CIRCUIT DESCRIPTION
SYSTEMS DEVELOPMENT DEPARTMENT
PRINTED IN U.S.A.

CD-239655
Issue 15-AR
Supplementing Iss. 14-D
dated 2/17/37
October 8, 1937
(1 Page) Page 1

PANEL SYSTEM
TWO-WIRE INCOMING SELECTOR
FROM TOLL KEY INDICATOR SYSTEM
DIRECT, TWO AND FOUR PARTY SEMI-SELECTIVE

CHANGES

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 The operate requirements of the 114 KA relay were changed to add new operate and readjust requirements, for 1500 ohm loops on subscriber lines as follows: Operate test from .026 to .025 ampere and operate readjust from .025 to .024 ampere.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332

JI)
FJS) YF

CIRCUIT DESCRIPTION
SYSTEMS DEVELOPMENT DEPARTMENT
PRINTED IN U.S.A.

CD-239655
Issue 14-D
February 17, 1937
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CD-239665, Issue 13-D
Dated June 26, 1934
(1 Page) Page 1

PANEL SYSTEM
TWO-WIRE INCOMING SELECTOR
FROM TOLL KEY INDICATOR SYSTEM
DIRECT, TWO AND FOUR PARTY SEMI-SELECTIVE

CHANGES

B. CHANGES IN APPARATUS

B.1 114KA relay (R) added.

B.2 G88 relay (S) added.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Note 19 added to care for extended range.

D.2 Circuit requirement notes 62 and 63 added.

D.3 Note 20 added to care for reversal of polarity of (R) magnets.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332

FSI)
WLF) TI

CIRCUIT DESCRIPTION
BELL TELEPHONE LABORATORIES, INC.
SYSTEMS DEVELOPMENT DEPT., NEW YORK.
PRINTED IN U.S.A.

CD-239655
Issue 13-D
Supplementing Issue 12-D
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June 26, 1934
(1 Page) Page 1

PANEL SYSTEM
2-WIRE INCOMING SELECTOR
FROM TOLL INDICATOR SYSTEM
DIRECT, TWO AND FOUR PARTY SEMI-SELECTIVE

CHANGES

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 In circuit requirements table test note 61 has been added to provide additional requirements for the (R1) relay to reduce the probability of an acoustic shock to the subscriber.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Contact numbering of the (R1) relay was incomplete as contacts 1T, 2T, 3T and 3B were not so designated.

D.2 Circuit notes 17 and 18 are added.

D.3 21-26 volt battery symbol was formerly 21-25 volts.

D.4 First line of title formerly read as follows:- "PANEL MACHINE SWITCHING SYSTEM".

All other headings, "No Change".

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A

LBS)MQ
WHM)

CIRCUIT DESCRIPTION
SYSTEMS DEVELOPMENT DEPARTMENT
PRINTED IN U.S.A.

CD-239655
Issue 12-D
March 16, 1926
Replacing all
previous issues.
(9 Pages) Page 1

PANEL MACHINE SWITCHING SYSTEM
TWO WIRE INCOMING SELECTOR
FROM TOLL KEY INDICATOR SYSTEM
DIRECT, TWO AND FOUR PARTY SEMI-SELECTIVE

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 This circuit has been changed to include a lead to the "Group busy register" circuit to indicate a busy condition whenever the sequence switch moves off normal.

B. CHANGES IN APPARATUS

B.1 Cam 0 is changed and sequence switches A29 and A30 are replaced by D81351 and D81352 respectively.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Test note 60 is added for adjusting 114-AK relay.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Striping requirements are added for pos. 1 and 8 of sequence switch.

D.2 SS1-0 was feed, and SS3-0 and SS4-0 were blank.

D.3 Leads connected to SS3-0 and SS4-0 were not shown.

D.4 Note 16 is added.

D.5 Circuit rating was standard.

D.6 Circuit replacement note is added.

D.7 The old tracing is replaced by a new one on account of poor condition.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in establishing connections between toll operators and subscribers in mechanical office areas.

