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TELEPHONE SYSTEM

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2 Sheets-Sheet 1

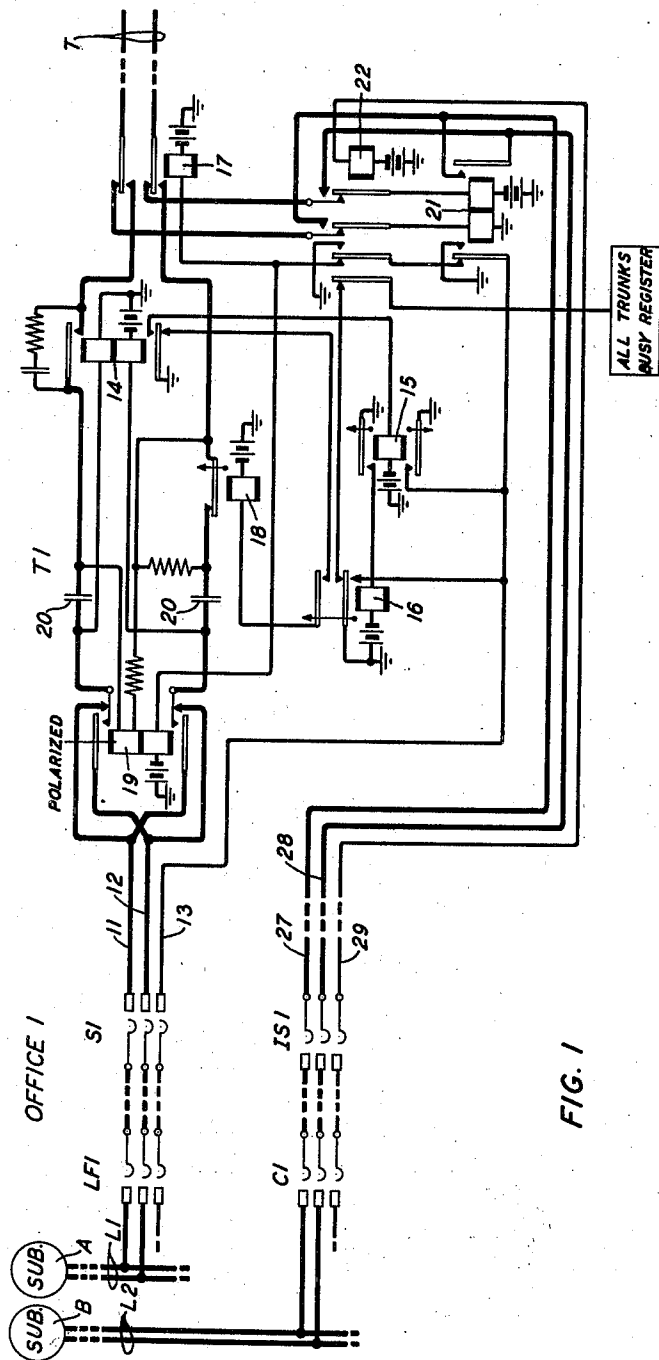


FIG. 1

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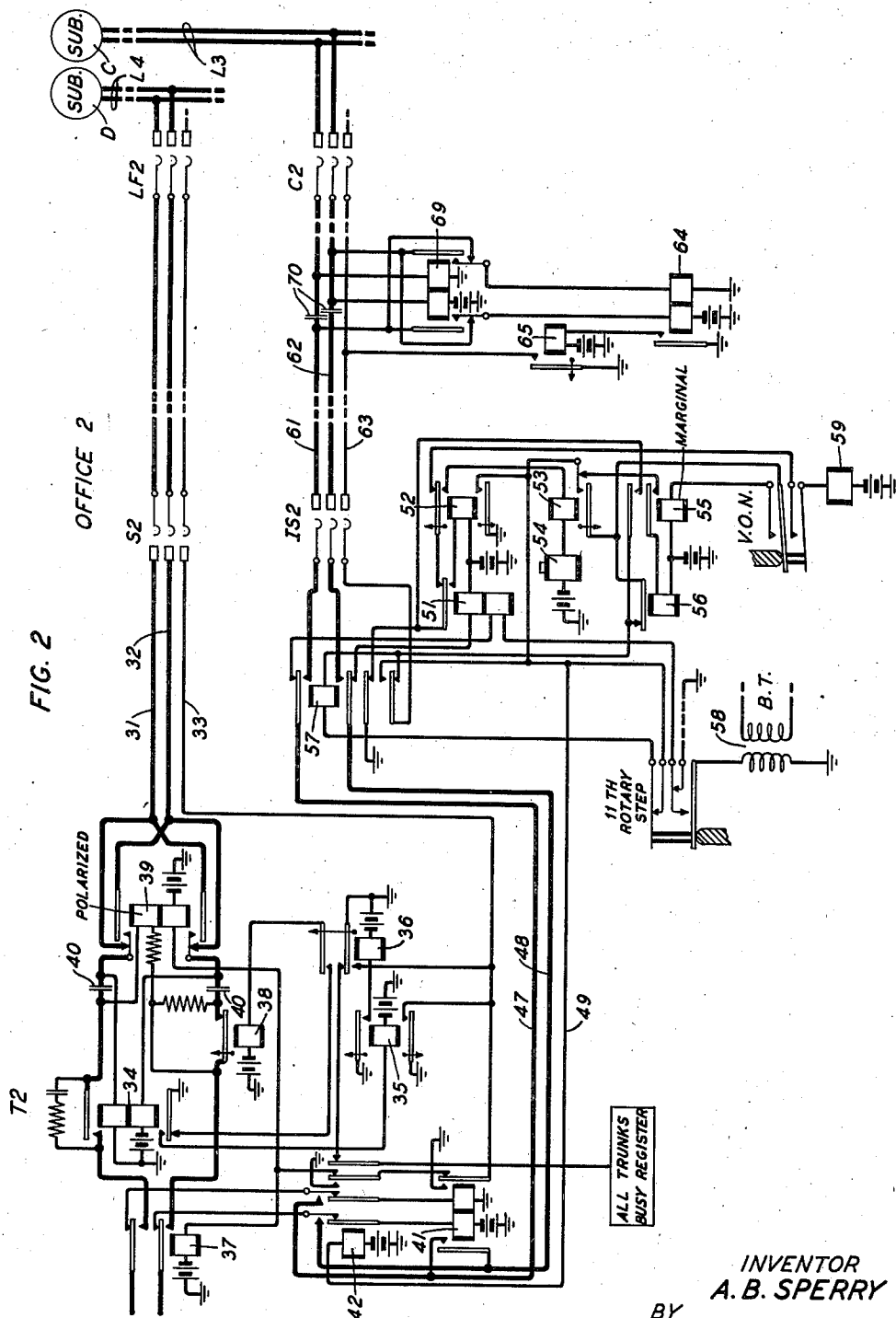
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**ALL TRUNKS
BUSY REGISTER**

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TELEPHONE SYSTEM

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6 Claims. (Cl. 179—16)

This invention relates to telephone systems and particularly to systems employing two-way trunks between automatic telephone offices.

It is the object of the invention to minimize the liability of double connections and to otherwise improve the efficiency of the switching equipment in telephone systems.

Where interoffice trunks in a dial system are used for completing calls in both directions, it is necessary to provide busy indicating means at each end of the trunk, which means is rendered effective as soon as possible after seizure of the trunk at the opposite end. Between the time a trunk is seized at one end and the time that the busy indicating means at the opposite end has become effective, the trunk is subject to double seizure. Various arrangements have heretofore been employed for reducing this unguarded interval. The trunk may normally be connected at each end to the line relay of an associated incoming selector in which case the busy guard awaits the operation of both the line relay and the release relay of the selector. Or the trunk may normally be connected at each end to an incoming repeater, the line relay of which is immediately effective upon seizure at the opposite end to establish a guard to prevent a double connection, the line relay also being effective to repeat impulses to the incoming selector.

According to this invention the interval during which a two-way trunk is unguarded at one end, after seizure at the opposite end, is greatly reduced by an arrangement comprising a line or trunk relay, normally connected to the trunk and operatively responsive to seizure of the trunk at the distant end, and a switching relay for transferring the trunk from the windings of the trunk relay to the windings of the line relay of the associated incoming selector switch. Operation of the trunk relay upon seizure of the trunk at the distant end, immediately connects a guarding potential to the test terminal of the trunk in the banks of selectors having access thereto and closes a local circuit for operating the line relay of the incoming selector. The resulting operation of the release relay, and connection of ground potential to the sleeve conductor, of the selector switch causes the operation of the switching relay so as to connect the trunk to the line relay of the incoming selector and make this line relay directly responsive to dial impulses incoming over the trunk.

