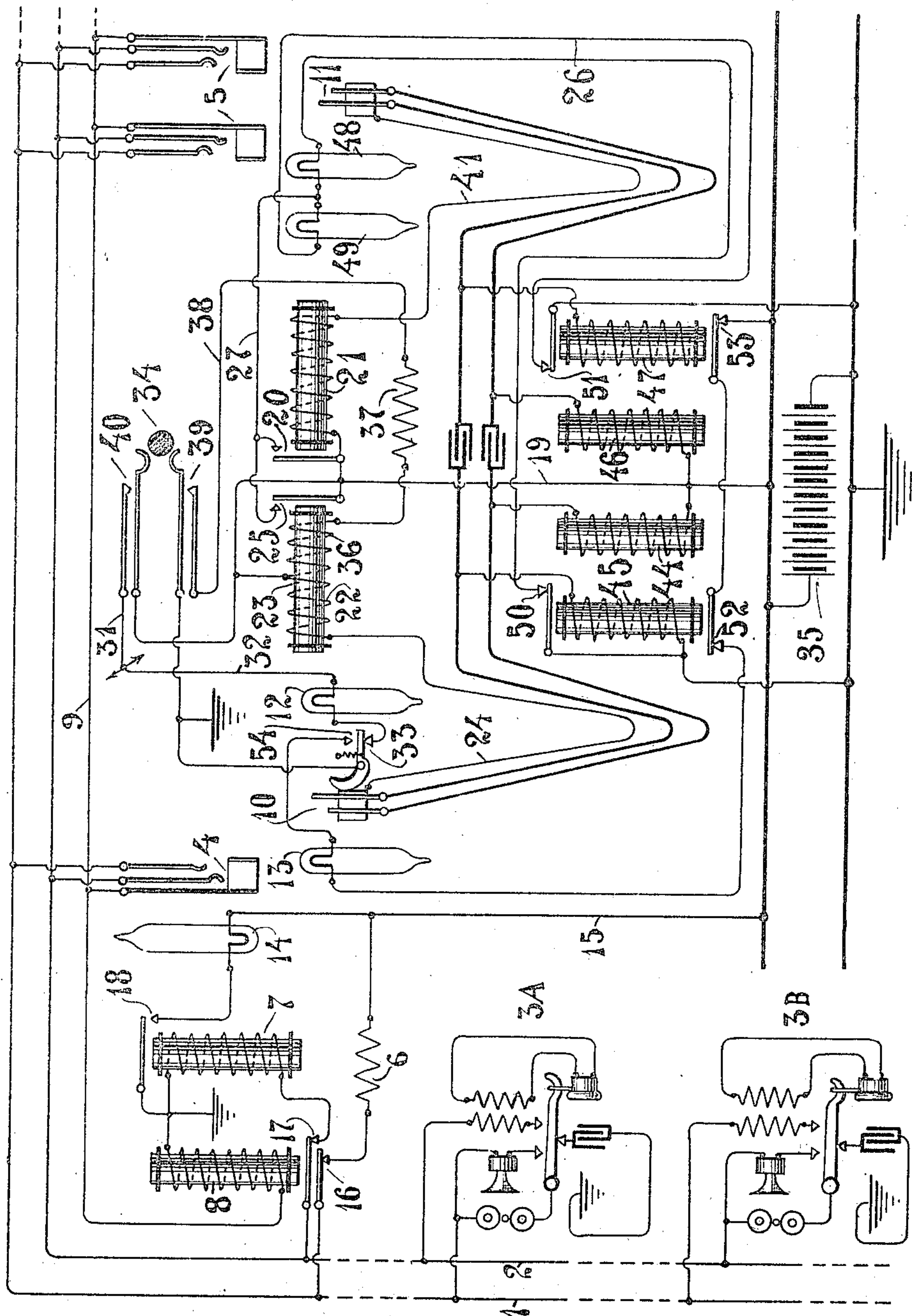


990,468.

Patented Apr. 25, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
B. W. Gouldock.
A. W. Southard.

