

Oct. 11, 1938.

A. G. LANG ET AL

2,132,857

TELEPHONE SYSTEM

Filed March 16, 1937

3 Sheets-Sheet 1

FIG. 1

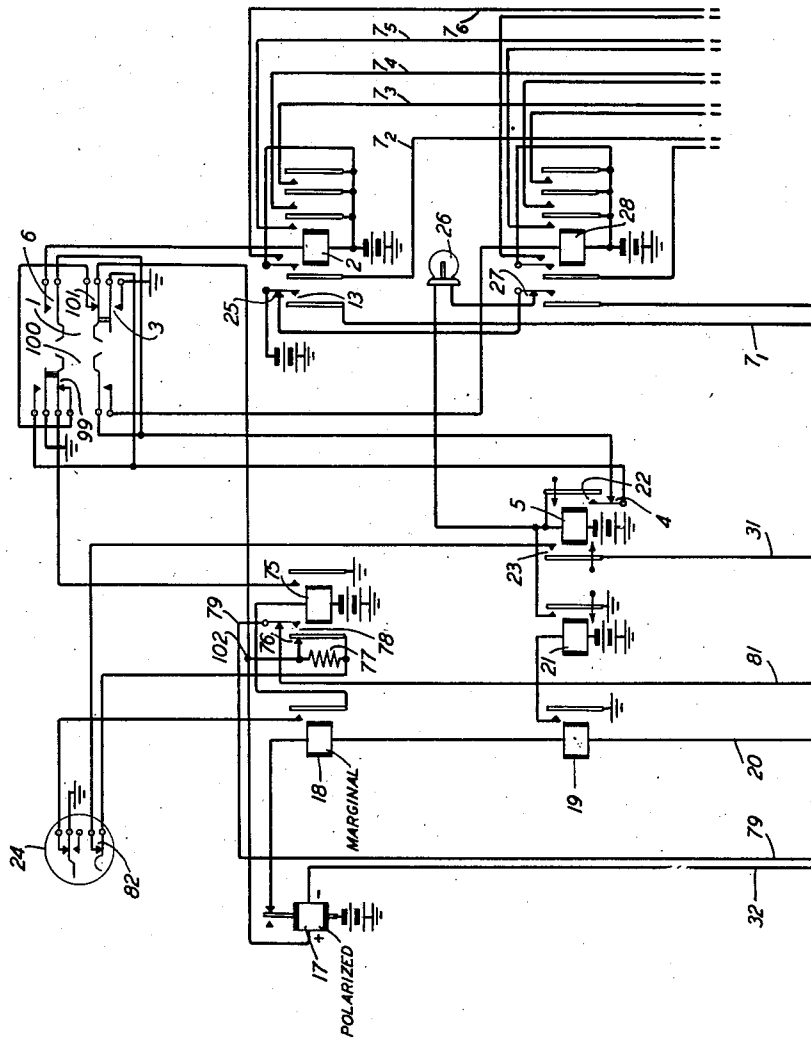
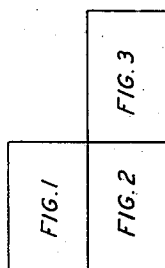