The invention will be readily understood by considering a telephone system in which it is embodied, one such system being illustrated sche-

matically in the drawings which form a part of this specification. The invention is not limited in its application to the system shown in the drawings but may be applied to any system employing automatic switches and two-way trunks for the completion of interoffice connections.

Referring to the drawings:

Fig. 1 shows an automatic telephone office comprising subscribers' lines L1 and L2, a line finder switch LF1 and an associated selector switch S1, a two-way trunk circuit T1 and an associated incoming selector switch IS1, and a connector switch C1; and

Fig. 2 shows another automatic office comprising subscribers' lines L3 and L4, a line finder LF2 and an associated selector switch S2, a two-way trunk circuit T2 and an associated incoming selector switch IS2, and a connector switch C2.

The trunk circuits T1 and T2 are alike and the corresponding switches in the two offices may also be similar. The finder, selector and connector switches are of the type usually known as step-by-step two-motion switches. For a description of the construction of such switches and their operation as selectors and connectors, reference may be had to "Automatic Telephony" by Smith and Campbell, second edition, pages 53 to 65 inclusive. For a description of the operation of such switches when used as line finders, reference may be had to Patent 1,799,654, granted to R. L. Stokely, April 7, 1931. The switches LF1, LF2, S1, S2, IS1 and C1 are each represented by a set of brushes and a single set of terminals, none of the associated circuit equipment being shown. The banks of the incoming selector switch IS2 and connector switch C2 are also represented by single sets of terminals; but the circuit equipment associated with the selector IS2 is shown in detail, and as much of the circuit equipment associated with the connector C2 is shown as is necessary for a clear and complete description of the system.

Consider first a call from station A of line L1 in office 1 to station C of line L3 in office 2, the call being completed over trunk T. Assuming the line finder LF1 to have been operated, in response to removal of the receiver at station A, to connect line L1 with the associated selector S1, and the selector S1 to have been selectively operated under the control of the dial (not shown) at the calling station to extend the connection to the trunk equipment T1, a circuit for operating relay 17 is closed from the ground potential temporarily connected to the sleeve brush of the selector, over sleeve conductor 13, through back contacts of relays 21 and 22, and the winding of relay 17 in 55

parallel with the biasing winding of relay 19; and a circuit for operating relay 14 is closed through the windings of relay 14, normally closed contacts of relay 19, conductors 11 and 12, the two upper brushes of switches S1 and LFI, and the conductors of line L1. Relay 14 closes at its lower front contact a circuit for operating relay 15 and relay 15 closes at its upper contact a circuit for operating relay 16. Each of relays 15 and 16 connects ground to the sleeve conductor 13 so as to hold the preceding line finder and selector switches in usual manner. This ground is further extended through the left back contact of relay 21 and next to the outermost back contact of relay 22 for holding relay 17 and for maintaining the energization of the biasing winding of polarized relay 19. Relay 17 disconnects the conductors of trunk T from the windings of trunk relay 21; and, with both of relays 14 and 17 operated, the upper winding of relay 19 is bridged across the trunk T, thereby completing a circuit through back contacts of relays 37 and 42 of trunk equipment T2 for operating trunk relay 41. The current in this circuit is in the opposite direction to that required for causing the operation of relay 19. At its right front contact, relay 41 connects ground to sleeve conductor 33 to guard the trunk equipment T2 from being seized by selector S2 or any other selector having access to this trunk. At its left front contact, relay 41 closes a circuit, over conductors 47 and 48 and through back contacts of relay 57 of incoming selector IS2, for operating the line relay 51 of the incoming selector. Relay 51 closes a circuit for operating relay 52 and relay 52 connects ground through its lower front contact to sleeve conductor 49 to operate relay 42 of the trunk equipment T2. Relay 42 transfers the conductors of trunk T from the windings of trunk relay 41 to the windings of line relay 51 of selector IS2. Relay 41 then releases so that relay 51 is held operated under the sole control of relay 14 of trunk equipment T1. When relay 41 releases, the sleeve conductor 33 is connected through the back contact of relay 41 to ground at the outer front contact of relay 42, thereby continuing the guard against seizure of trunk T by a selector in office 2.