2. WORKING LIMITS

This circuit has an external circuit loop range for selection of 1088 ohms minimum and 1488 ohms maximum, not to include more than 12 miles of cable, with a minimum leak of 30,000 ohms. For trunk supervision the maximum external circuit loop is 2250 ohms. This circuit works with subscriber's loop whose maximum resistance is 900 ohms and whose minimum leak is 10,000 ohms. When AC-DC ringing is used the tripping loop for the 114-AK relay is 750 ohms.

3. FUNCTIONS - This circuit is used in establishing connections between toll key indicator systems and Final selectors. Its principal functions are as follows:

3.1 Selection of proper idle final selectors.

3.2 Signaling the called subscriber.

3.3 Establishing the talking selection.

3.4 Relaying supervision to the toll office.

3.5 Returning to normal.

4. CONNECTING CIRCUITS - This circuit functions with the following circuits:-

4.1 Standard Final circuits.

4.2 Toll key indicator outgoing circuits.

4.3 Power Driven key indicator system circuits.

DETAILED DESCRIPTION

5. TRUNK SEIZURE

When this trunk is selected by a key indicator trunk selector at the toll office, the trunk number is displayed at the key indicator position and the plug of a toll or holding cord is inserted in the jack of the outgoing trunk multiple. The fundamental circuit is also closed operating the L relay. The L relay operated, locks over the fundamental circuit

and advances the switch to position 2.

6. BRUSH SELECTION

With the switch in position 2, ground from the L relay operates the UP magnet. As the selector moves upward, carrying the commutator brushes over the commutator segments, ground is intermittently connected to the tip side of the fundamental circuit from the A commutator brush and segment, through cam K, holding the L relay operated but successively short circuiting the stepping relay in the associated sender circuit, thus permitting its release and reoperation until the proper brush has been selected. 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 UP magnet which stops the upward movement of the selector, and advances the switch to position 3.

7. GROUP SELECTION

With the switch in position 3, the TRIP magnet operates. In position 3, the L relay is again operated and locked through the fundamental circuit, advancing the switch to position 4. In position 4 the UP magnet is again operated, and with the TRIP magnet operated, causes the previously selected set of brushes to trip as the selector moves upward for group selection. The "B" commutator is connected to the fundamental circuit and the operation is the same as described for brush selection. After a sufficient number of impulses have been sent to satisfy the sender for group selection, the fundamental circuit is opened. The L relay releases, releasing the UP magnet and advancing the switch to position 5. In position 5, the L relay operates through its outer winding, advancing the switch to position 6 for trunk hunting.

8. TRUNK HUNTING

If the first trunk of the group in which the selector is hunting is busy, the L relay is held operated over a circuit from battery through its inner winding, to ground on the sleeve terminal of the busy trunk. With the L relay held operated, a circuit through the UP magnet is maintained and the selector travels upward until an idle trunk is found. When an idle trunk is found the holding circuit through the inner winding of the L relay is opened, but the relay does not release immediately due to a circuit from ground through the C commutator brush and seg-

ment to battery through the outer winding of the L relay. When the brushes are centered on the trunk, the circuit through the C commutator segment is opened and the L relay releases, in turn opening the circuit through the UP magnet which stops the selector brushes on the terminals of the selected trunk. The L relay released, also advances the switch to position 7.

9. "C" COMMUTATOR

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 terminals and making contact with the sleeve terminals 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, thus releasing the relay. The L relay released, disconnects ground from the commutator feed bar (G), thus releasing the UP magnet. The selector then drops into place, centering the brushes on the trunk terminals. During the trunk hunting, (in position 6 only), the commutator feed ground is supplied through cam E from ground on the armature of and under control of the L relay. This is to prevent the reoperation of the L relay by the closing of a circuit in the C commutator brush and segment on the overthrow of the selector, or as it drops into place.

10. SELECTED TRUNK BUSY

The release of the L relay in position 6 connects a temporary ground from cam K to the S terminal of the trunk, thus holding the selected final trunk busy while the switch advances. When the switch enters position 6-3/4, the selected final trunk is held busy to all other hunting final selectors by ground on cam H.