FIG. 4



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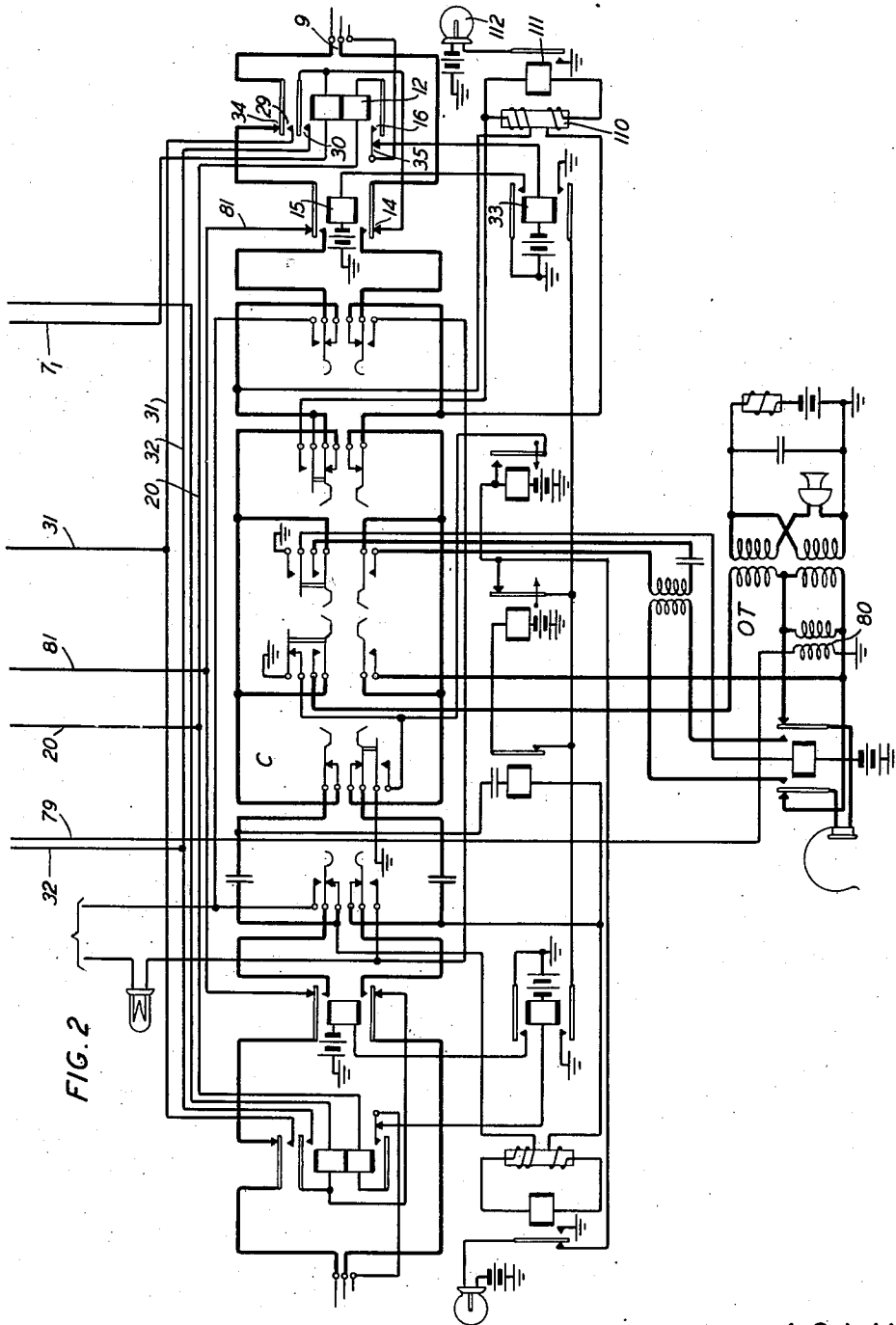


