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Western Electric Co., Incorporated
Engineering Dept.,
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**METHOD OF OPERATION
SELECTOR CIRCUIT**

Incoming From Toll Key Indicator - Direct Two And Four Party Semi-Selective Ringing - Power Driven Machine Switching System.

GENERAL DESCRIPTION

1. This circuit is used as an incoming trunk circuit between a toll operator in a distant manual office and subscribers' in mechanical offices. It is selected at its outgoing end, at the manual office, by a key indicator trunk selector, and connects with a final selector, establishing connections for talking purposes.
2. The circuit may be arranged for direct and two party ringing, or four party semi-selective ringing. The ringing, after being started by operating the ringing key in the toll cord circuit, is continued automatically under the control of a machine. The toll operator receives a lamp signal, as an indication that the trunk is closed for ringing. When the ringing key is operated, the lamp is extinguished but relights as a supervisory signal when the key is released. When the receiver at the called station is removed from the switchhook the lamp is extinguished, and when the receiver is replaced on the switchhook, the lamp relights as a disconnect signal.
3. The circuit is released whenever the toll operator withdraws the plug of the toll cord from the trunk jack regardless of whether or not the called subscriber has replaced the receiver on the switchhook.
4. The circuit is arranged so that the toll operator may rering the PBX operator, in which case the ringing is controlled manually.
5. During the ringing period, the toll operator receives an audible ringing tone.
6. The circuit may be arranged for coin collect service.
7. The circuit is arranged for routine testing.

DETAILED DESCRIPTION

INCOMING SELECTED

8. SWITCH IN POSITION 1. When a toll key indicator trunk selector selects the outgoing end of this circuit, the L relay operates over the fundamental circuit. CIRCUIT: Battery, inner winding of L relay, cam I, cam K, cam L, "T" compensating resistance, tip side of fundamental circuit, through stepping and overflow relays in toll key indicator sender circuit, back over ring side of fundamental circuit, "R" compensating resistance, cam M, ground. The L relay operated, advances the switch to position 2. CIRCUIT: Ground, L relay operated, cam D, R magnet, battery.

BRUSH SELECTION

9. SWITCH IN POSITION 2. As the switch advances from position 1, the L relay locks. CIRCUIT: Battery, inner winding and make contact of L relay, to ground, as described under paragraph 8. As the switch enters position 1-3/4, the A commutator is connected to the tip side of the fundamental circuit, through cams K and L, and as the switch enters position 2, the UP magnet operates to ground, through cam D and contacts of the L relay, thus causing the selector to move upward for brush selection.

10. SWITCH IN POSITION 2. As the selector moves upward in position 2 carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connects ground to the tip side of the fundamental circuit, successively short circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation, until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened in the sender, releasing the L relay. Ground is connected to the G commutator through contacts of cam E. The L relay released, opens the circuit through the UP magnet, stopping the upward movement of the selector, and advances the switch to position 3. CIRCUIT: Ground, L relay normal, cam B, cam A, R magnet, battery.

TRIP MAGNET OPERATED

11. SWITCH IN POSITION 3. As the switch enters position 3, the TRIP MAGNET (TM) operates to ground on cam H.

GROUP SELECTION

12. SWITCH IN POSITION 3. As the switch enters position 3, the L relay operates and advances the switch to position 4 the same as described under paragraph 8.

13. SWITCH IN POSITION 4. As the switch advances from position 3 the L relay locks, as described under paragraph 9. As the switch enters position 3-3/4, the B commutator is connected to the tip side of the fundamental circuit through cam L, and as the switch enters position 4, the UP magnet operates, as described under paragraph 9, causing the selector to move upward for group selection. The TM magnet being operated, trips the previously selected set of brushes as the selector moves upward.

14. SWITCH IN POSITION 4. As the selector moves upward for group selection, carrying the commutator brushes over the commutator segments, the B segment and brush intermittently connects ground to the tip side of the fundamental circuit, successively short circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation, until the proper group has been selected. When sufficient impulses have been sent back to satisfy the sender for group selection, the fundamental circuit is opened in the sender, releasing the L relay. Ground is connected to the G commutator through cam E. The L relay released, in turn releases the UP magnet, thus stopping the upward movement of the selector, and advances the

switch to position 5 as described under paragraph 10.

