June 17, 1947. W. T. POWELL 2,422,565

INTERCOMMUNICATING TELEPHONE SYSTEM

Filed Aug. 24, 1944 2 Sheets-Sheet 1

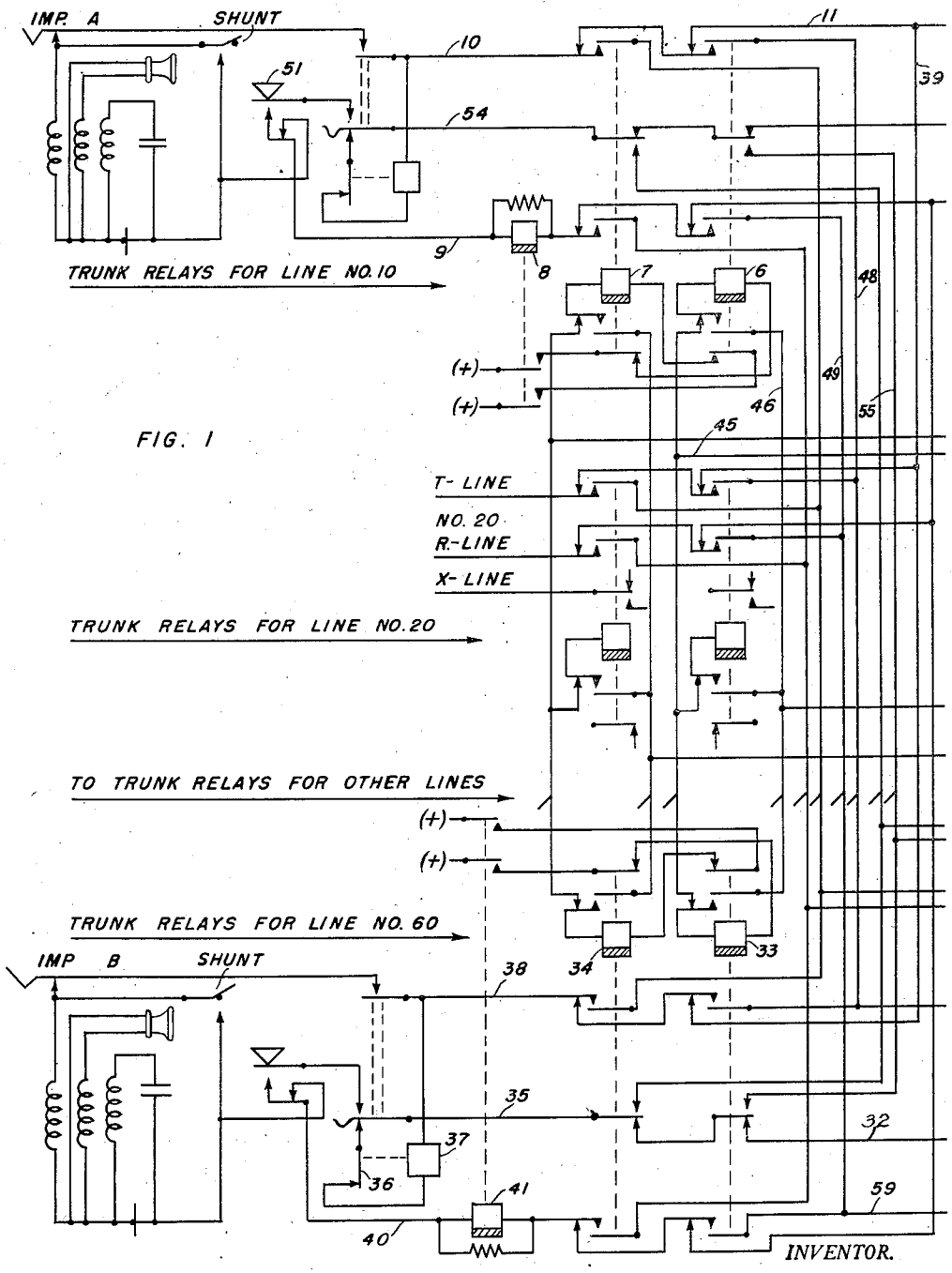


FIG. 1

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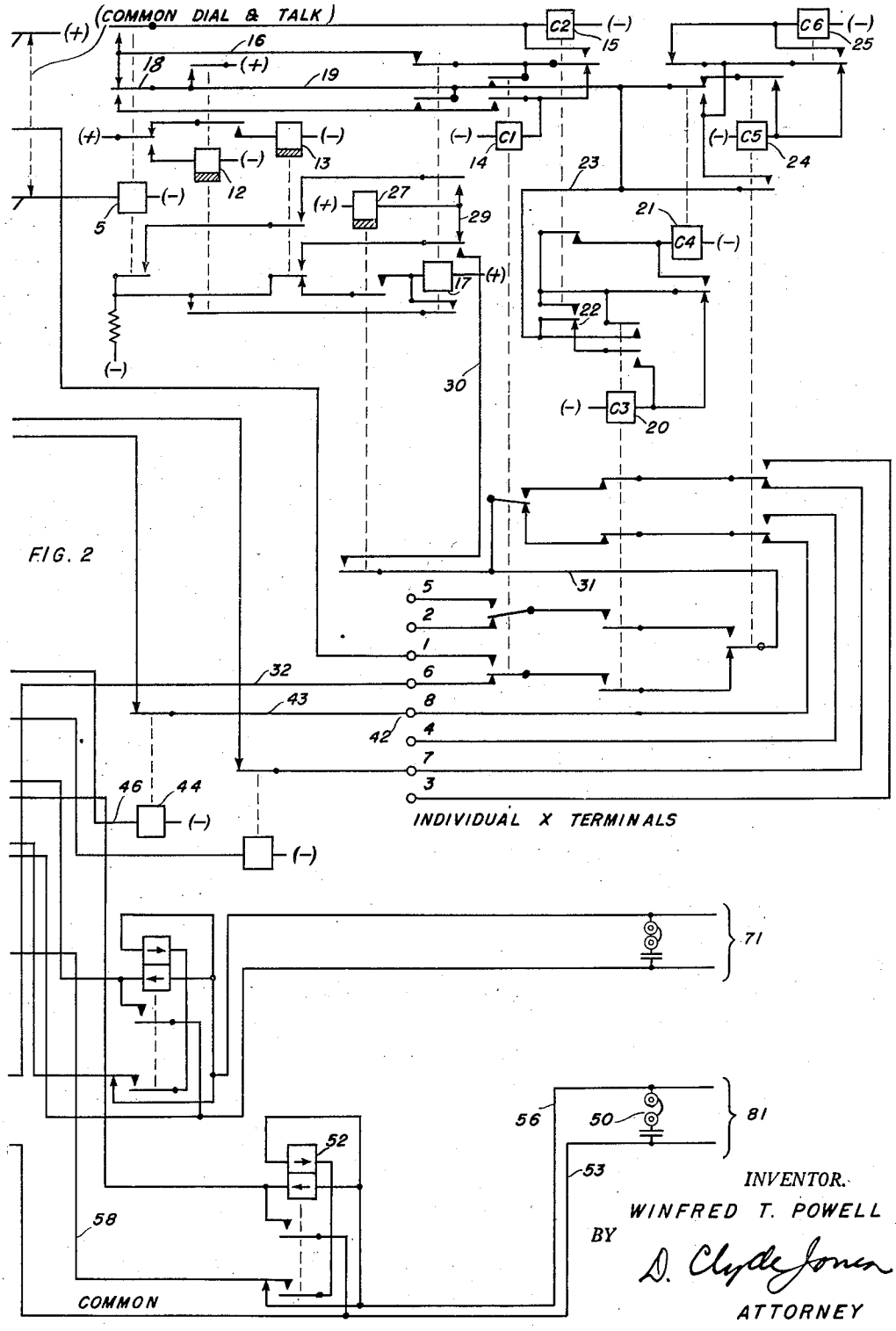


FIG. 2

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2,422,565

INTERCOMMUNICATING TELEPHONE SYSTEM

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10 Claims. (Cl. 179—17)

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This invention relates to a telephone system in which dial controlled relays effect intercommunication between a limited number of telephone subscribers or interconnection with one of several trunks leading to an exchange.

The various features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which:

Figs. 1 and 2, when arranged side by side in the order named, diagrammatically represent a telephone system incorporating the present invention. Fig. 1 at its upper and lower portions indicates two complete telephone line circuits together with the relays individual thereto, while in the intermediate portion of Fig. 1 other telephone lines are merely indicated. Fig. 2, on the other hand, shows control equipment common to the mentioned lines as well as two trunks leading to a distant exchange.