FIG. 2

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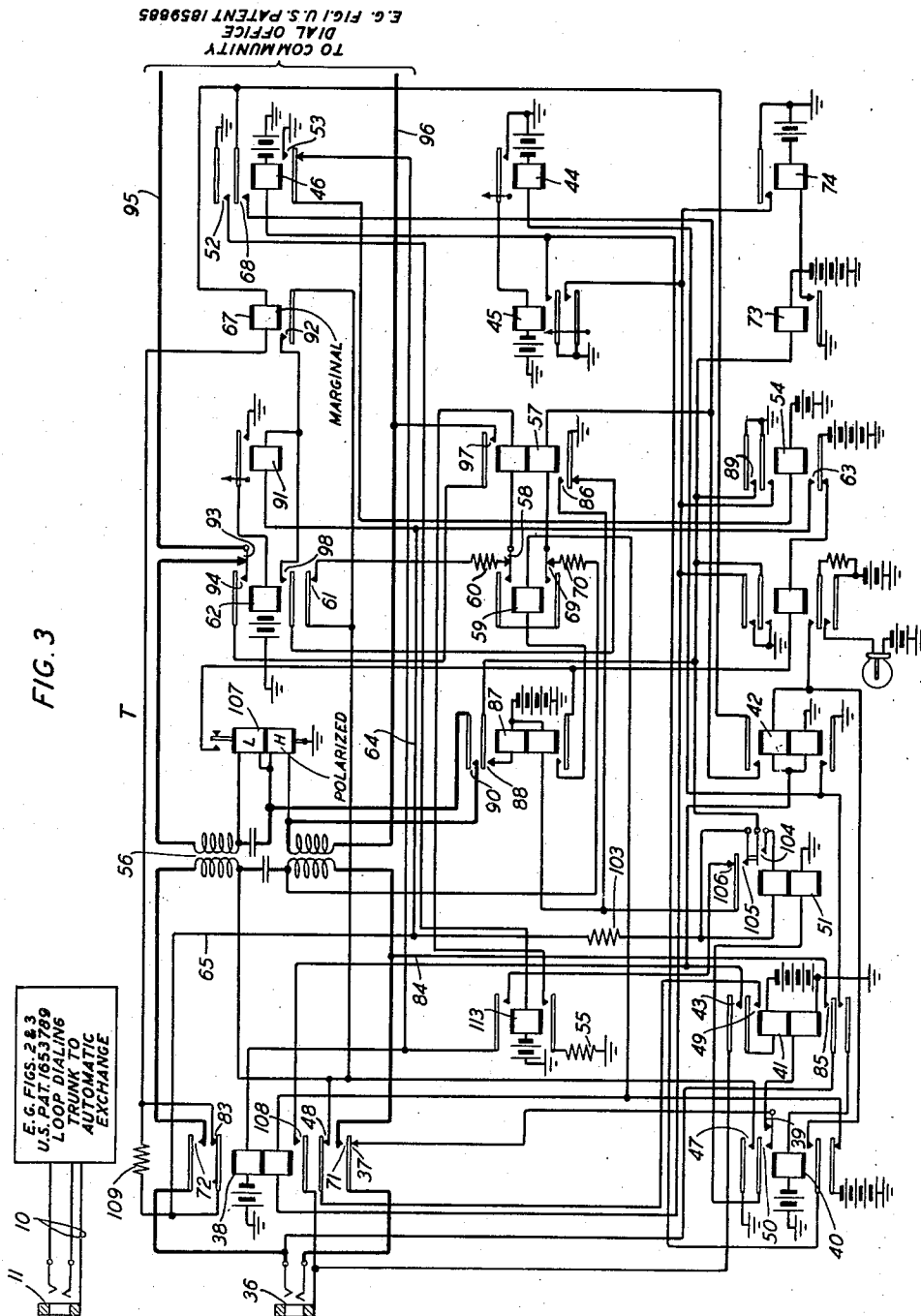
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3 Sheets-Sheet 3



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TELEPHONE SYSTEM

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Application March 16, 1937, Serial No. 131,144

3 Claims. (Cl. 179-27)

This invention relates to telephone systems and more particularly to semiautomatic telephone systems.

An object of the invention is to facilitate the completion of calls through a toll switchboard to subscribers' lines in an automatic community (unattended) exchange over operators' connecting (cord) circuits primarily arranged for completing calls over trunk circuits to subscribers' lines in main automatic exchanges at which exchanges a reversal of the line battery occurs when the final selector switch connects with the called line.

In toll switchboard cord circuits adapted for use with trunks of the above-described latter type, the dial circuit, once it is connected to the cord circuit, remains associated therewith until the before-mentioned reversal occurs at which time a polarized relay operates in the toll operator's position to disconnect the dial circuit from the cord.

The circuits of what are commonly known as community dial offices, i. e. relatively small unattended satellite offices, are in some cases not arranged to transmit a battery reversal when the switch connects with the called line and hence a toll cord arranged to function with trunks to a main exchange over which a reversal occurs when the called line is seized could not be operated in the same manner when connected to a community office trunk for the reason that once the cord is connected to the trunk, the dial is connected and the speech transmission circuit through the cord is opened, all under control of a polarized relay in the position circuit which only operates when the line battery is reversed.

To overcome this difficulty, in the past, it has been the custom, when community office trunks are present in the same switchboard with trunks to main exchange, to provide a special dial jack for each community office trunk and, when a call is to be extended thereover, after plugging up the main trunk jack with the cord circuit to be used in completing the connection, to plug another cord circuit, from that over which the connection is to be completed, into the dial jack. The operator then operates the dial key and actuates the dial now associated with this other cord and upon the completion of dialing removes this other cord from the dial jack whereupon a talking connection is established by means of the first cord. By this sequence of operation, the operator is enabled to complete calls over both types of trunks, but, in the case of connections to community office trunks, the double handling of cords consumes

time and tends to slow up the service, particularly when a considerable number of such calls are completed at certain hours of the day.

A specific object of the invention is therefore to provide facilities whereby a single cord circuit can be interchangeably used to complete calls to trunks of either of the above described types without any of the objections above described.