15. SWITCH IN POSITION 5. As the switch enters position 5, the L relay operates through its outer winding, cam J, D relay normal, ground. The L relay operated, advances the switch to position 6 as described under paragraph 8.

FIRST TRUNK OF GROUP IDLE

16. SWITCH IN POSITION 6. If the first trunk of the group on which the selector is resting is idle, the L relay releases as the switch advances from position 5-1/2, thereby advancing the switch to position 7, as described under paragraph 10. As the switch enters position 5-1/2, the sleeve of the selector trunk is made busy to other hunting incoming selectors by ground, cam K, L relay normal, cam H, sleeve terminal. In positions 6-3/4 to 15-1/4, the selected trunk is held busy by ground through cam H.

FIRST TRUNK OF GROUP NOT IDLE

17. SWITCH IN POSITION 6. If the first trunk of the group in which the selector is hunting is busy, the L relay locks as the switch advances from position 5-1/4. CIRCUIT: Battery, inner winding of L relay, L relay operated, cam H, S terminal, to ground on the sleeve of the busy trunk. As the switch enters position 6, the UP magnet operates as described under paragraph 9, causing the selector to move upward for an idle trunk. When an idle trunk is found, the circuit through the inner winding of the L relay is opened but the L relay does not release immediately due to a circuit being closed from battery through the outer winding of the L relay, cam J, to ground on the C commutator brush and segment. When the circuit through the C commutator brush and segment is opened, the L relay releases. Ground is connected to the G commutator through contacts of L relay and cam E. The L relay released, opens the circuit through the UP magnet, thereby stopping the upward movement of the selector, disconnects ground from the G commutator and advances the switch to position 7, as described under paragraph 10. As the switch enters position 6-3/4, the selector trunk is made busy by ground on cam H.

"C" COMMUTATOR FUNCTION

18. The adjustment of the "C" commutator brush with relation to the tripped sleeve multiple brush is such that it does not break contact with the "C" commutator segment until slightly after the holding circuit through the inner winding of the L relay is opened by the sleeve brush leaving the busy terminal and making contact with the sleeve terminal of the idle trunk. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the trunk terminals, thus allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time the holding circuit through the outer winding of the L relay is opened at the "C" commutator, releasing the relay. The selector then drops into place, thus centering the brushes on the trunk terminals. During trunk hunting, in position 6, the commutator feed ground is supplied through cam E under control

of the L relay. This is to prevent the reoperation of the L relay by the closure of a circuit between the C commutator brush and segment on the over-throw of the selector, or as it drops into place.

19. SWITCH IN POSITION 7. As the switch enters position 7, the L relay operates. CIRCUIT: Battery, inner winding of L relay, cam I, cam H, ground. The L relay operated, advances the switch to position 8 as described under paragraph 8.

SELECTION BEYOND

20. SWITCH IN POSITION 8. As the switch advances from position 7 the L relay locks. CIRCUIT: Battery, inner winding of L relay, L relay operated, cam G, R terminal, to ground in the final circuit. As the switch enters position 8, the tip side of the fundamental circuit is closed through to the final, operating the final line relay. After the final circuit satisfies the sender for final brush, final tens, and final units selection, the final switch advances, opening the holding circuit through the L relay, which releases. The L relay released, advances the switch to position 9, as described under paragraph 10.

SENDER ADVANCE

21. SWITCH IN POSITION 9. With the switch in position 9, the L relay awaits the closure of the fundamental circuit in the sender. When this is made, the L relay operates. CIRCUIT: Battery, inner winding of L relay, cam I, "R" compensating resistance, ring side of fundamental circuit, through the stepping and overflow relays in the sender, back over the tip side of the fundamental circuit, "T" compensating resistance, cam L, cam K, ground. The L relay operated, advances the switch to position 10, as described under paragraph 8. The A cam advances the switch to position 11. The reversed battery and ground remains on the fundamental circuit during positions 9 and 10 to insure the operation of the polarized overflow relay in the sender circuit. As the switch advances from position 10, the L relay releases.