In this system, as herein illustrated, there are provided six telephone lines and two trunks leading to a central office. There are provided six counting relays, five control relays and two trunk relays common to all of the lines as well as a line relay and two trunk relays individual to each telephone line when two trunks are used in the system. However, by the addition of another pair of counting relays, the number of lines in the system can be increased to eight. In the present arrangement only three wires extend to each substation where the telephone line is provided with a dial, a direct current bell and a push button. The push button is used to transfer to another telephone, a call incoming over a trunk to a given telephone. In this system, common dialing and talking circuits are used and therefore trunk selection cannot be made while a local connection is established. However, local calls are not secret, and consequently a party wanting a trunk connection, can break in on the local call and request the parties to the local call to hang up. In the present layout, no busy tone is required since only one party can dial at a time. If a party gets the common dialing circuit and hears no one else on this circuit, it is an indication that no local line is busy and any telephone of the group can be selected. In the case of trunk calls, the absence of dial tone from a dial control office indicates that the selected trunk is busy. In the case of a connection with a manual central office, if a trunk call is not answered within a reasonable time, the local party hangs up and dials the other trunk number.

It is believed that the operation of this system will best be understood by describing a telephone connection from the substation A on a telephone line #10 to a substation B on the line having the designation #60. When the subscriber at A removes his receiver from its switchhook, it completes a circuit from the negative side of battery, winding of the common relay 5, back contacts and continuity springs of the switching relays 6 and 7, winding of the slow-releasing line relay 8, ring conductor 9, through the substation circuits at A, tip conductor 10, back contacts and continuity springs of relays 7 and 6, conductor 11, to the positive side of battery. Relay 5, on operating, closes an obvious operating circuit for the slow releasing relay 12.

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Since it has been assumed that the calling subscriber wishes to call the subscriber at substation B on the line which is designated #60, the subscriber at A operates his dial sender to transmit six impulses. In response to each of these impulses, the common relay 5 is released six times, after which it remains operated. While the line relay 8, which is slow releasing, may or may not respond to these impulses, this is immaterial since the line relay 8 performs no useful function at this time. On the release of the common relay 5 in response to the first impulse of the series, the slow releasing change-over relay 13 is energized in a circuit completed at the front contact and armature of relay 12 and at the back contact and armature of the relay 5. The first release of the relay 5 also closes a circuit for operating the first counting relay 14 of the series. This circuit extends from the negative side of battery, winding of the relay 14, innermost back contact and armature of the #2 counting relay 15, uppermost armature and back contact of ringing relay 17, conductor 16, armature 18 and back contact of relay 5, front contact and armature of relay 12 to the positive side of battery. Relay 14, on operating, locks itself in this condition, through its outer, upper armature and front contact, front contact and armature of relay 12, to ground. When the relay 5 operates again at the end of the first impulse, the #2 counting relay 15 is operated in a circuit traceable from the negative side of battery, winding of the relay 15, uppermost armature and front contact of relay 5, conductor 16, back contact and armature of relay 17, armature and front contact of the #1 counting relay 14, conductor 19, front contact and armature of relay 12 to the positive side of battery. As soon as the #2 counting relay is operated, it closes a circuit for operating the #3 counting relay 20. This circuit extends from the negative

side of battery, winding of relay 20, back contact and armature of the #4 counting relay 21, front contact and armature 22 of the relay 15, conductors 23 and 19 to the positive side of battery at the armature and front contact of relay 12. When the relay 5 releases at the beginning of the second impulse, the #1 counting relay 14 releases and when the relay 5 operates at the end of the second impulse, the #2 counting relay 15 is released. This operation of the #1 counting relay 14, and the #2 counting relay 15 follows the operation of the relay 5. In other words, the #1 counting relay shifts its position at the beginning of each impulse repeated by the relay 5 on releasing. Thus, the #1 counting relay is operated at the beginning of each odd numbered impulse and released at the beginning of each even numbered impulse. The #2 counting relay 15 is operated at the end of each odd numbered impulse and is released at the end of each even numbered impulse, as repeated by the relay 5. The #3 counting relay 20 and the #4 counting relay 21 are operated in response to the operations of the #2 counting relay 15 in the same manner as the #1 and #2 counting relays were operated by the relay 5, otherwise expressed, the #3 counting relay 20 shifts its position each time that the #2 counting relay is operated and the #4 counting relay 21 shifts its position each time that the #2 counting relay is released. The #5 counting relay 24 and the #6 counting relay 25 are controlled by the #4 counting relay 21, in the same manner that the #3 counting relay and the #4 counting relay are governed by the #2 counting relay 15.

