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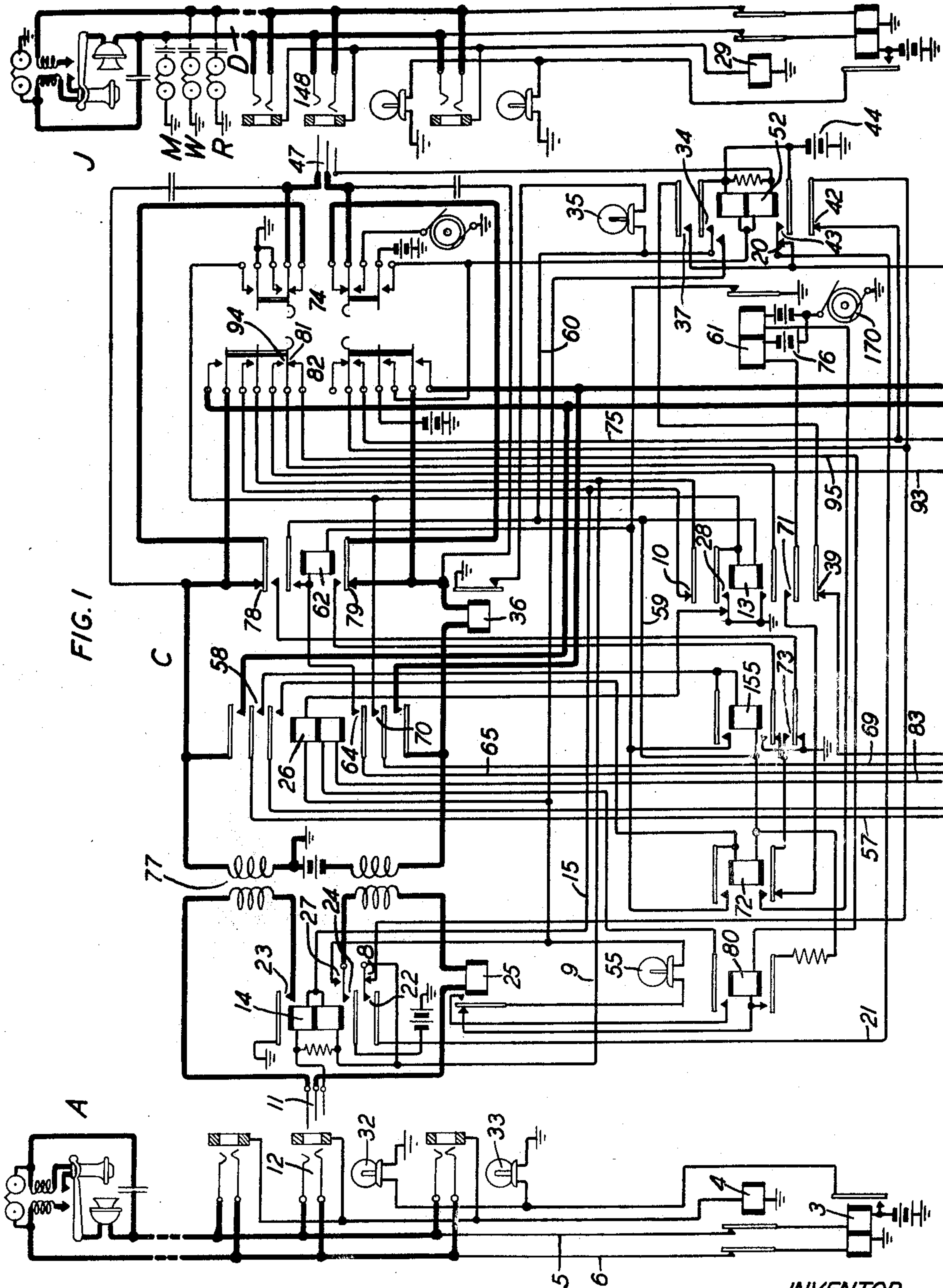
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1,944,961