A feature of the invention whereby the foregoing specific object is obtained, resides in such modifications of the present operator's cord and position circuits and community office trunks that upon completion of dialing on a community office trunk, and the release of a positional dial key, the trunk conductors at the toll office will be reversed to supply line battery to the cord in a reversed direction thereby operating a polarized relay in the position dial circuit to disconnect the dial circuit from the cord and condition the cord circuit for conversation in the same manner as when the call is extended to a main exchange and a line battery reversal automatically occurs thereat when the called line is seized.

Other features will appear hereinafter from the following description and accompanying drawings, Figs. 1, 2 and 3, which figures, when arranged as shown in Fig. 4, represent a toll operator's cord circuit together with its associated position and dial circuit (as shown in Figs. 1 and 2) adapted to be connected to either a standard trunk circuit terminating at an automatic central office, arranged to reverse the battery supply to the cord when a called line is seized, or to be connected to a trunk circuit extending to a so-called community dial office not so arranged, as shown in Fig. 3.

Fig. 1 of the drawings shows the position dial circuit. Fig. 2 shows a cord circuit with the operator's telephone circuit, and Fig. 3 shows the outgoing jack of a standard out-dial trunk to an automatic exchange and the circuit at the outgoing end of a trunk to a community dial office arranged to simulate a battery reversal back into a connected dial circuit when the position dial key is released at the termination of the dialing operation.

A description of the operation of the circuits of this invention follows:

Assuming that the operator is what is known as an inward operator and has answered a call by inserting the rear plug of her cord circuit C, Fig. 2, into a calling toll line, not shown, and desires to extend the connection to a station in an automatic office reached over trunk 10, she will first operate the trunk dial key 1 thereby operating

relay 2 in a circuit which can be traced from ground, contacts 3 of key 1, contacts 4 of relay 5, contacts 6 of key 1 and winding of relay 2 to battery. Relay 2 in operating connects battery to leads 7₁, 7₂, etc., to operate dial relays, such as 12, individual to the respective cords in the position, when the front plug 9 of the cord is connected to an out-dial trunk such as 10.

Trunk 10 is a standard out-dial trunk of the type fully described in Patent 1,653,789 to Stokely dated December 27, 1927 and shown in Figs. 2 and 3 thereof and therefore will not be redescribed here.

By referring to the above patent it will be noted that the ring conductor of the trunk jack 200 shown in Fig. 2 is grounded through the left-hand winding of relay 202 and consequently when the plug 9 of the present cord is inserted in jack 11, which corresponds to jack 200 of the Stokely patent, a circuit is completed to operate the dial relay 12 which can be traced from battery, contacts 13 of relay 2, lead 7₁, upper winding of relay 12, contacts 14 of relay 15, and the ring conductor of the plug 9 and jack 11 to ground in the trunk circuit as previously mentioned.

Dial relay 12 operates in this circuit, disconnects relay 33 from the plug sleeve, and at its contacts 16 completes a holding circuit for itself, including its lower winding, which can be traced from battery, contacts of polarized relay 17, relays 18 and 19, lead 20, lower winding and contacts 16 of relay 12, sleeve conductors of plug 9 and jack 11 to ground over the left-hand contacts of relay 202 and the right-hand winding of relay 203 shown in the above-noted Stokely patent. Operation of relay 12 also connects, at its contacts 29 and 30, the tip and ring conductors of the trunk to leads 31 and 32 extending to the dial circuit of Fig. 3.

Relay 18 is marginal and does not operate in the above traced circuit but relay 19 and trunk relay 203 do operate which latter relay, it will be observed, operates relay 201 to extend the trunk to pulsing relay 204 thereby connecting ground and battery respectively to the tip and ring conductors of the connected cord plug 9.

Relay 19 in operating causes the successive operation of relays 21 and 5. The latter relay locks up over its contacts 22 to ground on the dial key 1, opens the operating circuit of relay 2 and at its contact 23 closes a circuit from the dial 24 over lead 31 and contacts 29 of relay 12 to the tip conductor of the cord plug 9. When relay 2 releases it disconnects battery from lead 7₁ and all other corresponding leads to other cords thereby opening the circuits previously traced which caused operation of relay 202 in the trunk. Relay 12, however, remains locked up over its lower winding as previously described.