When the calling subscriber dials the next digit of the called subscriber's number, relay 14 is alternately released and reoperated in response to each impulse in usual manner thereby opening and closing the bridge across trunk T to cause a corresponding release and reoperation of relay 51 of incoming selector IS2 in office 2. The release of relay 14, in response to the first impulse, also closes a circuit for operating relay 18; and relay 18, which is slow in releasing, remains operated to improve the impulse circuit over trunk T while all of the impulses in the train are being repeated by relay 14. Relays 15 and 16 are also slow in releasing so that ground is not disconnected from the sleeve conductor 13 while relay 14 is responding to dial impulses. Each release of relay 51 of selector IS2 closes a circuit through the winding of slow-to-release relay 53 and the winding of the vertical stepping magnet 54. Each operation of magnet 54 steps the brushes of switch IS2 up one level, relay 53 remaining operated until all of the impulses in the train have been received. Relay 53, being slow in releasing, remains operated during the response of relay 51 to dial impulses. When the shaft and brushes are moved out of normal position, the vertical off-normal springs VON are actuated thereby closing a circuit, through the upper contacts of

these springs and the front contact of relay 53, for operating relay 55. When relay 53 releases after the brushes have been stepped up to the desired level, relay 55 is held operated through the back contact of the rotary stepping magnet 56, the outer front contact of relay 55, and the middle lower back contact of relay 57; and a circuit for operating magnet 56 is closed through the inner front contact of relay 55, and through the back contact of relay 53 to ground at the lower front contact of relay 52. When magnet 56 operates, the brushes are stepped into contact with the first set of terminals in the selected level. The operation of magnet 56 causes the release of relay 55; and relay 55 in turn causes the release of magnet 56. If the first set of terminals is idle, relay 57 is operated by the current in a circuit from battery through the winding of relay 55, upper contact of the VON springs, back contact of magnet 56, winding of relay 57, upper contact of the "11th rotary step" springs, to ground at the lower front contact of relay 52. Relay 55, being marginal, does not operate in series with relay 57. If, however, the first set of terminals is guarded by ground potential connected to the sleeve terminal, this ground is connected through the sleeve brush and lowermost back contact of relay 57 to short-circuit the winding of relay 57 and cause the reoperation of relay 55; relay 55 then again closes the circuit for operating magnet 56 and the brushes are stepped to the next set of terminals. This stepping operation is repeated until an idle set of terminals is encountered at which time relay 57 operates as above described. At its upper and inner lower front contacts, relay 57 extends the connection from trunk T over conductors 61 and 62 to the line relay 64 of the connector switch C2. At the lowermost front contact of relay 57, ground at the lower front contact of relay 52 is temporarily extended to the sleeve terminal of the selected set to prevent seizure of the same connector by any other hunting selector. The operation of relay 57 also causes the release of relays 51 and 52. The operation of the line relay 64 of connector C2 closes a circuit for operating the release relay 65; and relay 65 connects ground to sleeve conductor 63 to hold relay 57 of selector IS2 and to hold relay 42 of trunk equipment T2. The dial impulses, corresponding to the last two digits of the called subscriber's number, are repeated by relay 14 of trunk equipment T1 to relay 64 of switch C2 and connection with the line L3 is thereby effected in usual manner. When the called subscriber answers, the line L3 is connected to relay 69, and the operation of relay 69 reverses the connection of the windings of relay 64 with respect to conductors 61 and 62 so that the current over these conductors, the trunk T, and through the upper winding of relay 19 of trunk equipment T2 is reversed to cause the operation of relay 19. Relay 19, in turn, reverses the connection of the windings of relay 14 with respect to conductors 11 and 12 to control metering or any other function dependent upon answer of the called subscriber. Conversation then takes place, the talking currents being transmitted through condensers 20 of trunk equipment T1, and condensers 70 of connector C2. If the called subscriber replaces the receiver, relay 69 releases, thus restoring the direction of current over trunk T to cause the release of relay 19 of trunk equipment T1. When the calling subscriber replaces the receiver, relay 14 releases. The release of relay 14 causes the release of relays 15, 16 and 17 and opens the bridge