TELEPHONE SYSTEM

Filed Aug. 19, 1932

2 Sheets-Sheet 1



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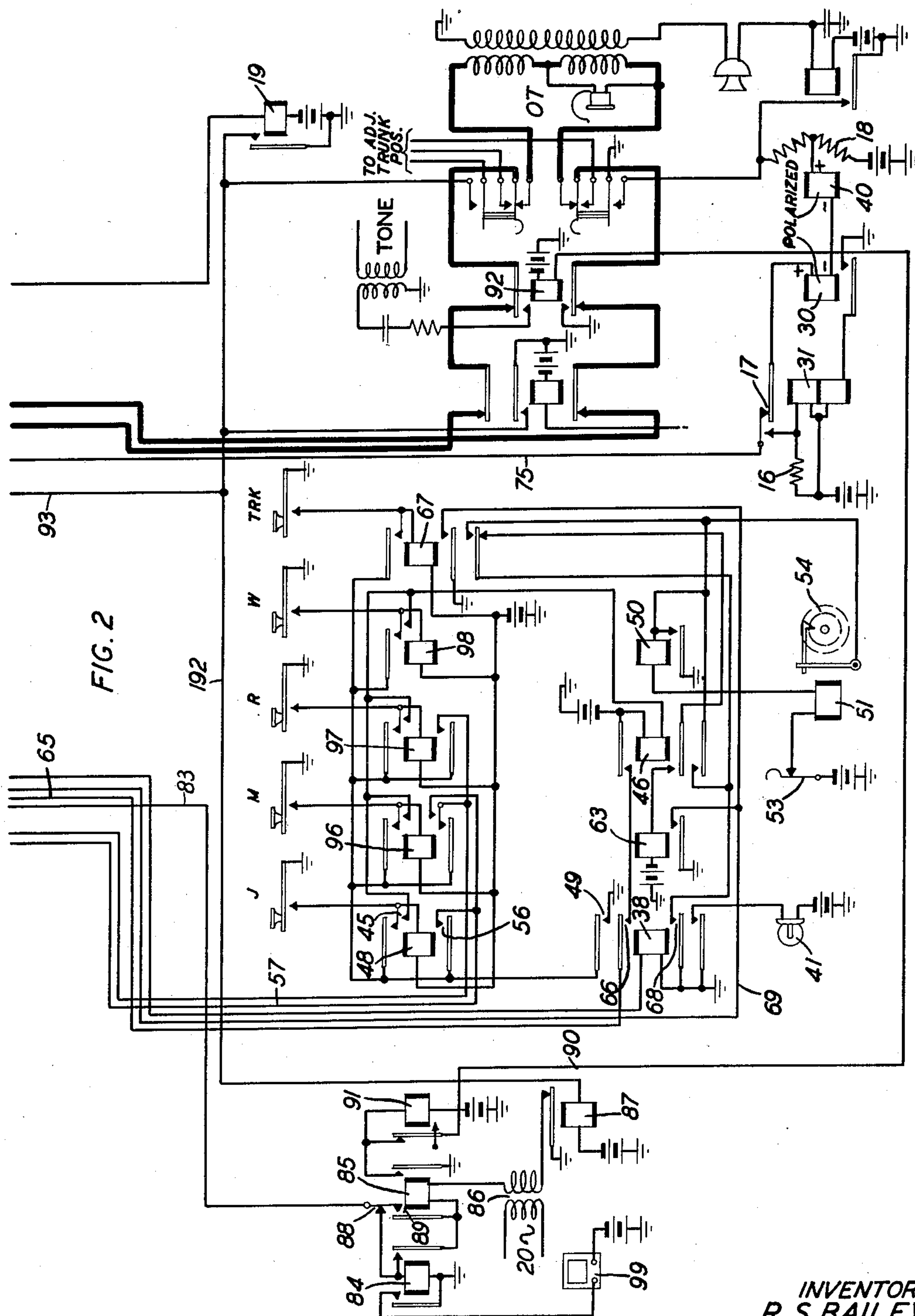
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1,944,961

TELEPHONE SYSTEM

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Application August 19, 1932. Serial No. 629,553

9 Claims. (Cl. 179—52)

This invention relates to telephone systems and more particularly to cord circuits for use in connecting calling and called subscribers' lines.

