressure
Test .019 amp. of the normally closed
 contacts shall be minimum
 20 grams. The contact
 pressure of all other
 contacts shall be minimum
 15 grams.

After operating on .047 amp. relay must remain operated when the circuit is broken for a minimum period of 0.1 second, and release on open circuit within a time interval of 0.3 second maximum.

Minimum tension of 20 grams on normally made contacts of the make-before-break combination of the top set of springs.

Test .036 amp. Test .032 amp.

5 M
Message
Register

Test .330 amp. Test .270 amp.

5 S
Message
Register.

ENG.--RAF-ML.
11/21/22.

CHK'D.--WCD-CHW.

APPROVED - C. L. SLUYTER, G.M.I.

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$$\begin{array}{r} 2/28 \\ 991/12 \\ \hline 1/11 \end{array}$$