TRUNK CLOSURE - TOLL CORD IN JACK

22. SWITCH IN POSITION 11. If the plug of a toll cord is inserted in the trunk jack at the outgoing end of this circuit, before the toll key indicator sender has completed its selections, trunk closure is made as follows. After the sender circuit has completed its selections, the tip and ring of the trunk is closed through the toll cord, operating the A relay. CIRCUIT: Ground "R" resistance, S-1 relay normal, outer windings of the DP and A relays, repeating coil, cam L, tip of trunk, through a bridged relay and retardation coil in toll cord circuit, ring of trunk, cam M, repeating coil, inner windings of A and DP relays, S-1 relay normal, "R" resistance, to battery.

23. SWITCH IN POSITION 11. The A relay operates, at this time since its windings are connected in series aiding, but the DP relay does not, as its windings are connected differently. The supervisory relay in the toll

cord circuit also operated in the above circuit, lighting the supervisory lamp, thereby indicating that ringing may be started. The A relay operated, operates the D relay. CIRCUIT: A relay operated, S-1 relay normal, winding of D relay 18 AE resistance battery. The D relay operated, operates the L relay. CIRCUIT: Ground, D relay operated cam J, outer winding of L relay, battery. The L relay operated, advances the switch to position 12, as described under paragraph 8. The A cam advances the switch to position 13.

TRUNK CLOSURE - HOLDING CORD IN JACK.

24. SWITCH IN POSITION 11. If the plug of a holding cord is inserted in the trunk jack at the outgoing end of this circuit before the toll key indicator sender has completed selections, trunk closure is made as follows. After the sender circuit has completed its selections, the outgoing end of this circuit functions, connecting the tip and ring of the trunk through to the holding cord circuit, thereby operating the A relay. This circuit is the same as described under paragraph 22, except that closure is made through the holding cord circuit instead of the toll cord circuit. In this case however, the lighting of the supervisory lamp in the holding cord circuit is not a ringing signal. The holding cord is then withdrawn from and a toll cord is inserted in the outgoing trunk jack. A timing circuit at the outgoing end short circuits the line temporarily to prevent disconnection while transferring the cords. If the A relay is momentarily released in transferring from the holding circuit to the timing circuit or from the timing circuit to the toll cord, the D relay being slow in releasing remains operated. When the trunk closure circuit is again closed, the A relay reoperates, reclosing the locking circuit for the D relay.

25. SWITCH IN POSITION 11. The A, D and L relays operate, the DP relay does not operate and the switch is advanced to position 13, as described under paragraph 23.

RINGING FOUR PARTY

26. SWITCH IN POSITION 13 or 15. The switch has two ringing positions, namely 13 and 15. In position 13, one ring interrupted ringing current is connected to the ring brush of the selector, and in position 15, two ring interrupted ringing current is connected to the ring brush of the selector. Stations having one ring are assigned numbers which are reached through final trunks terminating in either groups 0 or 2 on the incoming frame. Stations which have two rings are assigned numbers which are reached through final trunks terminating in either groups 1 or 3 on an incoming frame. The ringing of stations on the tip side of the line is cared for by a cross connecting and reversing scheme at the distributing frame. The switch stops in position 13 when the selector is on a final trunk so located that the circuit through the P commutator brush and segment is open, but advances to position 15 when the selector is on a trunk so located that the circuit through the P commutator is closed.

GROUPS 0 AND 2.