5 An object of the invention is to both visibly and audibly attract an operator's attention to the removal of a calling subscriber's receiver from the hook as a recall signal following the completion of a conversation.

10 A further object of the invention is to cause the answering supervisory lamp of a connected cord circuit to flicker as a recall signal and also to momentarily impress a tone signal on the operator's receiver, if the operator is free, when the calling subscriber recalls by removing his receiver from the hook following its replacement at the close of a preceding conversation.

15 Another object of the invention is to automatically connect the operator's telephone set to the cord when the calling subscriber recalls following the completion of a conversation when the operator is free to receive the recall and to disconnect it when the subscriber hangs up.

20 Still another object of the invention is to actuate an audible signal when the calling subscriber recalls if the operator is connected to another cord circuit at the time.

25 The foregoing objects are attained in accordance with one feature of the invention by the provision of means for connecting current through the supervisory lamp to one or the other of two paths to ground, depending on whether the supervisory relay is deenergized or energized, whereby the supervisory lamp is lighted in one manner when the supervisory relay is deenergized upon the calling subscriber's hanging up and lighted in a different manner when the supervisory relay is reenergized upon the calling subscriber again removing his receiver for a recall. More specifically, the supervisory lamp is steadily lighted when the calling subscriber first hangs up and is caused to flicker when he removes his receiver for a recall.

30 In accordance with another feature of the invention the circuit for the lamp, when the supervisory relay is reenergized, controls other means which momentarily connects a source of audible frequency current (tone impulse) to the operator's telephone to attract her attention to the recall.

35 Another feature resides in means controlled by the supervisory relay whereby the operator's telephone is automatically reconnected to the cord when the calling subscriber recalls and is disconnected when the subscriber subsequently abandons the recall.

Still another feature resides in means, controlled by the apparatus for connecting the operator's telephone to the cord circuit at her position, for preventing the supervisory lamp from lighting, for preventing the connection of the audible frequency source to the operator's telephone and for causing an audible signal device (buzzer) to be operated when the calling subscriber recalls while the operator's telephone is connected to another cord circuit.

Other features will appear from the following description and the accompanying drawings.

In the drawings:

Figure 1 shows a calling station A and a called station J with associated line circuits, and one of a plurality of connecting or cord circuits C which may be used to interconnect such stations. The station J is one of four stations of the selected line D, the other stations M, W and R being shown schematically;

Fig. 2 shows an operator's telephone set, common testing circuit, party line signaling equipment and the visual and audible signaling means hereinafter described. The circuit arrangement shown on Fig. 2 is common to an operator's position and serves a plurality of cord circuits, such as C, thereat.

Each of the stations A and J is shown terminating at a central office in a plurality of answering jacks and also in multiple jacks. Each answering jack has a signaling device associated therewith. The answering jacks and their associated line lamps terminate at different operators' positions. Multiple jacks, only one of which is shown in the drawings, may appear at each operator's position.

In the following detailed description, it will be first assumed that a subscriber at the station A is the calling subscriber and that a subscriber at a station W, who has telephone equipment similar to the one shown at station J is the called subscriber.

Upon initiating a call, the subscriber at station A removes the receiver from the switchhook and establishes an obvious circuit for line relay 3, which relay thereupon operates. Relay 3 in operating, completes a circuit extending from grounded battery, through the filaments of lamps 32 and 33, which lamps are located in front of different operators any one of which may answer the call. These lamps are illuminated to notify all operators that a call is awaiting attention.

It will be assumed that, at this time, the operator at the position at which lamp 32 is located

is free to handle the incoming call. This operator therefore inserts plug 11 associated with the cord circuit C into jack 12 located at her position and associated with the calling subscriber's line.

Upon insertion of plug 11 into jack 12 a circuit is completed to operate the polarized relay 30, Fig. 2, which can be traced from battery, resistance 18, winding of polarized relay 40, winding of relay 30, contacts of relay 31, conductor 75, contacts 42 of front sleeve relay 52, contacts 8 of back sleeve relay 14, over conductor 9, contacts 10 of relay 13, conductor 15 through the upper low resistance winding of relay 14 and over the sleeve contacts of plug 11 and jack 12 to ground through the cut-off relay 4 of the calling line. It will be noted that the lower winding of relay 14, which is of high resistance, is short-circuited by the normally closed contacts 10 of relay 13. The upper low resistance winding of relay 14 does not receive sufficient current due to the high resistance of the previously traced circuit to operate at this time, but polarized relay 30 does operate thereby closing an obvious circuit to operate relay 31 of the non-interfering test circuit associated with the operator's telephone set.

