

May 18, 1943

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THROUGH SUPERVISION SYSTEM

2,319,358

Filed Oct. 7, 1941

3 Sheets-Sheet 1

FIG. 1

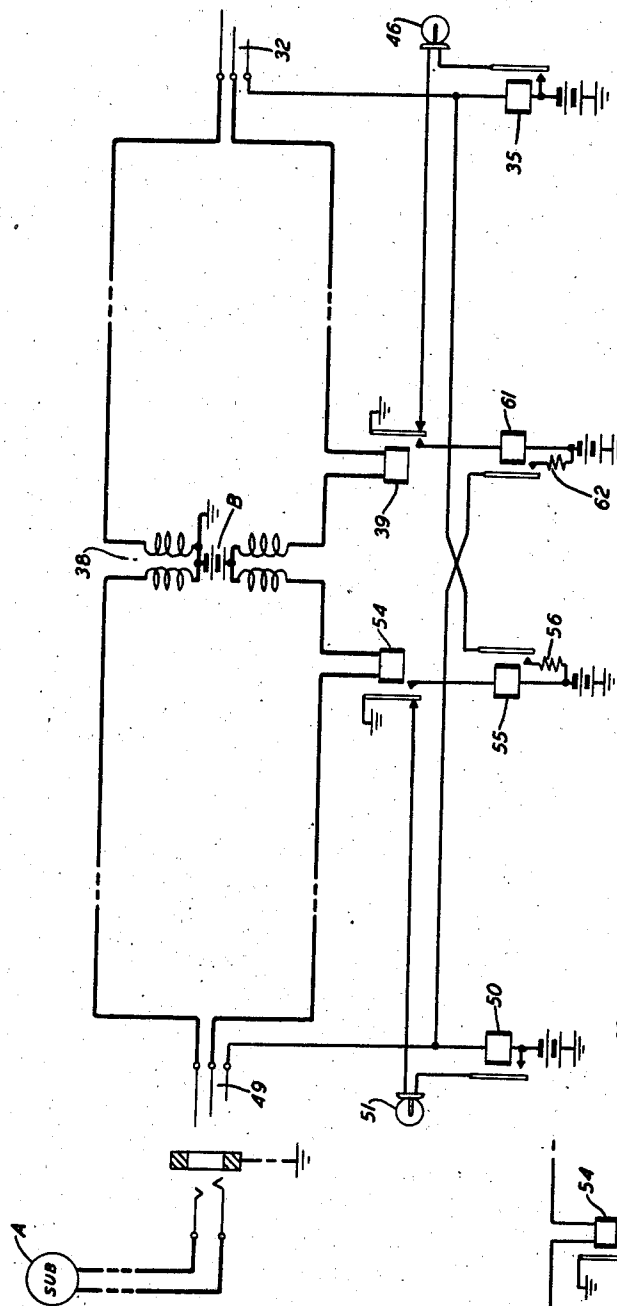
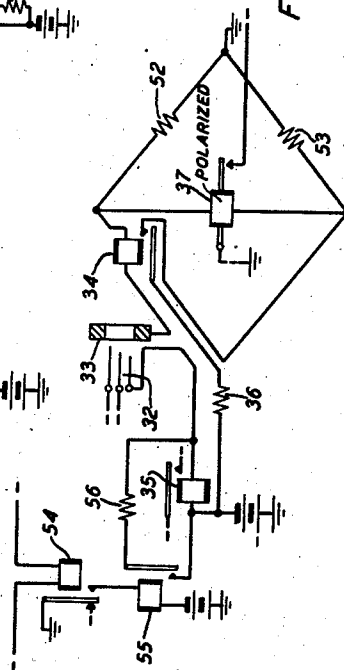