Relays 19, 21 and 5 are sufficiently slow in operating, however, to permit relays 201 and 202 in the trunk to lock up before the original operating circuit for relay 202 is opened by the release of relay 2. Release of relay 2 closes, at its contact 25, a circuit to light the dial pilot lamp 26 which can be traced from battery, contacts 25 of relay 2, contacts 27 of relay 28, lamp 26 and contacts 22 of relay 5 to ground over contacts 3 of dial key 1.

The circuit is now in condition for dialing and actuation of the dial 24 transmits pulses over the trunk to operate the pulsing relay 204 in the trunk as shown in Patent 1,653,789. As described in the above patent, when the connector switch in the distant office comes to rest on the called

line, if the line is idle, current flowing back over the trunk to the dial circuit is reversed thereby causing polarized relay 17 to operate. Operation of this relay opens the circuit including relays 18, 19 and 12 thus permitting relays 19 and 12 to release.

Relay 12 in releasing disconnects the trunk from leads 31 and 32 extending into the dial circuit, opens contacts 16, and closes contacts 34 and 35. Closure of contacts 34 connects the tip of plug 9 through to the upper armature of relay 15 and closure of contacts 35 connects sleeve relay 33 to the plug sleeve whereupon relay 33 operates to ground over the sleeve of the trunk. Relay 33 in operating closes an obvious circuit to operate relay 15 which relay closes its inner upper and lower contacts to connect the tip and ring of plug 9 through to the cord.

Release of relay 19 releases relay 21 and if the operator released dial key 1 at the conclusion of the dialing operation, relay 5 will now release thereby extinguishing lamp 26 which completely restores the dial circuit to normal and conditions the cord for conversation.

Call to a community dial office

In case the called subscriber is reached over a trunk to a so-called community dial office which is not arranged to send a current reversal back to operate polarized relay 17 to release the dial circuit from the cord when the called subscriber's line is reached, some means must be provided to simulate such a reversal in order to free the dial circuit and condition the cord for conversation and to accomplish this the trunk T (Fig. 3) has been provided, the operation of which is as follows:

When the operator desires to reach a community dial office subscriber, she first operates dial key 1 as before described, thereby operating relay 2 which connects battery over leads 7₁, 7₂, etc. to operate the respective dial relays such as 12 when the respective plug, such as 9, is inserted in trunk jack 36 at which time a circuit is completed to operate relay 12 which can be traced from battery, contacts 13 of relay 2, lead 7₁, upper winding of relay 12, contacts 14 of relay 15, ring conductors of plug 9 and jack 36, contacts 37 of relay 38, contacts 39 of relay 40 and lower winding of relay 41 to ground. Relays 12 and 41 operate in this circuit. Operation of relay 12 extends the tip and ring of the plug 9 to the dial circuit (Fig. 1) over its contacts 29 and 30 and leads 31 and 32, and prepares a locking circuit for itself at contacts 16. Relay 41 in operating operates relay 42 in a circuit which can be traced from battery, contacts of polarized relay 17 of the dial circuit, windings of relays 18, 19 and the locking winding and contacts 16 of relay 12, sleeve of the plug 9 and jack 36, contact 43 of relay 41 and lower winding of relay 42 to ground.

In the standard out-dial trunk 10, before discussed and described in Patent 1,653,789, the right-hand winding of sleeve relay 203 is of sufficiently high resistance to prevent operation of marginal relay 18 in the dial circuit, but the lower winding of sleeve relay 42 in the community trunk T (Fig. 3 of the present application) is made low enough to permit this relay (A) to operate thereby closing a circuit to operate relay 75 which can be traced from battery, winding of relay 75, contacts of relay 18 and the upper normal contacts of the dial to ground. Operation of relay 75 opens at its contact 76 the normal short-circuit around resistance 77 and closes its contact 78 thereby

transferring the lead 79, which extends to ground through the transformer winding 80 of the operator's induction coil in the telephone circuit OT, shown at the bottom of Fig. 2, from the lead 81 normally connected to the tip of the plug 9, to the lead 32 and thence to the ring conductor of the trunk in order to receive dial tone from the distant community office over the ring conductor of the trunk. Relay 19 also operates in this circuit, as previously described, which operates relays 21 and 5 in turn. Relay 5 releases relay 2 which completes the circuit of dial pilot lamp 26. Relay 5 in operating also closes its contacts 23 which extends lead 31 to the dial 24. With relay 12 operated and locked when relay 5, which is slow to operate, finally closes its contacts dial 24 is connected across the tip and ring springs of the trunk jack 36 in series with polarized relay 17. Operation of trunk relay 42 completes, at its lower contacts an obvious circuit to energize relay 40, which circuit was prepared by the operation of relay 41, and a second obvious and parallel circuit to operate slow acting relay 44.