The above referred non-interfering testing circuit which includes a potentiometer arrangement, and which is not shown in its entirety in this application, is described in Patent 1,632,063 to C. B. Fowler, dated June 14, 1927. Relays 30, 31 and 40 in this application correspond to the same numbered relays in the Fowler patent. As this non-interfering test circuit, however, forms no part of the present invention it is not deemed necessary to either show or describe it in detail.

Relay 31 in operating opens the previously traced circuit through relays 30 and 40 and provides a substitute path to battery over conductor 75 through resistance 16 over the make-before-break contact 17 of relay 31. This substitute path to battery sufficiently lowers the resistance of the circuit for relay 14 permitting its operation. When relay 14 operates it locks up to battery in a circuit which can be traced from battery, winding of relay 19, contact 20 of the front sleeve relay 52, conductor 21, contacts 22 of relay 14, conductor 9 and thence over the previously traced circuit including contacts 10 of relay 13 to ground at the cut-off relay 4. Relay 4 operates in this circuit and releases the line relay 3 which extinguishes the line lamps 32 and 33. Relay 14 in operating closes its contacts 23 and 24 thereby supplying talking and supervisory current to the calling line through the answering supervisory relay 25 which operates due to closure of the subscriber's line at the switchhook contacts of calling station A.

In the foregoing description it was assumed that the plug 11 of cord circuit C was the first to engage an answering jack of the calling line, otherwise, as described in the previously mentioned Fowler patent 1,632,063, polarized relay 30 would not have operated due to the presence of potential on the sleeve of jack 12, supplied from the sleeve of another cord circuit, and therefore relay 14 would have remained inert.

When relay 14 operated, it also closed a circuit to operate relay 26 which can be traced from battery over contacts 24 and 27 of relay 14, upper winding of relay 26 and contacts 28 of relay 13 to ground. Relay 26 in operating connects the tip and ring conductors of the cord circuit to the conductor leading to the operator's telephone OT

thereby automatically "listening the operator in" on the answered line.

The operator's telephone set being now connected to the cord circuit, the operator may converse with the calling subscriber and ascertain the desired connection.

Upon noting that a party on the line B is desired, the operator makes the usual busy test and if the desired line is idle, she inserts plug 47 into jack 48.

The insertion of plug 47 into jack 48 causes sleeve relay 52 to operate in an obvious circuit which includes the winding of line cut-off relay 29. At its contacts 34 relay 52 causes the calling supervisory lamp to be illuminated over an obvious circuit to ground at the back contact of the calling supervisory relay 36. When relay 52 closes its contacts 37 it closes a circuit to operate relay 38 in the position circuit (Fig. 2) which circuit can be traced from battery, winding of relay 19, contacts 37 of relay 52, contacts 39 of relay 13 and winding of relay 38 to ground. Relay 38 operates and causes pilot lamp 41 to glow. At its contacts 42 relay 52 opens at another point the original energizing circuit for relay 14 and by closing contacts 43 and opening contacts 20 it substitutes battery 44 to hold relay 14 operated in place of battery supplied to relay 19. Relay 19, however, remains operated due to the circuit just traced.

Operator rings

If the calling subscriber asks for party J the operator momentarily actuates key J to cause that subscriber to be signaled automatically. The actuation of key J causes relay 48 to operate which thereupon locks up to ground at contacts 49 of relay 38 which is now operated as previously described.

The operation of relay 48 closes at its contacts 45 an obvious circuit to operate peg count relay 46 which operates the peg count relay 50 in case the key 53 is operated which, however, is the case only when a check of the number of calls handled by an operator is to be made. The operation of relays 50 and 51 causes the actuation of the registering device 1 whenever any one of the keys J, M, R, W or TRK is operated.