27. SWITCH IN POSITIONS 13 OR 15. When the ringing key in the toll cord circuit is operated, the R-2 relay operates on ringing current through cams L and M, in turn operating the S-1 and RC-1 relays. The S-1 relay operates. CIRCUIT: Ground, L relay normal, R-2 relay operated, outer winding of S-1 relay, battery. The S-1 relay operated, releases the A relay, and disconnects battery and ground from the tip and ring of the trunk circuit, extinguishing the toll cord supervisory lamp. The RC-1 relay, (a) locks under control of the R1 relay, (b) short circuits windings of the 7-8 and B-R of the repeating coil, preventing a false ring when code ringing is used, (c) operates the PU relay. CIRCUIT: Ground, RC-1 relay operated, R-1 relay normal, RC-1 relay operated, X wiring, RC relay normal, cam C, outer winding of S-1 relay, battery. The A relay released closes a circuit holding the D relay. The D relay is slow in releasing, prevent its release, when the holding circuit is transferred from the make to break contact of the A relay. The PU relay operated, locks under control of the R relay, and operates the R1 relay. CIRCUIT: Battery winding of the R-1 relay ground, PU relay operated. The R1 relay operated opens a locking circuit, releasing the RC-1 relay, connects ground to the tip of the line and connects ringing current to the ring side of the line. When the ringing key is released in the toll cord circuit, the R2 relay releases in turn releasing the S-1 relay. The S-1 relay released, (a) operates the A relay, (b) connects battery and ground to the tip and ring of trunk circuit, lighting the toll cord supervisory lamp. The A relay operated transfers the holding circuit for the D relay. CIRCUIT: lead R-1, cam Q, winding of R relay, PU relay operated, R-1 relay operated, cam G, over the ring side of the final and called line, sub-set ground. The R relay is slow acting and does not operate until the receiver is removed from the switchhook at the called station.

GROUPS 1 OR 3.

28. SWITCH IN POSITION 12. As the switch enters position 12, with the selector on a trunk in either group 1 or 3, the L relay re-operates. CIRCUIT: Battery, outer winding of L relay, cam O, P commutator brush and segment, ground. The L relay operated, releases the S-1 relay. The L relay operated, advances the switch to position 14, as described under paragraph 8. The A cam advances the switch to position 15. As the switch advances from position 13-1/4, the L relay releases. The L relay released, operates the S-1 relay, which function as described under paragraph 27. As the switch enters position 15, the RC-1 relay operates, as described under paragraph 27.

29. SWITCH IN POSITION 15. Under this condition, the PU relay awaits its ground through a pickup interrupter. When the interrupter contact closes, the PU relay operates. CIRCUIT: Battery, winding and break contact of PU relay, RC-1 relay operated, cam P, interrupter contact, resistance lamp, ground. The PU relay locks and operates R-1 relay, described under paratrph 27. The R-1 relay operated, connects the tip and ring of the trunk through for ringing and releases the RC-1 and S-1 relays.

30. SWITCH IN POSITION 15. With the switch in position 15, ringing current for the two bell code is connected to the line. CIRCUIT: R-2 lead, cam G, winding of R relay, PU relay operated, R-1 relay operated, cam G, ringing of final and called subscriber's line, sub-set, ground.

AUDIBLE RINGING SIGNAL

31. During the ringing period, part of the ringing current passes through the .02 MF condenser, windings 7, 8, and 8R of repeating the coil, inner winding of S relay, battery, thus inducing an audible ringing in windings 1, 2, 5 and 6 of the repeating coil tone which is transmitted back to the toll operator.

RINGING - DIRECT AND TWO PARTY

32. Under this class of ringing, the RC-1 relay and "X" wiring are omitted, and "Y" wiring is provided.

33. SWITCH IN POSITION 13. When the toll operator operates the ringing key, the R-2 relay operates, as described under paragraph 27 in turn operating the PU relay. CIRCUIT: Battery, winding of PU relay, PU relay normal, "Y" wiring, RC relay normal, cam C, R-2 relay operated, L relay normal, ground. The S-1 relay also operates through its outer winding, R-2 relay operated, L relay normal, ground. The S-1 relay operated, disconnects battery and ground from the windings of the DP and A relays. The D relay is now held operated, through the make contact of the S-1 relay, and break contact of the A relay. When the ringing key is released, the R-2 relay releases in turn releasing the S-1 relay. The S-1 relay released, connects battery and ground to the windings of the DP and A relay, operating the A relay and relighting the supervisory lamp in the toll cord circuit. The D relay is now held operated through the break contact of the S-1 relay and make contact of the A relay.