FIG. 4



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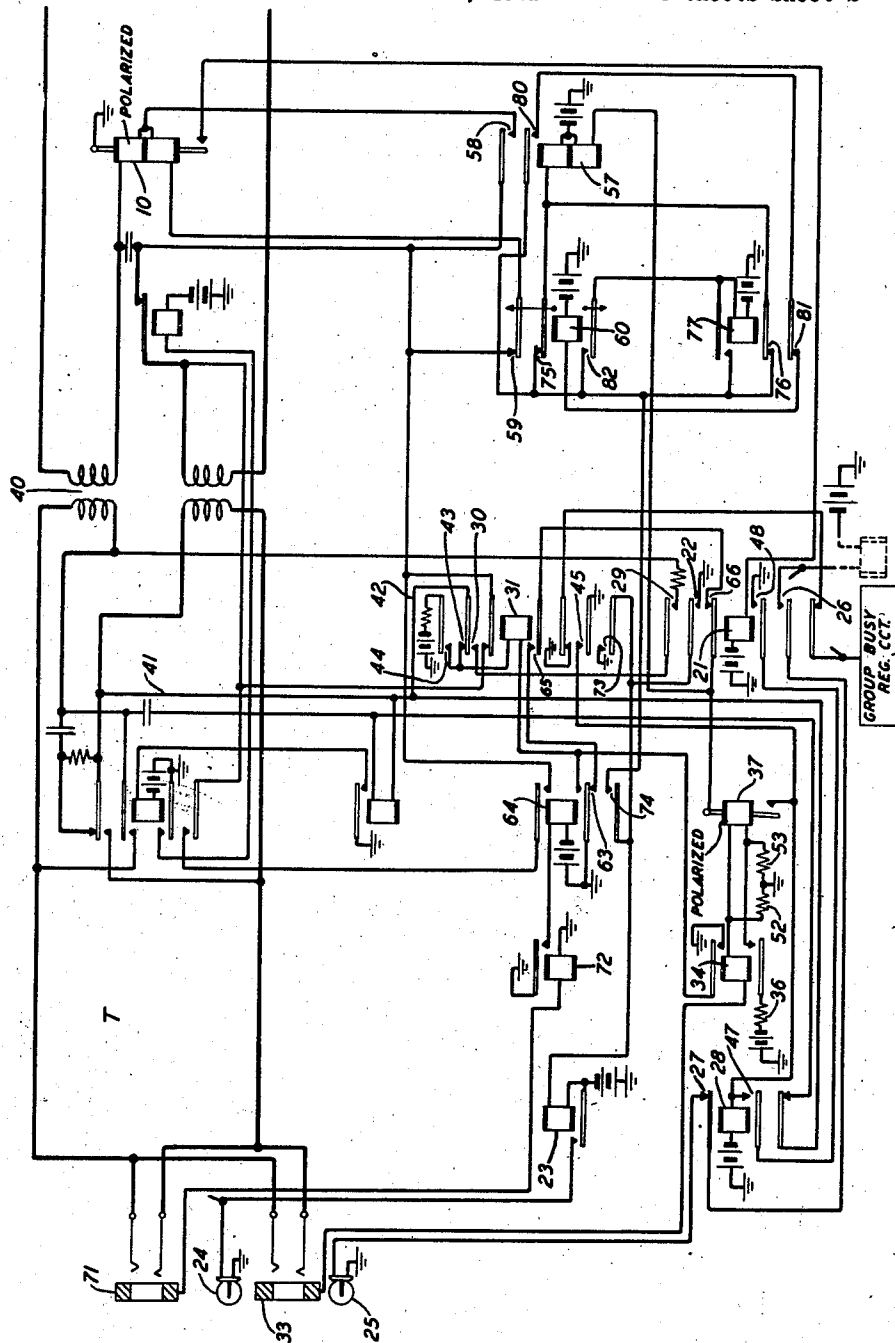
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FIG. 2