11. INCOMING ADVANCE

With the switch in position 7, the L relay operates by a circuit through its inner winding and cams I and H to ground. The L relay operated, advances the switch to position 8 and locks to ground on the

ring terminal of the final selector circuit. After selection beyond has been completed, the final circuit advances and removes the ground from its ring terminal, releasing the L relay, which advances the switch to position 9. With the switch in position 9, the L relay operates in a circuit through its inner winding, cam I, the fundamental circuit, cam L, to ground on cam K. The direction of the current over the fundamental circuit being reversed causes the associated key indicator sender to function. The L relay operated, advances the switch to position 10, the A cam advancing it to position 11. As the switch advances out of position 10, the circuit through the L relay is opened at cam I, releasing the relay.

12. TRUNK CLOSURE

With the switch in position 11, a circuit is closed from battery and ground on the contacts of the S-1 relay, through the windings of the DP and A relays, the repeating coil, cams L and M, and the trunk circuit to the supervisory relay in the toll operator's cord circuit, operating the A relay and the toll supervisory relay. The DP relay does not operate at this time since its windings are connected differentially in this circuit. The A relay operated operates the D relay under control of the S-1 relay. The D relay operated, operates the L relay. The L relay operated, advances the switch to position 12, the A cam advancing it to position 13. The D relay is made slow in releasing to prevent its release on a momentary release of the A relay.

13. DIRECT AND TWO PARTY SELECTIVE RINGING ("X" WIRING)

If the called number is reached by a final trunk located in either group 0 or 2 of the incoming frame, the sequence switch will stop in position 13. With the switch in position 13, the supervisory signal in the toll operator's cord circuit is lighted, as a ringing signal by battery and ground from the A relay. When the operator rings, the R2 relay is operated. The R2 relay operated operates the S1 relay, which releases the A relay. The D relay is held operated from the back contact of the A relay through the S1 relay contact. The operation of the R2 relay also operates the RC1 relay which locks under control of the R1 relay. The RC1 relay operates the PU relay from ground on cam P. The PU relay operated, locks under control of the R relay, and operates the R1 relay, thereby connecting ringing current to the line. Ringing on the tip side is accomplished by reversing the cross connection at the distributing frame.

14. DIRECT AND TWO PARTY SELECTIVE RINGING ("Y" WIRING)

When no provision is made for four party service, "Y" wiring shall be used and "X" wiring and equipment omitted. Under this condition, the operation of the R2 relay operates the PU relay which in turn operates the R1 relay and connects ringing current to the line, otherwise the circuit functions as described for "X" wiring.

15. FOUR PARTY SEMI-SELECTIVE RINGING

If the called number is reached by a final trunk located in either group 1 or 3 at the incoming frame, the sequence switch will not stop in position 13 as the L relay will be operated by ground through the P commutator. The L relay operated, advances the switch to position 14, the A cam advancing it to position 15. As the switch passes through position 14, the L relay releases. When the operator rings, the R2, S1 and RC1 relays operate. The operation of the RC1 relay short circuits one winding of the repeating coil (7-8R) to prevent ringing the subscribers bell by ringing current from the operator's cord circuit. The PU relay operates under control of the PU interrupter and locks to the L relay under control of the R relay. The PU relay operates the R1 relay which connects ringing current from the two ring interrupter of the ringing machine.

16. CALLED PARTY ANSWERS

When the receiver at the called station is removed from the switchhook, the R relay operates to ground through the make contact of the R1 relay due to the increased amount of current which flows through the switchhook contacts. The R relay is not necessarily slow acting but is designed to be less responsive to alternating than to direct current. The operation of the R relay releases the PU relay which in turn releases the R1 relay. The R1 relay closes the tip and ring of the final trunk through the windings of the repeating coil to the S relay, which operates. The operation of the S relay operates the S1 and RC relays. The RC relay places the R1 relay under the control of the ringing key in the toll operator's cord circuit for use when ringing on PBX lines. The RC relay is made slow in releasing to prevent its release during the time that its holding circuit is being transferred from the contacts of the S relay to the contacts of the PU relay on a recall to a PBX. The operation of the S1 relay disconnects the battery and ground from the

tip and ring of the trunk circuit, extinguishing the supervisory lamp in the toll cord circuit.

17. RERING PBX

When ringing current is connected to the trunk at the toll office to recall a PBX, the R2 relay operates. The R2 relay operated, operates the R1 relay through make contacts of the RC relay. The operation of the R1 relay connects continuous ringing current to the called line.