Relay 40 in operating completes a locking circuit for relay 41 which can be traced from ground, contacts 47 of relay 40, contacts 48 of relay 38, and contacts 49 and upper winding of relay 41 to battery. Relay 40 also opens its contacts 39 and closes contacts 50 thereby transferring the connection of the ring conductor of the jack 36 from the lower or operating winding of relay 41 to the lower winding of relay 51, which latter relay now operates. Further, relay 40 opens its lowermost contact thereby disconnecting battery from the lower or primary winding of relay 38 and preventing that relay from falsely operating in response to the operation of relay 45 which immediately follows. When relay 44, closes its contacts it completes a circuit for relay 45 which is slow acting. After a short interval this latter relay operates and in turn operates relay 46. Relay 45 is made slow to operate in order to insure that relay 40 has operated and removed battery from relay 38 before relay 45 closes its lowermost contact which otherwise would cause the premature operation of that relay (38) which is not desired at this time.

Relay 46 in operating closes, at its contact 52, an obvious circuit for operating relay 113 and at its contact 53 closes an equally obvious circuit for operating relay 54. Operation of relay 113 connects ground through resistance 55 to the right-hand terminal of the upper winding of pulsing relay 57. Operation of relay 54 closes its contact 63 thereby connecting battery through the lower winding of relay 57 and thence to the left-hand armature of relay 5 in the dial circuit (Fig. 1) which due to its slow-acting characteristic has not yet operated. This circuit can be traced from battery, contact 63 of relay 54, leads 64 and 65, contact 83 of relay 38, winding of marginal relay 67, contact 88 of relay 46, lower winding of pulsing relay 57, contact 69 of relay 59, resistance 70, lower left-hand winding of repeating coil 56, lead 84, contact 85 of relay 41, tip spring of jack 36 and tip of plug 9, contact 29 of relay 12 and lead 31 to the left armature of relay 5. Relay 5, however, operates almost immediately after relay 54 and the foregoing circuit may be continued over contact 23 of relay 5, pulsing contact 82 of dial 24, resistance 77, winding of polarized relay 17, lead 32, contact 30 of relay 12, contact 14 of relay 15, ring conductor of plug 9 and ring spring of jack 36, contact 37 of relay 38, contact 50 of relay 40 to ground through the lower winding of relay 51.

The resistance of this circuit, due to resistance 77, is such that marginal relay 67 does not operate, but pulsing relay 57 does operate, over its lower winding, thereby closing its lower contact 86 to operate relay 87 in an obvious circuit.

Relay 87 in operating closes its locking contact 88 thereby completing a locking circuit for itself from ground at contact 89 of relay 54, and at its contact 90 short-circuits the lower, and high resistance, winding of relay 91 thereby decreasing the resistance of the loop to the community dial office sufficiently to operate a marginal line relay thereat, not shown, thereby causing the circuit at that point to be conditioned to receive dial pulses, in a well-known manner, and as trunk T is a two-way circuit, to make the outgoing terminals of this trunk busy to any switch which may attempt to seize it to originate a call in the opposite direction, i. e. toward the toll office end.

The toll operator now actuates the dial 24 to transmit the proper impulse code corresponding to the wanted line. When the dial is moved off normal, the upper or off-normal contacts of the dial are opened thereby releasing relay 75 which thereupon transfers the busy test lead 79 from lead 31 back to its normal connection to lead 81 and reestablishes the short circuit around resistance 77 thereby removing this resistance from the previously traced pulsing circuit which includes the dial, relay 17, pulsing relay 57 and marginal relay 67 whereupon relay 67 now operates which in turn operates relay 91 in a circuit traced from battery, contact 63 of relay 54, winding of relay 91, contact 92 of relay 67 to ground over contact 47 of relay 40. Relay 91 closes an obvious circuit to operate relay 62, which relay opens its contact 93 and closes contact 94 thereby connecting the tip conductor 85 of the trunk to the ring conductor 96 through the pulsing contact 97 of relay 57 to the exclusion of the repeating coil 56, upper winding of polarized relay 107 and contact 90 of relay 87.