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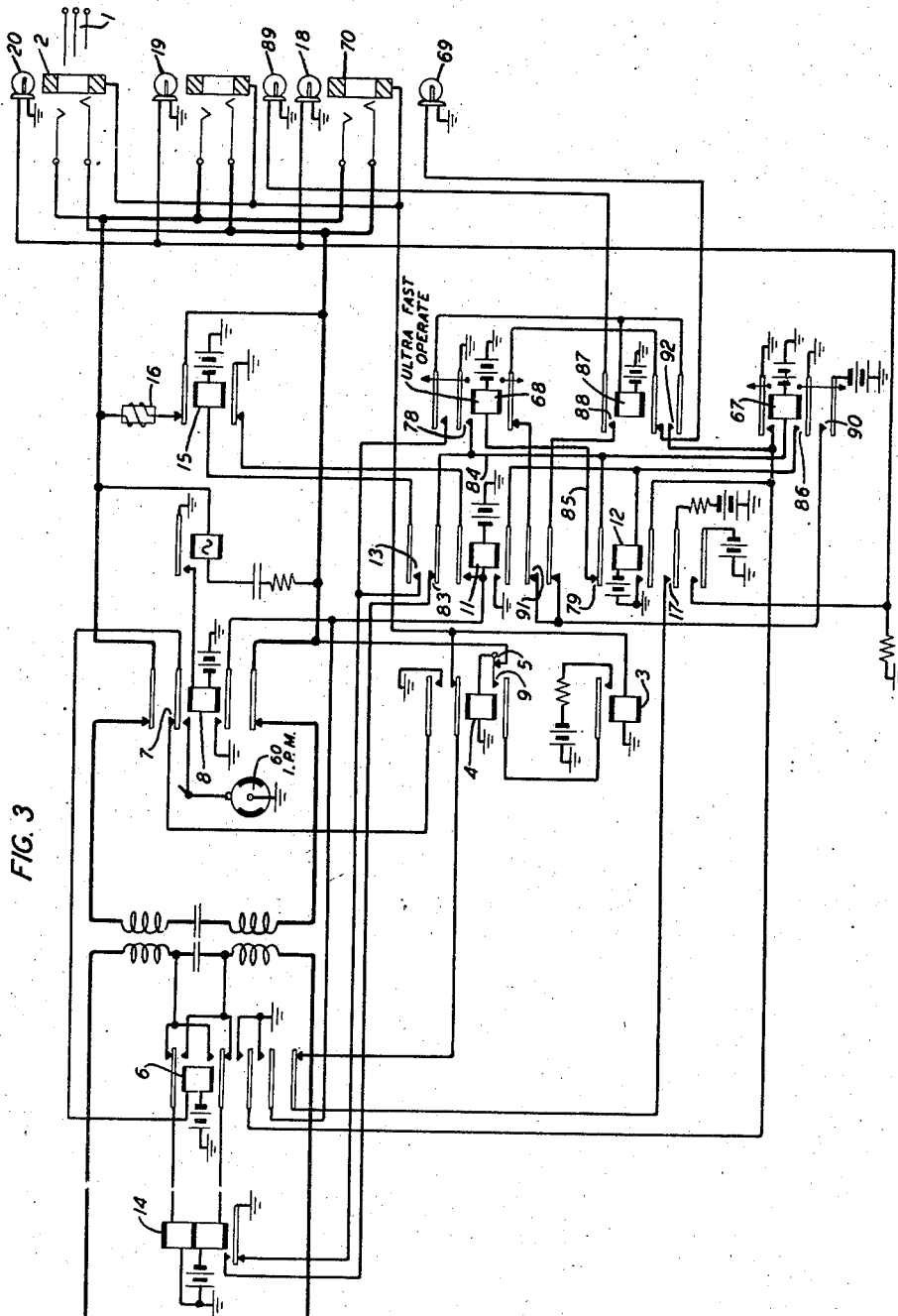
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THROUGH SUPERVISION SYSTEM

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3 Sheets-Sheet 3



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THROUGH SUPERVISION SYSTEM

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6 Claims. (Cl. 179-41)

This invention relates to telephone systems and more particularly to improvements in cord and trunk circuits for interconnecting a telephone subscriber in a local or tributary exchange with a toll office.