34. SWITCH IN POSITION 13. The PU relay operated, locks through its make contact, R and L relays normal, ground; and operates the R-1 relay. The R-1 relay operated, connects ringing current to the line. CIRCUIT: Ringing current, "Y" wiring, winding of R relay, PU and R-1 relays operated, cam G, ring brush.

CALLED SUBSCRIBER ANSWERS

35. SWITCH IN POSITION 13. When the receiver at the called station is removed from the switchhook, the ringing circuit is closed back over the tip of the line, cam F, R-1 relay operated, ground, thus increasing the current through the winding of the R relay which operates during the 48 volt period of the ringing cycle. The R relay operated, releases the PU relay, which in turn releases the R-1 relay. The R relay is not necessarily slow acting, but designed to be less responsive to alternating than direct current.

36. SWITCH IN POSITION 13. The R-1 relay released, (a) short circuits the .02 MF condenser, (b) releases the R relay, and (c) connects the tip and

ring of the line, through to the S relay, which operates. CIRCUIT: Battery, inner winding of S relay, windings of repeating coil, R-1 relay normal, cam C, over the ring side of the final and called subscriber's loop, sub-set, back over the tip side of the called subscriber's loop and final, cam F, winding of repeating coil, outer winding of S relay, ground. The S relay operated, in turn operates the S-1 relay through its inner winding and the RC relay through cam N.

37. SWITCH IN POSITION 13. The S-1 relay operated, disconnects battery and ground from the windings of the DP and A relays, thereby releasing the A relay, and extinguishing the supervisory lamp in the toll cord circuit, as an indication that the called subscriber has answered. The D relay is now held operated through the make contact of the S-1 relay, and break contact of the A relay.

CALLED SUBSCRIBER DISCONNECTS FIRST

38. If the receiver at the called station is replaced on the switchhook before the plug of the toll cord is withdrawn from the outgoing trunk jack, the circuit disconnects as follows.

39. The S relay releases, in turn releasing the S-1 and RC relays. The S-1 relay released, connects battery and ground to the windings of the DP and A relays, operating the A relay, and lighting the rear supervisory lamp in the toll cord circuit, as a disconnect signal. Ground through the make contact of the A relay and break contact of the S-1 relay, holds the D relay operated. The RC relay released, closes the circuit to operate the RC-1 relay for re-ringing purposes, as described under paragraph 53 and 54.

40. When the plug of the toll cord is withdrawn from the outgoing trunk jack, a timing circuit in the outgoing end of the circuit functions, connecting ground and battery through windings of a relay to the tip and ring of the trunk. The A relay may or may not release in the circuit, depending upon the difference in the central office battery voltage, and earth potential.

41. The operate requirement of the DP relay overlaps the release requirement of the A relay and in any case where the current flowing is sufficient to hold the A relay operated, the DP relay will operate.

42. SWITCH IN POSITION #13 or #15. Assume the conditions are such that A and DP relays operate. The circuit then functions as follows. The DP relay operated, short circuits the winding of the D relay which releases, operating the L relay through its outer winding and cam J. The L relay operated, advances the switch to positions 14, 16 and 17, as described under paragraph 8. The A cam advances the switch to position 15.

43. SWITCH IN POSITION 17. In position 17, the L relay reoperates through cam I to ground on the make contact of the A relay. The L relay operated, advances the switch to position 18, as described under paragraph 8.

44. SWITCH IN POSITION 17. As the switch enters position 17, the S-1 relay operates. CIRCUIT: Battery, outer winding of S-1 relay, cam C, ground. The S-1 relay operated, disconnects the battery and ground from the tip and ring of the trunk, releasing the DP relay. When the S-1 relay operates the B relay in the trunk circuit (not shown) operates. CIRCUIT: Battery, one winding of relay (b) in the trunk circuit, tip of trunk, cam L 2-1 winding of repeating coil, outer windings of A and DP relays, S-1 relay operated, "X" wiring RC-1 and R-1 relays normal, inner winding of DP and A relays, 6-5 winding of repeating coil, cam M, ring of trunk, other winding of B relay in the trunk circuit ground. As the switch advances from position 17, the L, S-1 and A relays, and the B relay in the trunk circuit release.