The operation of relay 48 also operates relay 155, the circuit for which can be traced from ground, contacts 49 of relay 38, contacts 56 of relay 48, conductor 57, contacts 58 of relay 26, winding of relay 155, conductors 59 and 60 and contacts 34 of relay 52 to battery. Relay 155 in operating, locks itself up, at its upper contacts, to ground at the normal contacts of the tripping relay 61.

The operation of relay 46, in addition to operating the peg count relay, also operates relays 62 and 63.

The circuit for operating relay 62 can be traced from ground at the back contacts of the tripping relay 61, through the winding of relay 62, contacts 64 of relay 26, conductor 65, contacts 66 of relay 38 and the upper contacts of relay 46 to battery.

The operating circuit of relay 63 is an obvious one and can be traced from ground at the contacts 68 of relay 38 through the lower contacts of relay 67 and the inner lower contacts of relay 46 to battery through the winding of relay 63.

The function of relay 62 is to connect the tip and ring conductors of the calling end of the cord circuit to the ringing circuit.

The operation of relay 63 operates the cut-off

relay 13 of the cord, the circuit for which can be traced from ground, lower contacts of relay 63, conductor 69, contacts 70 of relay 26, winding of relay 13, conductor 60, and contacts 34 of sleeve relay 52 to battery.

Cut-off relay 13 operates and releases the previously operated relays 19, 26 and 38. Relay 38 releases relay 48 and in turn relays 46 and 63 release. The release of relay 26 disconnects the operator's telephone OT from the cord circuit.

Relay 13 is now locked up to ground at its inner lower contacts under control of the front sleeve relay 52.

With relays 62, 155 and 13 operated, ground is connected to the ring of the calling end of the cord and the source of ringing current 70 is connected to the tip of the cord in series with the tripping battery and left-hand winding of tripping relay 61.

The ringing circuit can be traced from generator 170, battery 76 and left-hand winding of relay 61, contacts 71 of relay 13, lower contacts of relay 72, contacts 73 of relay 155, upper contacts of relay 62 to the tip of the cord, thence over the contacts of manual ringing key 74, tip of plug 47 and jack 48, line D, and ringer of substation J to ground. The ringer mechanism of station J is so constructed and connected to the tip conductor of the line D that it alone responds to the alternating ringing current supplied by generator 170 and modified by the polarity of the series battery 76. This method of selective ringing is well known in the art and need not be further described.

The ringing current applied to the tip of the line does not cause operation of the ringer of station M due to the fact that it is polarized in the opposite direction from the ringer of station J.

The ringers of stations W and R are unaffected as they are short-circuited by the ground connected to the ring conductor over the inner, lower contacts of relays 155 and 62.

The called subscriber's bell continues to ring at frequent intervals under control of the well known interrupter arrangement used in machine ringing systems, until the subscriber answers.

Called subscriber answers

When the subscriber answers, tripping relay 61 operates in the usual manner due to an increased flow of current through its left-hand winding occasioned by the operation of the subscriber's switchhook.

The operation of tripping relay 61 releases relays 155 and 62 which in turn open the ringing circuit previously traced from the generator 170 through relay 61 and over operated contacts of relays 55 and 62 to the line. Due to the cessation of ringing current through relay 61 this relay now releases.

When relay 62 released it closed its normal contacts 78 and 79 thereby completing a circuit to energize the cord supervisory relay 36 which can now be traced from battery, lower right-hand winding of the cord repeating coil 77, winding of supervisory relay 36, contacts 79 of relay 62, contacts of manual ringing key 74 to the ring conductors of the plug and jack, over the subscriber's line, through his telephone set, back over the other side of the line, and through the tip conductor of the jack and plug, contacts of key 74, contacts 78 of relay 62 and upper right-hand winding of repeating coil 77 to ground.

Relay 36 operates and removes ground at its back contact to extinguish the supervisory lamp 35 as an indication that the subscriber has answered. Communication may now be carried on between the calling and called subscribers.