An object of the invention is to provide through supervision of the trunk from the subscriber to the toll operator regardless of the direction of the call.

A feature of the invention resides in such an arrangement of the trunk and local exchange cord circuit that when the toll operator is connected to one end of the trunk and the subscriber to the other through the medium of the local exchange cord circuit, the subscriber's switchhook will control supervision through to the toll operator.

More specifically the arrangement of the cord and trunk circuit is such that when the subscriber is connected to the trunk and the receiver is on the hook, a balanced Wheatstone bridge circuit is established, including the sleeve circuit of the cord and trunk, which bridge is unbalanced to operate supervisory control means in the trunk when the subscriber's receiver is removed from the hook. The invention will be understood from the following description and accompanying drawings:

Fig. 1 of which illustrates a common battery subscriber's line adapted to be connected to by a cord circuit SC at a local exchange.

Fig. 2 shows the local exchange end of a two-way trunk line T extending to a toll office.

Fig. 3 shows the toll office end of trunk T; and

Fig. 4 is a schematic diagram showing a Wheatstone bridge circuit established when the cord SC is connected to the trunk T and before the subscriber's receiver is removed from the hook.

The operation of the circuit of the invention will now be described. First, it will be assumed that a toll operator at the distant toll office (Fig. 3) desiring to be connected with subscriber A in the local exchange (Fig. 1) has inserted a plug 1 of a toll cord, not shown, in the outgoing jack 2, of a trunk extending to the local exchange, whereupon sleeve relay 3 in the trunk operated from battery, not shown, on the sleeve of plug 1, in an obvious circuit. Relay 3 in operation prepares a locking circuit for relay 4. When plug 1 is fully inserted in jack 2, battery, not shown, connected to the ring of plug 1 causes relay 4 to operate over its contact 5. Relay 4 operated closes a circuit to operate reversing relay 6 which circuit can be traced from battery,

winding of relay 6, contact 7 of relay 8 and uppermost contact of relay 4 to ground. Relay 4 also locks over its contact 9, and the contacts of relay 3, to battery in series with a resistance. Operation of relay 4 removes its winding from the ring conductor of the trunk. Operation of relay 6 reverses battery and ground over the trunk, thus causing operation of polarized relay 10 at the local exchange in a well-known manner. Operation of relay 6 also closes a circuit to operate relay 11 which in turn operates relay 12 and further, at its contact 13, closes a circuit from ground at the back contact of relay 14 to operate relay 15 which relay in operating opens at its upper contacts, the bridge, including retard coil 16 across the trunk, thereby lighting the supervisory lamp, not shown, of the associated cord circuit at the toll office. Operation of relay 12 connects battery at its lowermost contacts to light the busy lamps 18, 19 and 20 associated with the multiple jack appearances of the trunk.

Operation of relay 10 at the local exchange causes relay 21 to operate, which at its contacts 22 closes a circuit for relay 23 to light the busy lamps such as 24, lights the line lamp 25 in a circuit including contacts 26 of relay 21 and contacts 27 of relay 28 and, at contacts 29, closes one point in a supervisory bridge which will be completed at contacts 30 of relay 31 when that relay operates.

When the local operator answers the call by inserting the answering plug 32 of cord circuit SC in jack 33, trunk sleeve relay 34 operates in series with cord supervisory relay 35 which latter relay also operates. Relay 34 closes its lower contacts thereby connecting battery in series with resistance 36 to the winding of polarized relay 37 and closes its upper contact, thereby connecting ground to the winding of relay 31 which relay operates to close its contacts 44 as soon as plug 32 is fully inserted in jack 33, the circuit for which can be traced from the cord circuit battery B, lower right winding of cord circuit repeating coil 38, winding of answering supervisory relay 39, ring contacts of the plug and jack, lower left winding of repeating coil 40, conductors 41 and 42, contacts 43 and winding of relay 31 to ground over the upper closed contacts of relay 34. Closure of contacts 44 of relay 31 connects battery to its winding thereby causing complete operation of this relay to close its contacts 45 which completes a circuit to operate relay 28, to open its contacts 43 to disconnect its windings from the ring of the trunk,

and by closing its contacts 30 to complete the closure of the supervisory bridge, whereupon cord supervisory relay 39 operates to remove ground at its back contact from the supervisory lamp 46. Operation of relay 28 locks over its contacts 47 to grounded contacts 48 of relay 21 and opens its contacts 27 to extinguish the line lamp 25.