across the conductors of trunk T to cause the release of relay 64 of switch C2 and the release of relay 19, if at that time operated. The release of relays 15 and 16 disconnects ground potential from sleeve conductor 13 thereby causing the return of switches LF1 and S1 to normal in usual manner. The release of relay 17 reconnects the conductors of trunk T to the windings of relay 21. The aforementioned release of relay 64 of switch C2 causes the release of relay 65. Relay 65 disconnects ground potential from the sleeve conductor 63 to cause the release of relays 57 and 42 and also causes the operation of the release magnet (not shown) to return the switch C2 to normal. The release of relay 42 reconnects the conductors of trunk T to the windings of relay 41 and disconnects the guarding ground potential from conductor 33 and the terminals to which this conductor is connected. The release of relays 51, 52 and 57 closes a circuit for operating release magnet 59; and switch IS2 is restored to normal in usual manner.

On a call from station D to station B, the line L4 is extended through the line finder switch LF2, selector S2, trunk equipment T2, trunk T, trunk equipment T1, incoming selector IS1, and connector C1 to line L2. The operation of trunk equipment T2 is like that of equipment T1, and the operation of trunk equipment T1 is like that of equipment T2, on the call from station A to station C hereinbefore described.

Although the system illustrated herein employs switches of the step-by-step type, it is understood that any suitable kind of switch may be used. It is further understood that the invention may be applied to systems in which operators take part in the establishment of connections.

What is claimed is:

1. In a telephone system, a two-way trunk line, means at each end of said trunk for seizing said trunk on outgoing calls, a trunk relay at each end of said trunk, said relays being normally bridged across the conductors of said trunk for operation upon seizure of the trunk at the opposite end, a selector at one end of the trunk for use in completing calls incoming over said trunk, a line relay for said selector, a circuit closed by the operation of the trunk relay at said one end of the trunk for operating said line relay, and means responsive to the operation of said line relay for transferring the conductors of said trunk from said trunk relay to said line relay.

2. In a telephone system, a trunk, means at each end of said trunk for seizing said trunk, a trunk relay normally connected to one end of said trunk for operation upon seizure of said trunk at the opposite end, said relay when operated being effective to guard said trunk against seizure at said one end, an incoming selector at said one end of the trunk for use in completing calls incoming over said trunk, a line relay for said selector, a circuit closed by the operation of

said trunk relay for operating said line relay, and means responsive to the operation of said line relay for transferring the trunk from said trunk relay to said line relay.

3. In a telephone system, a trunk, means at each end of said trunk for seizing said trunk, a trunk relay normally connected to one end of said trunk for operation upon seizure of said trunk at the opposite end, said relay when operated being effective to guard said trunk against seizure at said one end, an incoming selector at said one end of the trunk for use in completing calls incoming over said trunk, a line relay for said selector, a circuit closed by the operation of said trunk relay for operating said line relay, and means responsive to the operation of said line relay for transferring the trunk from said trunk relay to said line relay and for guarding said trunk against seizure at said one end.

4. In a telephone system, a two-way trunk, like means at each end of said trunk for seizing said trunk on an outgoing call, a trunk relay at each end of said trunk, each of the trunk relays being normally bridged across the conductors of the trunk for operation in response to seizure of the trunk at the opposite end, a selector at each end of the trunk for use in completing calls incoming over the trunk, a line relay for each of the selectors, contacts on each of said trunk relays for guarding the trunk against seizure at the end at which the relay is located and for operating the line relay of the selector at the end of the trunk at which the trunk relay is located, a switching relay at each end of said trunk for transferring the trunk from the windings of the trunk relay to the windings of the line relay of the selector, and relay means in each of the selectors responsive to operation of the line relay for operating said switching relay.

5. In a telephone system, a two-way trunk, means at each end of said trunk for seizing said trunk on an outgoing call, a trunk relay at each end of said trunk, said relays being normally bridged across the conductors of said trunk for operation upon seizure of the trunk at the opposite end, an incoming selector at each end of the trunk for use in completing calls incoming over said trunk, a line relay for each of said selectors, the operation of the trunk relay at one end of said trunk upon seizure of the trunk at the other end being effective to guard said trunk from seizure at said one end and to cause the operation of the line relay of the associated incoming selector, and means responsive to the operation of said line relay for disconnecting said trunk relay from said trunk and for connecting said line relay to said trunk.

6. In a telephone system, according to claim 5, means controlled by said line relay for guarding said trunk from seizure at said one end.

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