Operation of key M with the consequent operation of relay 96 causes both relay 72 and 155 to operate thereby connecting the ringing current generator 170 through the right-hand battery and right-hand winding of relay 61 instead of the left-hand winding thereby supplying ringing current of an oppositely polarized character from the current flowing through the left-hand winding. This current flows over the tip of the subscriber's line as before but causes the oppositely polarized ringer M to be actuated instead of ringer J.

Operation of ringing key R and the consequent operation of relay 97 causes the operation of relay 72 only and does not operate relay 155. Under this condition the generator 170 is connected through the right-hand battery and right-hand winding of relay 61 as in the case of ringing party M but due to the unoperated condition of relay 155 this current now flows over the ring conductor of the line instead of the tip thereby causing operation of the correspondingly polarized subscriber's ringer R.

In case ringing key W is operated with the consequent operation of relay 98, neither relay 72 or 155 is operated and under this condition the ringing generator 170 is connected through the battery 76 and left-hand winding of tripping relay 61 to the ring conductor of the line which causes actuation of the correspondingly polarized ringer W.

It is now assumed that both subscribers have their receivers off the hook and conversation is being carried on and under this condition and in this stage of the connection relays 14, 25, 52, 36 and 13 are operated.

Conversation completed—subscribers hang up

When the conversation is completed both subscribers will hang up thereby releasing supervisory relay 25 and 36 with the consequent re-lighting of supervisory lamps 55 and 35, respectively, which is an indication to the operator that the connection can be taken down. The circuit for lighting lamp 55 can be traced from battery, contacts 24 and 27 of relay 14, lamp 55, back contacts of relay 25, winding of relay 80, contacts 81 of emergency listening key 82 to ground at the inner lower contact of relay 13. Relay 80 operates in series with the lamp 55 and locks up at its lower contacts to battery 44 over contacts 34 of relay 52.

Calling subscriber recalls

In case the original calling subscriber should desire to attract the operator's attention for any reason such as to call another subscriber, he will again remove his receiver from the hook in the usual manner and wait for the operator to answer.

When the calling subscriber's receiver is again removed, supervisory relay 25 will again operate thereby breaking at its back contact the previously traced energizing circuit for relay 80 but this relay is now locked up at its lower contact and therefore is not released.

If operator is idle

It will now be assumed that the operator is idle at the time the subscriber recalls and under this condition when relay 25 operates a circuit is completed from battery over contacts 24 and 27 of

relay 14, lamp 55, front contacts of relay 25, upper contacts of relay 80, lower winding of relay 26, conductor 33, contacts 88 of relay 85, and winding of the high resistance relay 84 to ground. Relay 84 due to its high resistance alone operates in this instance. However, it immediately closes its right-hand contact thereby providing a relatively low resistance shunt path to ground for the previously traced circuit through the winding of relay 85, right-hand winding of transformer 86 and the contacts of relay 87. Relay 85 operates, opens the operating circuit for relay 84 at contact 88 and locks up at its contact 89 in the circuit previously traced for relay 84. Relay 84 therefore releases.

The resistance of this previously traced path to ground is sufficiently low to permit the operation of relay 26 which connects the operator's telephone OT to the cord and maintains lamp 55 lighted, it being noted that the operation of relay 85 occurs so quickly that the lamp is not extinguished for any appreciable length of time during the operation of relay 84.

Lamp 55, however, instead of burning steadily in this circuit is caused to flicker due to the superimposed 20-cycle alternating current flowing in the right-hand winding of transformer 86, thereby indicating that a recall has been initiated on the subscriber's line to which the answering end of the cord associated with lamp 55 is connected.

When relay 85 operates it also connects ground at its right-hand contact to energize slow-to-operate relay 91. During the interval before relay 91 operated, ground from relay 85 is connected to conductor 90 at the back contacts of relay 91. This ground on conductor 90 causes tone relay 92 to operate, which connects an audible frequency source of current to the operator's telephone OT, but this relay is immediately released when relay 91 operates thereby disconnecting the tone source. This momentary application of alternating current to the operator's telephone serves as an audible signal to the operator that she has been reconnected to an established connection on which a recall has been initiated. The flickering lamp serves as a visual indication of the recall and identifies the particular cord circuit involved.