The local operator after ascertaining the number of the wanted subscriber by well-known means, not shown, inserts calling plug 49 in the jack of the called line, whereupon the subscriber is rung in a well-known manner by means not shown.

When plug 49 is inserted in the jack of the called line, the calling sleeve relay 50 operates thereby lighting supervisory lamp 51 until the subscriber answers and operates supervisory relay 54.

Through supervision

It will be noted that when the operator inserts plug 32 in jack 33, a sleeve circuit was completed from battery, winding of cord sleeve relay 35, and winding of trunk sleeve relay 34 to ground in series with a resistance 52. With trunk sleeve relay 34 operated in this circuit, a Wheatstone bridge circuit is established as shown schematically in Fig. 4 in which one arm comprises the winding of sleeve relays 35 and 34, the second arm includes resistance 52, a third arm includes resistance 53, the fourth arm includes resistance 36, the winding of relay 37 is connected between the junction point of arms 1 and 2 and 3 and 4, and battery is connected between the junction points of arms 1 and 4 and 2 and 3. The resistances 52, 53 and 36 and the windings of relays 34 and 35 are so chosen that under the conditions existing prior to answer of the called subscriber, the bridge is in a balanced condition and a zero potential exists across the winding of relay 37 which therefore remains unoperated.

When the called subscriber answers, however, supervisory relay 54 operates thereby opening its back contacts to extinguish the supervisory lamp 51 and connects ground, at its front contacts, to operate relay 55 which relay in operating connects a resistance 56 in shunt to the winding of relay 35 thereby lowering the resistance of the first arm of the Wheatstone bridge circuit and upsetting its balance, whereupon relay 37, which is of a sensitive type, operates, thus completing a circuit for operating relay 57 which can be traced from battery, lower winding of relay 57 and contacts of relay 37 to ground at contacts 45 of relay 31. Operation of relay 57 short-circuits the lower (high resistance) winding of relay 10 which circuit can be traced from the upper terminal of the lower winding, contacts 58 of relay 57 and contacts 59 of relay 60 to the lower terminal. This reduction in resistance of relay 10, which is connected across the trunk to the toll office, causes relay 14 at the toll office to operate, thus removing ground from relay 15 which releases and connects retard coil 16 across the trunk to operate the toll operator's supervisory relay and extinguish the supervisory lamp.

When the called subscriber replaces his receiver, the supervisory relay 54 will release to re-light the supervisory lamp 51 in the local cord and release relay 55 thereby restoring the Wheatstone bridge circuit to a balanced condition whereupon relay 37 will release in turn releasing relay 57 which removes the short circuit from the lower winding of relay 10 thus increasing its resistance across the trunk sufficiently to cause

relay 14 at the toll office to release, thereby re-operating relay 15 and removing the bridge from across the trunk which causes the toll operator's supervisory relay to release and the cord supervisory lamp to light as a signal to the operator that the called subscriber has hung up.

If the call is in an opposite direction, i. e., from subscriber A to the toll office, the call will be answered by inserting plug 32 of the cord circuit SC in the subscriber's line jack and extended to the toll office by inserting the calling plug 49 in the jack 33 of the trunk T.