From the foregoing, it should be understood that a counting relay circuit arrangement is provided in which the number of channels that can be selected is doubled by the provision of each additional pair of counting relays.

Under the condition assumed in which the digit 6 was dialed to select substation B, at the end of this series of impulses, the #1 counting relay 14, the #2 counting relay 15 and the #5 counting relay 24 will be in their released positions, whereas the #3 counting relay 20, the #4 counting relay 21, and the #6 counting relay 25 will be in their operated positions.

At the end of this series of impulses, the slow releasing, change-over relay 13, and the slow releasing relay 27 will be released in sequence, relay 27 having been operated by the closure of the lower outer front contact of relay 13. The change-over relay on releasing closes a circuit for operating the ringing relay 17 from the positive side of battery, winding of this relay, front contact and armature of slow releasing relay 27, back contact and armature of change-over relay 13 and through the resistor, to the negative side of battery. The ringing relay 17 is operated in this circuit and closes a locking circuit for itself through its lower front contact and armature, armature and front contact of relay 12, through the resistor, to the negative side of battery. Thus, the locking circuit of the ringing relay is maintained even when the slow releasing relay 27 releases. The ringing relay, on operating, prevents additional dial impulses from changing the setting of the counting relays.

It now becomes necessary to ring the bell at the substation B of the wanted line. In order to effect this ringing, the subscriber at substation A operates his dial to transmit a series of impulses which may be ten in number if a long

ringing period is desired. These impulses effect the intermittent release of the relay 5 which relay effects the operation of the slow releasing change-over relay 13 at the beginning of the series of impulses. When the relay 5 is again operated after the first impulse, the slow releasing relay 27 is operated from the positive side of battery, winding of this relay, front contact and armature of the ringing relay 17, front contact and armature of the change-over relay 13, lower front contact and armature of relay 5 to the negative side of battery. It will be noted that the relay 27 does not have its circuit completed unless relay 5 operates following its release in response to the second digit. This condition is to prevent the ringing of a called station when the calling party hangs up and thereby releases the relay 5 without turning the dial to effect ringing operation. The circuit for ringing the call bell at substation B extends from the negative side of battery through the resistor, lower armature and front contact of relay 13, armature and front contact of relay 17, conductor 30, front contact and armature of relay 27 and thence over the executing conductor 31, armature and back contact of the #5 counting relay 24, armature and front contact of the #3 counting relay 20, armature and back contact of the #1 counting relay 14, conductor 32, back contacts and armatures of the switching relays 33 and 34, which relays 33 and 34 are the trunk relays for line #6, X line conductor 35, back contact of the switch-hook at station B, armature and back contact 36 and winding of the bell 37, tip conductor 38, continuity springs and back contacts of relays 34 and 33, conductor 39, to the common ground connection. The completion of this circuit causes the intermittent operation of the bell 37 over the conductor 35 of the called line for a period of time determined by the number of impulses in the ringing digit and also the slow acting time of the change-over relay 13.

When the called party answers, his telephone circuit including the conductors 38 and 40 is connected in multiple with the tip conductor 10 and the ring conductor 9 of the calling party's telephone circuit so that the conversation may be carried on. When both the calling party and the called party hang up, the circuit including the relay 5 is opened for effecting the release of this relay. This in turn effects the release of the slow releasing relay 12. Relay 12 effects the release of the ringing relay 17 as well as any counting relays which have been left operated. It will be noted that when the relay 5 releases and before the relay 12 releases, the change-over relay 13 will be operated but this operation performs no useful function. It will also be seen that the line relay 41 is operated when the called party removes his receiver from its switch-hook but this operation likewise performs no useful function.