Upon receiving the audible tone signal and noting the cord circuit identified by the flickering lamp 55 the operator challenges and after receiving the details of the recall extinguishes the lamp 55 by operating the emergency listening key 82 which first opens the energizing circuit for relay 80 which releases.

Relay 80 in releasing opens the previously traced circuit for lamp 55, relay 26, and relay 85. The lamp 55 is therefore extinguished but the operator is not disconnected from the cord by the release of relay 26 due to the operation of the emergency listening key 82 which establishes a substitute connection to the cord at its extreme upper and lower contacts.

Key 82 when operated also completes the circuit to operate relay 87 which can be traced from battery, winding of relay 87, conductors 192 and 93, contacts 94 of key 82, conductor 95 to ground by way of the innermost lower contacts of relay 13.

Relay 87 operates and removes ground from the right-hand winding of transformer 86 to prevent other recalls which may be initiated at the position from operating relay 85 and causing the answering supervisory lamp of the other recall-

ing cord corresponding to lamp 55 from being lighted.

When the operator is finished she releases key 82 and thereby disconnects her set from the cord.

When operator is busy.

It will now be assumed that the operator is busy with another call and has her telephone set connected to another cord similar to the cord C, by virtue of the operation of a relay such as relay 26 in the other cord.

As hereinbefore described, the cut-off relay 13 operates immediately after the operator has actuated a ringing key such as key J and in operating causes release of relays 26 and 19. Since relay 19 controls the operation of relay 87, the latter relay remains operated as long as the operator's telephone is connected to a cord by the operation of a relay such as relay 26, thereby preventing the operation of such relays as 85, 90 and 92 to give the visual and audible recall signals hereinbefore described under this condition. However, should the party at station A initiate a recall under this condition the answering supervisory relay 25 reoperates in an obvious circuit, it being understood that relay 14 is still operated by virtue of the fact that plug 11 is still inserted in jack 12. A circuit may now be traced extending from ground, high resistance winding of relay 84, conductor 83, lower winding of relay 26, upper contacts of relay 80, front contacts of relay 25, filament of lamp 55, contacts 27 and 28 of relay 14 to battery and ground. The resistance of this circuit is such that relay 26 does not operate and lamp 55 does not receive sufficient current to be lighted. Relay 84, however, does operate and establishes an obvious circuit for buzzer 99 which is sounded as a signal to the busy operator that a recall has been initiated and is awaiting her attention at her position.

When the operator becomes free, that is, when the cut-off relay similar to relay 13 of the cord to which she was connected, operates to release relay 19 and the relay corresponding to relay 26, relay 87 releases as a direct result of the release of relay 19. Relay 87 released, connects ground to the right-hand winding of transformer 86 and winding of relay 85 in series, thereby causing relay 85 to operate by way of the right-hand contacts of relay 84, make-before-break contacts 88 of relay 85 and thence by way of the circuit just traced for the operation of relay 84. Relay 85 in operating causes relay 84 to release silencing the buzzer. Lamp 55 flickers and relay 26 operates in the same manner described in connection with a recall when the operator was idle. Tone relay 92 also operates in the same manner and for the same purpose as hereinbefore described. These visual and audible signals identify the cord upon which the recall is waiting attention.

From the foregoing, it is evident that applicant has devised a novel system for producing recall signals, in which the answering supervisory lamp flickers and a tone signal is impressed upon the operator's receiver when she is idle, and when she is busy the flickering lamp and tone signal are replaced by the sounding of a position buzzer which remains operated until the operator becomes free when it is silenced and the flickering lamp and tone signal again function as on a "non-busy" recall.

What is claimed is:

1. In a telephone system, a calling and a called

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subscriber's line, an operator's cord circuit interconnecting said lines for conversation, an operator's telephone disconnected from said cord circuit during the conversation, means for connecting said telephone to said cord circuit, a source of audible frequency current, means responsive to the calling subscriber hanging up at the close of the conversation and a subsequent recall before said cord circuit is disconnected from the calling line to actuate said connecting means and to momentarily connect said audible frequency source to said operator's telephone.