When the plug 49 is inserted in jack 33, thereby operating relays 50 and 34, a Wheatstone bridge circuit similar to the arrangement previously described and shown in Fig. 4 is established except that relay 39 replaces 54, relay 61 replaces 55, relay 50 replaces 35 and resistance 62 replaces resistance 56. If the subscriber remains on the line, i. e., his receiver is not replaced on the switchhook after giving the call to the operator, and if the operator does not disconnect his line by removing plug 32, the Wheatstone bridge circuit thus established will be unbalanced due to the fact that relay 61 is operated which connects resistance 62 in shunt to the winding of relay 50, thus causing relay 37 in the trunk to operate. When the plug 49 is fully seated in the trunk jack, battery B in the cord is connected over the lower left winding of repeating coil 38, winding of relay 54, ring contacts of the plug 49 and jack 33, lower left winding of trunk repeating coil 40, and conductors 41 and 42, contacts 45 and winding of relay 31, to ground at the upper contacts of sleeve relay 34. Relay 31 partially operates in this circuit to close its contacts 44 whereupon this relay fully operates and locks under control of relay 34.

Relay 31 in operating closes a circuit to operate relay 28 which opens the circuit of line lamp 25. Relay 31 also opens its contacts 43 to disconnect its winding from the ring of the trunk, closes at its contacts 30 one point in the supervisory bridge and at contacts 45 connects ground to a contact of relay 37.

Under the assumed condition, i. e., subscriber's receiver off the hook, relay 37 is operated and therefore a circuit is closed to operate relay 57 which can be traced from ground, contacts 45 of relay 31, contacts of relay 37 and lower winding of relay 57 to battery. Until the toll operator answers, a parallel circuit, independent of relay 37, is also closed to operate 57 which can be traced from ground, contact 63 of relay 64, contacts 65 of relay 31, contacts 66 of relay 21 and lower winding of relay 57 to battery. Operation of relay 57 closes its contacts 58 thereby placing a short-circuit around the lower (high resistance) winding of relay 10, thereby operating relay 14 in the trunk at the toll office to operate relays 67 and 68. Relay 67 operates relay 12 which opens at its upper contacts the energizing circuit for relay 68 which releases thereby completing a circuit to light the trunk lamp 69.

When the toll operator answers, relays 3, 4 and 6 operate. Relay 6 reverses the battery over the trunk thereby operating relay 10 which operates relay 21 to close its contacts 29 thereby completing the supervisory bridge to cause relay 54 in the cord to operate to extinguish the cord supervisory lamp 51. Operation of relay 21 opens its contacts 66 thereby opening the previously mentioned parallel circuit for relay 57 and closes its contacts 48 to provide a locking ground for relay 28. Busy relay 23 operated to light the busy lamp when re-

lay 31 operated. The short-circuit around the lower winding of relay 10 is now maintained under control of the calling subscriber's switchhook thus holding relay 14 operated in an obvious manner which will be understood from the preceding description.

When the calling subscriber replaces his receiver on the hook, thus balancing the Wheatstone bridge, relay 31 will release thereby releasing relay 57 to cause relay 14 at the toll office to release and light the toll cord supervisory lamp.

In case the local operator inserts plug 49 in the trunk jack 33, before connecting to the subscriber's line, or if the subscriber's line has been connected and the subscriber has hung up, relay 37 will not be operated, but relay 57 will operate as soon as relay 31 operates, as before, due to the closure of that relay's contact 65. When the toll operator answers the call and relay 10 operates, relay 21 operates thereby opening its contacts 66 whereupon relay 57 releases thereby causing relay 14 at the toll office to release to operate relay 15 and light the cord supervisory lamp.

Selective signaling to inward toll operator by means of plug supervision jack

It will be noted that, on calls from the local exchange to toll, if the plug 49 of the cord circuit is inserted in through supervision jack 33, the line lamp 69 at the toll office is lighted, which lamp, and its corresponding answering jack 70, is located at a so-called through operator's position at which position calls for points served by others and distant toll operators are handled. At this through position facilities are provided for accurately timing such calls. The usual method being for the details of the call to be entered on a so-called ticket which is stamped by means of a calculagraph to indicate the start and finish of the conversation.