45. SWITCH IN POSITION 18. As the switch enters position 18, the DOWN magnet operates to ground on cam E, returning the selector to normal. When the selector reaches normal, the "Y" commutator brush and segment advances the switch to normal.

46. SWITCH IN POSITION 13 OR 15. If the conditions are such that the A relay releases and the DP relay remains normal, the circuit functions as follows. The A relay released, releases the D relay, which operates the L relay through its outer winding, cam J, D relay normal, ground. The L relay operated, functions as described in paragraph 42. As the switch advances from position 16, the L relay releases.

47. SWITCH IN POSITION 17. As the switch enters position 17, the S-1 relay operates through its outer winding, cam C, ground. From this point the circuit functions in a similar manner to that described under paragraphs 44 to 45 inclusive.

TOLL OPERATOR DISCONNECTS FIRST

48. SWITCH IN POSITION 13 or 15. If the plug of the toll cord should be withdrawn from the outgoing trunk jack before the receiver at the called station is replaced on the switchhook, the circuit functions as follows. When the plug of the toll cord is withdrawn from the outgoing trunk jack, the timing circuit in the outgoing end of this circuit functions, thereby transferring the trunk closure circuit for the A relay from the toll cord circuit to the windings of the B relay in the trunk circuit. CIRCUIT: Battery, (24 volts) over tip of trunk, cam L, 2-1 winding of repeating coil, outer windings of A and DP relays, S-1 relay operated, "X" wiring, RC-1 and R-1 relays normal, X wiring, inner windings of DP and A relays, 6-5 windings of repeating coil, cam M, ring of trunk, to ground.

49. The A relay and the relay in the trunk circuit, operate. The DP relay does not operate since its windings are connected differentially. The A relay operated, opens the locking circuit through the D relay which releases and locks the S-1 relay.

50. SWITCH IN POSITION 13 OR 15. When the D relay releases, the L relay operates through its outer winding, cam J, D relay normal, ground. The L relay operated, advances the switch to position 17, as described under paragraph

42. As the switch advances to position 16, the L relay releases.

51. SWITCH IN POSITION 17. In position 17, the A relay operates, the L relay through its inner winding, cam I, A relay operated, ground. The L relay operated, advances the switch to position 18, as described under paragraph 8. As the switch advances from position 17, the L, A, S-1 and D relays release.

52. SWITCH IN POSITION 18. The circuit is restored to normal as described under paragraph 45.

RE-RING

53. SWITCH IN POSITION 13 or 15. The circuit is arranged so that a toll operator may re-ring a P.B.X. operator. Under this condition the circuit functions as follows. Assumed the switch is in position 13. The S, S-1, RC, and D relays are operated. When the toll operator operates the ringing key, the R-2 relay operates as described under paragraph 27, thereby operating the R-1 relay. CIRCUIT: Battery, winding of R-1 relay, RC relay operated, cam C, R-2 relay operated, L relay normal, ground. The R-1 relay operated releases the S relay. The S-1 relay, however, remains operated through its outer winding, R-2 relay operated, L relay normal, ground. The R-1 relay operated, holds the RC relay. CIRCUIT: Battery, winding of RC relay, R-1 relay operated, PU relay normal, ground. The RC relay is slow in releasing, so that it will remain operated while its circuit is being transferred from the make contact of the S relay to the make contact of the R-1 relay. The R-1 relay operated, also removes the short circuit from the .02 MF condenser, and connects alternating ringing current to the ring side of the line and ground to the tip side. CIRCUIT: Ringing current, 6-B resistance lamp, PU relay normal, R-1 relay operated, cam G, ring side of the line; Ground: R-1 relay operated, cam F, tip side of line.

54. When the ringing key is released, the R-2 and R-1 relays release, and the S relays release and the S relay reoperates. The S relay operated, operates the S-1 relay, and closes the holding circuit for the slow release RC relay.