2. In a telephone system, a calling and a called subscriber's line, an operator's cord circuit interconnecting said line for conversation, a supervisory lamp associated with the cord circuit, a circuit for said supervisory lamp including a source of direct current, said circuit being open during the conversation, a source of low frequency alternating current of the order to twenty cycles, means responsive to the calling subscriber hanging up at the close of the conversation and a subsequent recall to close said lamp circuit and to superimpose said low frequency source thereon whereby said lamp is caused to flicker.

3. In a telephone system, a calling and a called subscriber's line, an operator's cord circuit interconnecting said lines for conversation, a supervisory lamp associated with the cord circuit, a circuit for said supervisory lamp including a source of direct current, said circuit being open during the conversation, a source of low frequency alternating current of the order of twenty cycles, an operator's telephone set normally disconnected from said cord circuit during the conversation, means for connecting said telephone set to said cord circuit, a source of audible frequency current, means responsive to the calling subscriber hanging up at the close of the conversation and a subsequent recall before said cord circuit is disconnected from the calling line, to close said lamp circuit, superimpose said low frequency source on said lamp circuit, actuate said connecting means to connect said operator's telephone to the cord circuit, and to momentarily connect said audible frequency source to said telephone set.

4. In a telephone system, a calling and a called subscriber's line, an operator's cord circuit interconnecting said lines for conversation, an operator's telephone, a source of audible frequency current, means responsive to the calling subscriber hanging up at the close of the conversation and a subsequent recall before said cord circuit is disconnected from the calling line to momentarily connect said audible frequency source to said operator's telephone.

5. In a telephone system, a calling and a called subscriber's line, an operator's cord circuit for interconnecting said lines for conversation, an operator's telephone adapted to be automatically connected to said cord circuit when said cord circuit is associated with said calling line, a source of audible frequency current, means responsive to the calling subscriber hanging up at the close of the conversation and a subsequent recall before said cord circuit is disconnected from the calling line to momentarily connect said audible frequency source to said operator's telephone.

6. In a telephone system, calling and called subscribers' lines, an operator's cord circuit interconnecting two of said lines for conversation, a second cord circuit connected to another of said calling lines, an operator's telephone connected to said second cord circuit, means to disconnect said telephone from said second cord circuit, an audible signal device, means responsive to the hanging-up of the subscriber on the calling line connected to said first cord circuit to prepare a circuit to actuate said audible device, and means responsive to a recall from said calling line to complete said prepared circuit to actuate the audible signal, thereby appraising the operator that a recall is waiting on another cord from the one she is connected to and automatic means responsive to the disconnection of said operator's telephone from said second cord circuit to connect it to said first cord circuit and to retire said audible signal.

7. In a telephone system, calling and called subscribers' lines, an operator's cord circuit interconnecting two of said lines for conversation, a second cord circuit connected to another of said lines, an operator's telephone connected to said second cord circuit, means to disconnect said telephone from said second cord circuit, a supervisory lamp signal associated with said first cord circuit, an audible signal device, means responsive to the hanging-up of the subscriber on the calling line connected to said first cord circuit to prepare a circuit to actuate said audible device, and to display said supervisory signal, and means responsive to a recall from said calling line to retire said supervisory signal, and to complete said prepared circuit to actuate said audible signal thereby appraising the operator that a recall is waiting on another cord from the one she is connected to and automatic means responsive to the disconnection of said operator's telephone from said second cord circuit to connect it to said first cord circuit, retire said audible signal and cause said supervisory lamp to flicker.

8. In a telephone system, calling and called subscriber's lines, a cord circuit interconnecting said lines for conversation, an operator's telephone set adapted to be connected to said cord circuit, a supervisory relay associated with said cord circuit and means responsive to the energization of said supervisory relay following its deenergization when the calling subscriber hangs up at the close of the conversation for automatically connecting said operator's telephone to the cord circuit.

9. In a telephone system, calling and called subscriber's lines, a cord circuit interconnecting said lines for conversation, an operator's telephone set adapted to be connected to said cord circuit, a supervisory relay associated with said cord circuit and means responsive to the energization of said supervisory relay following its deenergization when the calling subscriber hangs up at the close of the conversation for automatically connecting said telephone to the cord circuit and responsive to a subsequent deenergization of said relay to disconnect said telephone.

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