It has been mentioned that the present system provides means for connecting the telephone circuits to one or more trunk circuits leading to an exchange. As herein illustrated, two such trunks are provided, one of which is designated #71 and can be selected by dialing digits corresponding to that number and the other trunk is designated 81 and can likewise be selected by dialing that number. For purposes of description, let it be assumed that it is desired to select the second trunk which is selected by dialing 81. Under the conditions assumed, the party at A removes his receiver from its switch-hook and

first dials the digit #8. In response to the impulses of this digit, the relay 5 vibrates its armature. This causes the operation of the slow releasing relay 12, change-over relay 13, relay 27 and the ringing relay 17 and the counting relays in the same manner as previously described for a local inter-station call. The counting relays are thus operated in the proper combination with all counting relays left de-energized to extend the execution conductor 31 to the #8 terminal, herein designated 42. Thereafter, when the subscriber at A dials the digit #1, relay 5 first releases and then operates again. The release of relay 5 closes a circuit for operating change-over relay 13 and at the same time that the relay 5 releases and operates, the line relay 8 of the calling line may release and may reoperate in like manner. Execution now takes place by reason of a circuit now closed from battery through the resistor, front contacts and armatures of relays 13 and 17, lowermost armature and front contact of relay 27, execution conductor 31, and through the armatures and back contacts of the counting relays 14, 20 and 24 to the #8 terminal, conductor 43, thence through the armature and back contact of relay 44, conductor 45, back contact, continuity spring and winding of the relay 6, back contact and armature of trunk switching relay 7, front contact and armature of the line relay 8 of the calling line to the other terminal of battery. The relay 6 operates and closes a locking circuit for itself from the positive terminal of battery, armature and front contact of relay 8, armature and back contact of relay 7, winding of the relay 6, its continuity spring and armature, conductor 46, winding of the relay 44, to the other terminal of battery. The operation of the relay 44 opens up the channel conductor, including the leads 43 and 45, for the purpose of making this trunk busy in the event that it is dialed by another station. The relay 6 switches the tip and ring line conductors, designated 10 and 9 to the conductors 48 and 49 of the trunk 81. Switching relay 6 on operating, disconnects the calling line from the common dialing and talking circuit which effects the release of the relay 5 and the slow-releasing relay 12 in sequence. The release of the relay 5 effects the release of the relay 27 and the release of the relay 12 effects the release of relay 13 and the ringing relay 17, thereby restoring the common dialing and talking circuit to its normal condition so that it can be used by another line. It will be understood that any other local call may now be established and another trunk call can be extended by dialing 71 in the event that that trunk is idle. In this way, trunks 71 and 81 may be used at the same time and also local interconnections may be established.

An incoming call over either of the trunks 71 or 81 signals by ringing the bell, such as 50 for trunk 81, located within hearing distance of one of the stations. In the answering of this call, some one of the six stations of the system dials the associated trunk number, for example, #81 which effects the circuit operation in the same manner as that described. If that line is the one designated #10, the line relay 8 of this line circuit remains operated for maintaining the switching relay 6 in an energized condition. It should be mentioned that the line relay 8 and the switching relay 6 are slow releasing so that the local station may signal a manual central station (not shown), or may dial into a dial central office (likewise not shown) without releasing the connection, if the mentioned openings of the line circuit are of not too great duration.

This system also provides for transferring a call. For example, if the incoming call just described is answered by the party on line circuit #10, when the party calling over the trunk, wishes to speak with a party on some one of the other line circuits of the system, this transfer can be effected by the party answering the call, without releasing the trunk connection. Since this is a trunk call, the line relay 8, the switching relay 6 and the trunk channel relay 44 will be operated in the event that the trunk #81 is in use. The circuit closing device such as push button 51 at the station is now operated to cause the differentially connected relay 52 to operate. The circuit for the relay 52 extends from battery at the exchange, trunk conductors 53 and 49, armature and continuity spring of the switching relay 6, back contact and continuity spring of the relay 7, winding of the line relay 8, line conductor 9, contacts of the push button 51, now closed, hook switch contacts now closed, conductor 54, armature and back contact of switching relay 7, armature and front contact of switching relay 6, conductor 55, lower winding of relay 52, tip conductor 56 of the trunk, to the other side of the battery at the central office. Relay 52 on operation, locks itself operated through its lower winding and its inner armature and front contact over the tip and ring conductors 56 and 53 of the trunk #81. The mentioned inner front contact and armature of relay 52 also short-circuits the relay 8 of the line #10 to effect the release of the line relay 8 which in turn releases the switching relay 6 and the channel relay 44. After the switching relay 6 releases, the closed circuit of station #10 operates the line relay 8 and the relay 5. The relay 5 operates the slow releasing relay 12 and the calling line #10 is now connected to the common dialing and talking circuit so that the wanted party can be selected and instructed to dial the trunk #81. Then after this trunk number is dialed by the wanted station, such as #60, and when this trunk is selected and when execution takes place, a circuit is completed from battery to the #8 terminal which extends through a back contact of relay 44, back contact, continuity spring and winding of relay 33, back contact of relay 34 and front contact of line relay 41 of the calling line to the other side of battery. Relay 44 is again operated in series with the locking circuit of relay 33.