OVERFLOW

55. SWITCH IN POSITION 6. Should all the trunks in a group be busy, the selector while trunk hunting in position 6, as described under paragraph 16 or 17, continues upward under control of the operated L relay, and the UP magnet, until the overflow terminals at the top of the group are reached. As the sleeve of the overflow terminals is open, the L relay releases, advancing the switch to position 7, as described under paragraph 10.

56. SWITCH IN POSITION 7. In position 7, the L relay operates and advances the switch to position 8, as described under paragraph 19.

57. SWITCH IN POSITION 8. As the switch advances from position 7, the L relay releases, since there is no locking circuit a final not having been selected. The L relay released, advances the switch to position 9, as described under paragraph 10.

58. SWITCH IN POSITION 9. With the switch in position 9, the L relay operates, advancing the switch to position 11, as described under paragraph 21.

59. SWITCH IN POSITION 11. In position 11, trunk closure is made as described under paragraph 22 or 24, operating the A relay. The A relay operated, operates the D relay, which in turn operates the L relay. The L relay operated, advances the switch to position 13, with the aid of cam A, as described under paragraph 23. As the switch advances from position 11, the L relay releases.

60. SWITCH IN POSITION 13. With the switch in position 13, the Z commutator brush and segment advances the switch to position 16.

61. SWITCH IN POSITION 16. As the switch enters position 16, the S-1 relay operates. CIRCUIT: Battery, inner winding of S-1 relay, cam N, interrupter contact, ground. The S-1 relay operates and releases under control of the interrupter, alternately disconnecting from and connecting battery and ground to the tip and ring of the trunk, thereby causing the toll supervisory lamp to flash as an overflow signal. When the toll operator withdraws the plug of the toll cord, the circuit functions as described under paragraph 40 to 52 inclusive.

TELL TALE

62. SWITCH IN POSITION 2 OR 4. Should the UP magnet fail to release during selections in positions 2 or 4, the selector will continue upward until the X commutator brush makes contact with the X commutator segment at the top of the bank.

63. SWITCH IN POSITION 2 OR 4. When the X commutator brush makes contact with the commutator segment, with the switch in position 2 or 4, and the L relay and UP magnet fail to release, the switch is advanced to position 9. CIRCUIT: Battery, R magnet, cam B, X commutator brush and segment, ground.

64. SWITCH IN POSITION 9. In the position 9, the L relay operates as described under paragraph 21, advancing the switch to position 11. The reverse battery and ground dismissing the sender. As the switch advances from position 10, the L relay releases.

65. SWITCH IN POSITION 11. As the switch enters position 11, the L relay operates as described under paragraph 22 or 24, and advances the switch, with the aid of cam A, to position 13, as described under paragraph 23. As the switch advances from position 11, the L relay releases.

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66. SWITCH IN POSITION 13. The switch is now advanced to position 16, by the X commutator brush and segment, through cam B.

67. SWITCH IN POSITION 16. The circuit now functions as described under paragraph 61.

68. When "11" wiring is used, the coin collect feature is provided. In this case, keys are provided in the full mechanical office by means of which current for restoring or collecting may be sent out through the final selector to the subscriber's station. The keys are operated, as required over an order wire by the toll operator.

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CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

OPERATE

NON-OPERATE

RELEASE

MECHANICAL REQUIREMENTS

114-AK
(R)

- (a) The flutter spring shall be adjusted so it will lie approximately half way between the back contact and the armature, when the armature is in the operated position.
- (b) There should be a clearance of .034 between the back contact and the flutter spring when the flutter spring is pressed flat against the armature and the armature is in the operated position.

ELECTRICAL REQUIREMENTS

Special requirements to insure A.C. Operation.

Test with "Testing Circuit" in offices in which a testing circuit is furnished or by connecting 550 ohms $\pm 1\%$ non-inductive resistance in series with the relay during ringing period.	Test with "Testing Circuit" in offices in which a testing circuit is furnished or by connecting 550 ohms $\pm 1\%$ non-inductive resistance in series with the relay during ringing period.
Readj. .036 amp.	Readj. .034 amp.

NOTE: #1. The above "Test" resistances are based on a ringing machine speed of approximately 1200 R.P.M. (20 cycles) and an A.C. voltage of 95 to 110 volts.