There are other cases, however, where calls from the local exchange are for subscribers located in the area served by the first toll center which calls are charged by the local operator, as for example, by the collection of a coin deposited by the subscriber in a coinbox. In the case of calls of this character, it is desirable, and the usual practice, for such calls to be handled at the toll office at a different operator's position, as for example at a so-called "inward" position of the toll board or at a local A board position at which no facilities are provided for timing calls, the only function of the operator being to establish a requested connection leaving the matter of charging the calling subscriber to the originating operator at the local exchange.

In order to enable the local operator to selectively route calls over the trunk T to the proper operator, the trunk is provided, in addition to the previously mentioned through supervision jack 33 with a second jack 71 which for convenience is termed a plug supervision jack.

If the local operator desires to extend a call to an inward toll operator, she will insert plug 49 of her cord circuit in jack 71 thereby operating sleeve relay 72 which in turn operates relay 64. Relay 64 in operating prepares relay 31 for operation when the plug is fully inserted in the jack as previously described. Closure of contacts 73 of relay 31, and contacts 74 of relay 64, complete a circuit including the upper winding of relay 57. This circuit can be traced from ground, contacts 73 of relay 31, contacts 74 of relay 64, contacts 76 of relay 77, and upper winding of relay 57 to battery. Operation of relay 57 short-circuits the high re-

sistance winding of relay 10 to cause line relay 14 at the distant toll office to operate.

Relay 57 also closes its contacts 80 thereby operating relay 60 in a circuit which can be traced from ground at contacts 73 of relay 31, contacts 74 of relay 64, contacts 80 of relay 57, contacts 81 of relay 77 and winding of relay 60 to battery. Relay 60 in operating opens its contacts 59 thereby opening the high resistance (lower) winding of relay 10. Relay 60 also opens its contacts 75 to open one parallel path for relay 57. Relay 60 further closes its contacts 82 thereby operating relay 77 which in operating opens its contacts 76 thereby opening the circuit for the upper winding of relay 57 which now releases to complete disconnection of relay 10 from the trunk to the toll office, thus releasing the line relay 14 at that point. Relay 77 in operating opens its contacts 81 thereby releasing relay 60 which is slow to release. When relay 60 is released, however, it recloses its contacts 59 and 75 and opens its contacts 82. Closure of contacts 59 recloses the circuit to connect the two windings of relay 10 in series across the trunk and closure of contacts 75 reoperates relay 57 to short the lower (high resistance) winding of relay 10, thereby reoperating line relay 14 at the toll office. Relay 77 now remains operated due to a locking circuit for itself at its upper contacts thereby preventing a repetition of the foregoing sequence of operation and consequent continuous alternate release and operation of relay 57.

From the foregoing it will be noted that when plug 49 was inserted in jack 71, line relay 14 at the toll office was momentarily operated, released, and immediately reoperated and thereafter held in an operated position as long as the plug is maintained in the jack.

On the first operation of relay 14, relays 67 and 68 operate. The circuit for relay 67 being traced from ground on the front contact of relay 14, contacts 83 of relay 11, conductor 84 and winding of relay 67 to battery and the circuit for relay 68 being traced over the same circuit from ground at relay 14, contact 83 of relay 11, conductor 84, contacts 79 of relay 12, conductor 85 and winding of relay 68 to battery. Relay 68 is ultra fast to operate and slow to release whereas relay 67 is only normally fast to operate but also slow to release. Relay 68 operated closes its contacts 78 thereby connecting ground to its winding over conductor 84, contacts 79 of relay 12 and conductor 85, thus holding itself operated under control of relay 12. Relay 67 is also held by this same ground connected to conductor 84. When relay 67 operates, which occurs slightly later than relay 68, it closes its contacts 86 thereby operating relay 12 which opens its contacts 79 thus opening the circuit for relay 68 which is slow to release. By this time, however, relay 14 has released. Relay 14, however, operates again almost immediately and relay 67 is reenergized again and held operated as long as plug 49 is maintained in jack 71.