It will be recalled that during the transfer of the call on the trunk #81 from station #10, the trunk relay 52 was locked energized from one side of battery at the exchange, not shown, tip conductor 56 of the trunk, lower winding of the trunk relay 52, its inner front contact and armature, ring conductor 53 of the trunk to the other side of battery. As a result of the subscriber on line #60 dialing the trunk #81, the execution circuit including the conductors 43 and 45 will be completed to energize the switching relay 6. As a result of the operation of this switching relay, the upper winding of relay 52 of the trunk, is energized in the opposite direction from the energization through the lower winding thereof in order to cause this relay to release. The energizing circuit through the upper winding of relay 52 may be traced from one side of battery (not shown) at the exchange, conductor 56, upper winding of the relay 52, lowermost armature and front contact of this relay, conductor 53, arma-

ture and front contact of relay 33, continuity spring and back contact of relay 34, conductor 38 through the contacts of the hook switch at station B, through the contacts of the impulse sender, through the substation circuit, back contact of the push button, conductor 40, winding of the line relay 41, back contact and continuity spring of relay 34, front contact and armature of relay 33, conductors 59 and 53 to the other side of battery at the exchange. The release of relay 52 removes the shunt from the trunk, which shunt included the lower winding of the relay 52. In the event that the subscriber at station B wishes to transfer this trunk call again, it can be transferred in the same manner as the original transfer was effected.

What I claim is:

1. In a telephone system, a plurality of telephone lines having their talking conductors permanently connected together in common, an impulse sending device provided on each telephone line, a series of sequentially operated relays common to said lines and operated in various combinations responsive to the number of impulses transmitted by a given sending device, a ringing circuit completed to a wanted telephone line, said ringing circuit being completed for a period determined by said last-mentioned sending device together with certain of said relays.

2. In a telephone system, a plurality of telephone lines having their tip and ring conductors permanently connected in common, each telephone line being provided with a substation including an impulse sender, a group of relays common to said telephone lines, means including the impulse sender of a calling line for selectively operating said relays in various combinations, each combination of relays being distinctive of a given one of said telephone lines, and a ringing circuit extended to the wanted substation by the selectively-operated relays, said ringing circuit being completed responsive to the operation of the impulse sender of the calling line as long as the operation thereof is continued.

3. In a telephone system, a plurality of telephone lines having their tip and ring conductors permanently connected in common, each telephone line having a line relay and being provided with a substation including an impulse sender, a trunk common to said lines, a trunk switching relay individual to each line for connecting its line to said trunk, a group of relays common to said telephone lines, means including the impulse sender of a calling line for selectively operating said relays in various combinations, each combination of relays being distinctive of a given one of said telephone lines, one of said combinations being distinctive of said trunk, a ringing circuit for each wanted line, said ringing circuit being controlled by the combination of relays distinctive of the wanted line, and an operating circuit for the trunk relay of the calling line, said operating circuit being completed by the line relay of the calling line and by that mentioned combination of relays distinctive of said trunk.

4. In a telephone system, a plurality of telephone lines having their tip and ring conductors permanently connected in common, each telephone line having a line relay and being provided with a substation including an impulse sender, a trunk common to said lines, a trunk switching relay individual to each line for disconnecting its line from the other lines and for connecting its line to said trunk, a group of relays common to said telephone lines, means including the impulse sender of a calling line for selectively operating said relays in various combinations, each combination of relays being distinctive of a given one of said telephone lines, one of said combinations being distinctive of said trunk, a ringing circuit for each wanted line, said ringing circuit being controlled by the combination of relays distinctive of the wanted line, and an operating circuit for the trunk relay of the calling line, said operating circuit being completed by the line relay of the calling line and by that mentioned combination of relays which is distinctive of said trunk.