NOTE: #2. If the relay fails to meet its test requirements it shall be readjusted to its readjust requirements. If, after having been readjusted, the relay still fails to meet its test requirements its adjustment shall be modified until it does meet the test requirements.

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467203 Spec 77 changes
BT-502170 to BT502311

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
149-AF (D)	Special requirements to insure slow release. After a soak of .055 amp. Readj. .016 amp. Test .017 amp. W.C.C. .026 amp. <i>Note 9 - T-502311 in 5 adjust (D) 149AF to operate without soak on .018 amp. and to release on open ckt.</i>		
	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 pos- sible contact pressure against the back contact.		
B159 Wdgs.in series aiding.	When used with loops having a maximum resistance of 750 ohms. After a soak of approximately .3 amp. Readj. .023 amp. Test .037 amp. W.C.C. .050 amp.		After a soak of approximately .3 amp. Readj. .009 amp. Test .0073 amp. W.C.C. .005 amp.
	When used with loops having a maximum resistance of 900 ohms. After a soak of approximately .3 amp. Readj. .023 amp. Test .033 amp. W.C.C. .043 amp.		After a soak of approximately .3 amp. Readj. .009 amp. Test .0073 amp. W.C.C. .005 amp.
B236 (DP) Wdgs.in series aiding.	Requirements to meet special circuit conditions. Readj. .0022 amp. Test .0024 amp. W.C.C. None		Readj. .0005 amp. Test .0004 amp.
Inner Wdg.	Readj. .0047 amp. Test .0050 amp. W.C.C. .0052 amp.		
B237 (A) Wdgs.in series aiding.	Requirements to meet special circuit conditions. Readj. .0059 amp. Test .0062 amp. W.C.C. .0070 amp.		Readj. .0029 amp. Test .0027 amp. W.C.C. None

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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>
Either Wdg.			Readj. .0055 amp. Test .0052 amp. W.C.C. .0051 amp.
E526 (L) Inner Winding (1000 ohms)	Special requirements to insure Fast operation. Readj. .016 amp. Readj. .012 amp. Test .0168 amp. Test .0114 amp. W.C.C. .017 amp.		
Outer Winding (1000 ohms)	Test .043 amp. W.C.C. .043 amp.		

NOTE:- Relay to be equipped with special armature stop
(piece part 163914).

E624 (R-1)	Readj. .020 amp. Test .021 amp. W.C.C. .021 amp.	Readj. .003 amp. Test .0028 amp.
E626 (PU)	Readj. .021 amp. Test .023 amp. W.C.C. .043 amp.	Readj. .004 amp. Test .0038 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.

E631 (RC)	Special requirements to insure slow release. Readj. .025 amp. Readj. .017 amp. Test .027 amp. Test .016 amp. W.C.C. .057 amp.	
E752 (S-1) Inner Wdg. (1000 ohms).	Test requirement of outer winding is proportional to test requirement of inner winding. Readj. .037 amp. Readj. .007 amp. Test .040 amp. Test .0066 amp. W.C.C. .043 amp.	

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CIRCUIT REQUIREMENTS

RE-ADJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E572 (S-1)			
Outer	Readj. .038 amp.		
Wdg.	Test .011 amp.		
(800 ohms)	W.C.C. .054 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.

E1201	Readj. .015 amp.	Readj. .009 amp.
RC-1	Test .029 amp.	Test .0085 amp.
	W.C.C. .043 amp.	

MECHANICAL REQUIREMENTS

- J-3 (a) Air gap shall be .023" minimum.
(R-2) (b) Contact follow shall be .003" minimum.
(c) Armature tension shall be 5 grams minimum.

ELECTRICAL REQUIREMENTS

Special requirements to insure A.C. operation.
Open all contacts (both back and front) of the E762 (S-1) relay. The J-3 relay shall operate on standard ringing voltage applied to terminals 1 and 6 of the repeating coil through 8500 ohms non-inductive resistance.

ENG.--TPI:ML.
3/22/22.

CHK'D.--AER-CWP.

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