18. DISCONNECTION

When the receiver at the called station is replaced on the switchhook while the switch is in position 13 or 15, the S relay releases, in turn releasing the S1 and RC relays. The S1 relay released, connects battery and ground through the A and DP relays to the trunk to operate the supervisory signal in the toll cord circuit. The A relay now operates and holds the D relay operated. When the plug of the toll cord is removed from the jack, the A and D relays are released. When the D relay releases, the L relay is operated through cam J to advance the switch. If the switch is in position 13, the L relay advances it to position 14, A cam to 15, L relay to 17. The L relay releases when the switch advances out of position 16. In position 17, the S1 relay is operated through its outer winding by ground on cam C.

19. TOLL OPERATOR DISCONNECTS

When the plug is removed from the trunk jack at the toll position, as noted above and the timing circuit functions, battery and ground are connected to the line, closing a circuit through the windings of the A and DP relays and S1 relay operated, operating the A relay. The A relay operated, operates the L relay, and advances the switch to position 18. In position 18, the DOWN magnet is operated from ground on cam E returning the selector to normal. When the selector is restored ground on the Y commutator advances the switch to position 1, and opening the circuit of the DOWN magnet.

20. TOLL OPERATOR FAILS TO PICK UP ASSIGNED TRUNK

If the Toll operator should fail to insert a plug in the outgoing end of this circuit, the key indicator circuit after an undue length of time, cause a short circuit to be closed across the trunk during the release time of slow to release relays.

This closure causes the A relay in this circuit to operate as described under "Trunk Closure" paragraph 12. When the short circuit is removed, the A relay will release and the circuit would then function as described under "Disconnection", paragraph 18.

21. DISCONNECTION UNDER CONTROL OF TOLL OPERATOR

The circuit is also arranged to disconnect under control of the toll operator, regardless of the condition at the called station. Assuming that the toll operator disconnects while the receiver is still off the switchhook at the called station, battery and ground are connected to the line at the toll end, operating the A relay. The operation of the A relay releases the D relay, and the circuit is restored to normal as described in paragraphs 18 and 18 except that the S relay releases as the switch advances from position 15.

22. OVERFLOW

When the sequence switch is trunk hunting in position 6 and all the trunks of the group are busy, the selector travels to the top of the group where the brushes make contact with the overflow terminals. The holding circuit through the L relay is opened at the sleeve terminal, releasing the L relay, and advancing the switch to position 7. In position 7, the L relay operates to ground on cam H, advancing the switch to position 8. The L relay releases in position 8, the R lead to the final being open, and advances the switch to position 9, where it is operated over the fundamental circuit to advance the switch to position 10, the A cam advancing it to position 11. In position 11, the A relay is operated, by battery and ground under control of the S1 relay, and the D relay is held operated on the make contact of the A relay. Ground on the D relay operates the L relay and advances the switch to position 12, the A cam advancing it to position 13. In position 13 ground from the commutator advances the switch to position 16. In position 16, interrupted ground is connected through cam N for operating the S1 relay through its inner winding, thereby flashing the toll supervisory lamp in the toll operator's cord circuit. When the toll operator removes the plug from the jack, the A relay releases and the circuit functions the same as described under Disconnection, paragraphs 18 and 20.

23. TELL-TALE

Should the selector travel to the top of the frame during selection, the switch advances to position 9 by ground on the X commutator. In position 9, the L relay is operated over the fundamental circuit and advances the switch to position 10, the A cam to position 11. The A relay operates in position 11, operating the D relay. The L relay is operated by ground on the D relay and advances the switch to position 12 the A cam to position 13. In position 13, ground from the X commutator advances the switch to position 16. In position 16 interrupter ground is supplied through cam K, operating the S1 relay and flashing the signal to the toll operator as described in OVERFLOW, paragraph 22.

24. SELECTOR GROUP REGISTER

Each time the switch advances through position 10 ground is connected to the lead to the Selector Group Register thus operating the register.

25. GROUP BUSY REGISTER

While the switch is in the normal position ground is connected to the "PBR" lead "To Group Busy Register" to indicate an idle condition. When the switch advances from normal this ground is removed to indicate that the circuit is busy.

BELL TELEPHONE LABORATORIES, INC.

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