5. In a telephone system, a plurality of telephone lines having their tip and ring conductors permanently connected in common, each telephone line having a line relay serially connected therein and being provided with a substation including an impulse sender, a trunk common to said lines, a trunk switching relay individual to each line for disconnecting its line from the other lines and for connecting its line to said trunk, a group of relays common to said telephone lines, means including the impulse sender of a calling line for selectively operating said relays in various combinations, each combination of relays being distinctive of a given one of said telephone lines, one of said combinations being distinctive of said trunk, a ringing circuit for each wanted line, said ringing circuit being controlled by the combination of relays distinctive of the wanted line, and an operating circuit for the trunk relay of the calling line said operating circuit being completed by the line relay of the calling line and by that mentioned combination of relays which is distinctive of said trunk.

6. In a telephone system, a plurality of telephone lines having their tip and ring conductors connected in common, each telephone line having a line relay and being provided with a substation including an impulse sender, a circuit closing device located at each substation, a trunk common to said lines, a differentially wound relay associated with said trunk, a trunk switching relay individual to each line for connecting its line to said trunk, a group of relays common to said telephone lines, means including the impulse sender of a calling line for selectively operating said relays in various combinations, each combination of relays being distinctive of a given one of said telephone lines, one of said combinations being distinctive of said trunk, an operating circuit for the trunk relay of the calling line, said operating circuit being completed by the line relay of the calling line and by that mentioned combination of relays which is distinctive of said trunk, means including a circuit closing device at the substation of a line connected to said trunk for locking one winding of the differentially wound relay across said trunk, and means including another telephone line connected to said trunk in the course of a call transfer thereto for energizing the other winding of said last-mentioned relay in differential relation to said first winding whereby this differential relay is released.

7. In a telephone system, a plurality of telephone line circuits having their tip and ring conductors normally connected to a common impulse responsive circuit, a substation including an impulse sender associated with each of said telephone line circuits, a group of relays associated with said impulse responsive circuit, means including the impulse sender of a calling line circuit for selectively operating said relays in various

combinations, each combination being distinctive of a particular called telephone line circuit, and a ringing circuit extended by the selectively operated relays and including at least one of the conductors of said called telephone line circuit.

8. In a telephone system, a plurality of telephone line circuits having their tip and ring conductors normally connected to a common impulse responsive circuit, a substation including an impulse sender associated with each of said telephone line circuits, a group of relays associated with said impulse responsive circuit, means including the impulse sender of a calling line circuit for selectively operating said relays in various combinations, each combination being distinctive of a particular called telephone line circuit, a ringing circuit extended by the selectively operated relays and including at least one of the conductors of said called telephone line circuit, and means responsive to the removal of the receiver at said called telephone line circuit for disabling said ringing circuit.

9. In a telephone system, a plurality of telephone line circuits having their tip and ring conductors normally connected to a common impulse responsive circuit, a substation including an impulse sender associated with each of said telephone line circuits, a group of relays associated with said impulse responsive circuit, means including the impulse sender of a calling line circuit for selectively operating said relays in various combinations, each combination being distinctive of a particular called telephone line circuit, a ringing circuit extended by the selectively operated relays and including at least one of the conductors of said called telephone line circuit, means responsive to the removal of the receiver at said called telephone line circuit for disabling said ringing circuit, and additional means for disconnecting said calling line circuit from said common impulse responsive circuit and

for connecting this line circuit to an individual trunk circuit.

10. In a telephone system, a plurality of telephone line circuits having their tip and ring conductors normally connected to a common impulse responsive circuit, a substation including an impulse sender associated with each of said telephone line circuits, a group of relays associated with said impulse responsive circuit, means including the impulse sender of a calling line circuit for selectively operating said relays in various combinations, each combination being distinctive of a particular called telephone line circuit, a ringing circuit extended by the selectively operated relays and including at least one of the conductors of said called telephone line circuit, means responsive to the removal of the receiver at said called telephone line circuit for disabling said ringing circuit, additional means for disconnecting said calling line circuit from said common impulse responsive circuit and for connecting this line circuit to an individual trunk circuit, and holding means for holding said individual trunk circuit when said calling line circuit is disconnected from said individual trunk circuit whereby a connection set up to said trunk circuit is maintained to permit the transfer of said connection to another line circuit of said plurality of line circuits.

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