The return of the dial interrupts the circuit through relay 57 the required number of times which relay releases and reoperates thereby alternately opening and closing the trunk loop to control the switching circuit at the distant office. Relay 67 also follows the interruption of the dial thereby alternately opening and closing the circuit previously traced for relay 91, but this relay, which is slow to release, holds operated over these brief open-circuit intervals thereby holding relay 62 operated. Further, due to the closure of contact 98 of relay 62, relay 91 is held operated as long as relay 57 is released, under control of relay 54. When the dial restores to normal, relay 75 reoperates which again removes the short circuit from resistance 77 thereby again increasing the resistance of the pulsing circuit including marginal relay 67 which latter relay thereupon releases which permits relays 91 and 62 to release in turn.

The release of relay 62 opens its contacts 94 and 98 and recloses contact 93 thereby reconnecting the trunk conductors 95 through the upper right winding of repeating coil 56, upper low resistance winding of relay 107, contact 90 of relay 87, and lower right winding of repeating coil 56 to the ring conductor 96. This restores the original condition which existed before the first digit was dialed.

When the dial is moved off normal to transmit the next digit, the same sequence of operations takes place, and so on, until the dial comes to rest at the conclusion of the dialing operation at

which time the operator must release the dial key 1 in order to free the dial circuit from the trunk and condition the cord for conversation.

When dial key 1 is released, due to the fact that relay 57 is now operated, ground at the right-hand contact of relay 75 will be applied over contact 99 of rear dial key 100 and contacts 101 of the front dial key 1 to junction point 102 between resistance 77 and relay 17 thereby grounding both the tip and ring of the trunk. This ground is connected through relay 17 to the ring spring of the trunk jack and thence over contact 37 of relay 38 and contact 50 of relay 40 to the lower winding of relay 51 thereby short-circuiting it. During the pulsing period although the pulsing circuit includes the lower winding of relay 51, and consequently is alternately opened and closed, this relay (51) remains operated, i. e., while the dial circuit is opened, relay 51 is held operated by its upper winding in a circuit traced from battery, contact 63 of relay 54, lead 64, resistance 103, upper winding and contacts 104 of relay 51 and contact 89 of relay 54 to ground. When the dial circuit is closed, thereby operating relay 57, the holding winding of relay 51 is short-circuited in the following path: Ground, contact 86 of relay 57, contact 105 and the upper winding of relay 51, contact 104 of this relay and contact 89 of relay 54 back to ground.

Ground connected at the junction point 102, by the release of dial key 1, is also connected through resistance 77, contact 82 of the dial and contact 23 of relay 5, to lead 31 and thence over the previously traced pulsing circuit including the lower winding of relay 57 and marginal relay 67 to battery. As before mentioned, resistance 77 is sufficiently high to prevent the operation of relay 67, but relay 57, however, holds operated in this circuit.

The short-circuiting of relay 51 and its consequent release at this time completes a circuit to operate relay 38 which can be traced from ground at the still closed contacts 86 of relay 57, contacts 106 of relay 51, now released, upper contacts of relay 113 and upper winding of relay 38 to battery. Operation of relay 38 closes its contacts 72 and 71 thereby connecting the tip and ring springs of the jack 36 to the respective terminals of the left-hand windings of repeating coil 56. Operation of this relay also opens its contact 48 thereby opening the locking circuit for relay 41 which thereupon releases which in turn opens the circuit for relay 40 which also releases. Release of relay 41 opens its contact 85 which up to this time has connected the tip spring of the jack 36 to the lower left-hand terminal of repeating coil 56 which extends to battery through relays 67 and 57.

Relay 38 in operating also closes its contact 108 thereby maintaining a connection between the sleeve of jack 36 and relay 42 and holding this relay operated, which otherwise would have released due to the release of relay 41.

Further, operation of relay 38 opens its contact 83, thereby removing the short circuit heretofore connected around resistance 109. The effect of the closure of contacts 72 and 71 and opening of contact 83 of relay 38 and the opening of contact 85 of relay 41 is to reverse and reduce the current flowing back into the dial circuit through polarized relay 17 and due to this reversal of current, relay 17 now operates.

The reversed circuit for operating relay 17 can be traced from ground, right-hand contact of relay 75, contacts 99 and 101 of keys 100 and 1,

winding of relay 17, lead 32, contact 30 of relay 12, contact 14 of relay 15, contacts of the plug 9, ring spring of jack 36, contact 71 of relay 38, lower left winding of repeating coil 56, resistance 70, contact 69 of relay 59, lower winding of relay 57, contact 68 of relay 46, winding of relay 67, resistance 109, leads 65 and 64 and contact 63 of relay 54 to the negative pole of battery. Operation of relay 17 releases relays 18, 19 and 12.