The timing is such that relay 14 releases before 68 releases and therefore the release of relay 14 with 68 operated, causes relay 87 to operate, which opens the circuit of "through" lamp 69 and closes its contact 88 to light lamp 89 at the "inward" board in a circuit from battery, contacts 90 of relay 67, contacts 91 of relay 11, contacts 88 of relay 87, to lamp 89. Relay 87 in operating closes its contacts 92 thereby completing a locking circuit for itself under control of relay 67.

It will therefore be understood that if the operator inserts plug 49 in jack 71, lamp 89 will be lighted instead of lamp 69 as in the case when the plug was inserted in jack 33.

What is claimed is:

1. In a telephone system, a first operator's position, a subscriber's station line terminating thereat, a trunk line also terminating at said first position, a cord circuit at said first position for interconnecting said line and trunk, a supervisory relay in said cord circuit controlled over said subscriber's line, a second operator's position terminating the other end of said trunk, means in said trunk at the first position for transmitting supervisory signals over said trunk to the second position, sleeve relays in said cord and trunk at said first position, a Wheatstone bridge circuit for controlling transmission of said supervisory signals over said trunk established when said cord circuit is connected to said trunk, said bridge including said cord and trunk sleeve relay, and means controlled by said cord supervisory relay for altering the balance of said bridge to control transmission of said supervisory signal.

2. In a telephone system, a subscriber's station and line, a trunk line, a link circuit for connecting said line and trunk, and means controlled by the subscriber for transmitting supervisory signals over said trunk, said means comprising a Wheatstone bridge circuit established when said link circuit is connected to said trunk and maintained in a balanced condition until the subscriber's station receiver is removed from the switchhook.

3. In a telephone system, a subscriber's station and line, a trunk line, a link circuit for connecting said line and trunk, and means controlled by the subscriber for transmitting the supervisory signals over said trunk, said means comprising a Wheatstone bridge circuit established when said link circuit is connected to the trunk in which one arm thereof includes the sleeve relays of said trunk and the corresponding sleeve relay of the link, and the other three arms include such resistance values that the bridge is in substantial balance until the other end of the link is connected to the subscriber's line and the subscriber's station receiver is removed from the hook.

4. In a telephone system, a subscriber's station and line, a trunk line, a link circuit for connecting said line and trunk, and means in said trunk for transmitting supervisory signals thereover,

5. said means comprising a relay connected in bridge between the junction of the first and second and third and fourth arms of a Wheatstone bridge established responsive to connection of said link circuit to said trunk in which the sleeve relay of the link and trunk form the first arm of the bridge, the second and third arms are of predetermined equal resistance and the resistance of the fourth arm is equal to the resistance of the first arm, whereby the potential across said bridge relay is substantially zero, and means controlled by the subscriber's switchhook for changing the resistance of the first arm of the bridge to cause operation of said bridge relay.

5. In a telephone system, a subscriber's station and line, a trunk line, a link circuit for connecting said line and trunk, and means responsive to actuation of said subscriber's station switchhook for transmitting a supervisory signal over said trunk, said means comprising a Wheatstone bridge circuit established when said link is connected to the trunk.

6. In a telephone system, a first operator's position, a subscriber's station line terminating thereat, a trunk line also terminating at said position, a cord circuit at said position for interconnecting said line and trunk, a supervisory relay in said first position cord and controlled over said subscriber's line, a second operator's position terminating the other end of said trunk, a cord circuit in said second position adapted to be connected to the trunk, means in said trunk for transmitting signals thereover, supervisory means in said second cord controlled by said trunk means, a sleeve circuit including a sleeve relay in said first cord operated when said cord is connected to the trunk, and means in said first cord controlled by the subscriber's supervisory relay for controlling said trunk means over the sleeve circuit of said cord without releasing said sleeve relay.

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