Relay 12 in releasing opens its contacts 29 and 30 thereby disconnecting the dial circuit (leads 31 and 32) from the tip and ring of the trunk, closes its contact 34 to extend the tip of plug 9 to the upper armature of relay 15, opens contacts 16 and closes contacts 35 thereby connecting battery through the cord sleeve relay 33 to the sleeve of plug 9 and consequently to the sleeve of the trunk thereby holding the trunk sleeve relay 42 operated which otherwise would also release. Cord sleeve relay 33 now operates in series with the trunk sleeve relay 42 thereby operating relay 15. Relay 15 closes through the tip and ring of the cord. Release of relay 18 releases relay 75 and release of relay 19 releases relays 21 and 5 thereby restoring the position dial circuit (Fig. 1) to normal.

With relay 12 released and relay 15 operated the tip and ring conductors of the cord are connected through and the supervisory bridge, comprising retard coil 110 and relay 111 in parallel across the cord, holds relay 57 operated. Relay 111 operates at this time and lights supervisory lamp 112.

When the called subscriber answers battery and ground are reversed in the usual manner, over the trunk from the community dial office, causing operation of polarized relay 107 in the trunk. Operation of relay 107 closes a circuit to operate relay 59 which can be traced over the lower contacts of relay 87 and lowermost normal contacts of relay 40 to battery. Operation of relay 59 opens its contacts 58 and 69 thereby disconnecting the two windings of relay 57 from the previously traced circuit through the cord which has held this relay operated and at its upper and lower front contacts substitutes a local holding circuit for relay 57. This, however, opens the circuit for supervisory relay 111 in the cord which releases and extinguishes the supervisory lamp 112.

When the conversation is ended and the called subscriber disconnects, relays 107 and 59 release in turn thereby reconnecting the winding of relay 57 to the cord and reoperating supervisory relay 111 which lights supervisory lamp 112. The toll operator then challenges on the line and finding the conversation finished removes plug 9 from jack 36 whereupon the trunk circuit restores to normal, which operation, as it forms no part of the invention, will not be described in detail.

What is claimed is:

1. In a telephone system, a trunk circuit, an operator's cord circuit adapted to be connected to said trunk, a dial adapted to be connected and locked to said cord circuit, a dial key, a polarized relay adapted to be connected in series with said dial when the dial is connected to the cord, means responsive to the joint connection of said cord circuit to said trunk and operation of said dial key to connect said dial to said cord and lock it under control of said polarized relay, a source of direct current adapted to be connected to said trunk responsive to the connection of said dial and in a non-operate direction with respect to said polarized relay, and means responsive to the release

of said dial key to cause said current source to be reversed in polarity with respect to said trunk to operate said polarized relay and release said dial from the cord.

5 2. In a telephone system, an operator's cord circuit, a trunk circuit, a dial, a dial key, means responsive to operation of said dial key and connection of said cord to the trunk to connect and lock the dial to the cord, a polarized relay in series with the dial controlling the locking circuit of said dial, a source of direct current, and means responsive to release of said dial key to connect said source to the trunk in such a polar direction as to operate said polarized relay to disconnect the dial from the cord.

10 3. In a telephone system, a manual exchange, a plurality of automatic exchanges, trunk circuits from said manual exchange to each of said automatic exchanges, cord circuits at said manual exchange for making connection to said trunk circuits, a position circuit including an impulse transmitting device and a key at the manual exchange, said device being adapted to be con-

nected and locked to any of said cord circuits jointly responsive to connection of the cord to any one of said trunk circuits and the operation of the key, polarized relay means at said manual exchange in series with said dial when it is connected to a cord adapted when operated to disconnect said dial from its connected cord circuit, means at certain of said automatic exchanges responsive to seizure of the called line thereat to reverse the connection of the exchange battery to the calling trunk circuit to operate said polarized relay means at the manual exchange, and means associated with said position circuit, cord circuits, and trunk circuits extending to automatic exchanges not arranged to reverse battery to the trunk when the called line is seized, responsive to release of the dial key, to cause direct current to be connected to the trunk circuit at the manual exchange in such a direction, as to operate said polarized relay means to release the dial from its associated cord circuit.

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