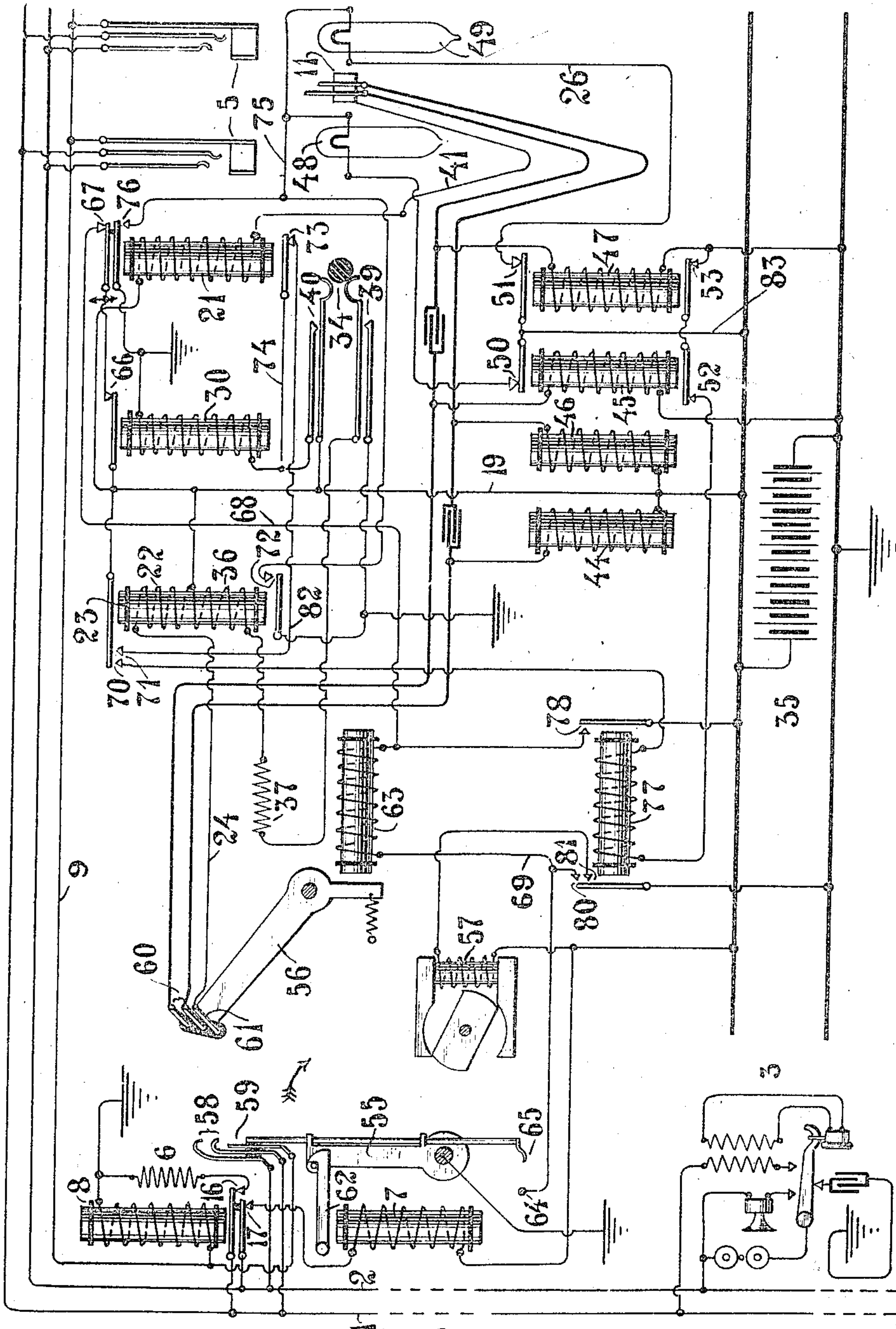
Francis G. Agrell Inventor
By his Attorney Lewis J. Doolittle

990,468.

Patented Apr. 25, 1911.

2 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
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UNITED STATES PATENT OFFICE.

FRANS GUNNAR AGRELL, OF STOCKHOLM, SWEDEN.

TELEPHONE SYSTEM.

990,468.

Specification of Letters Patent.

Patented Apr. 25, 1911.

Application filed February 15, 1908. Serial No. 416,072.

To all whom it may concern:

Be it known that I, FRANS GUNNAR AGRELL, a subject of the King of Sweden, and resident of Stockholm, Sweden, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems and more particularly to that class usually designated as call distributing systems, where a calling subscriber is by means of a distributing operator, or other means, connected to a switching circuit controlled by an operator that is not busy at the time, in order to equalize the work among and eventually decrease the number of operators.

One of the chief objections to such a system as heretofore devised has been the difficulty to adapt the same for party line service.

In a call distributing system the operator does not know the number of the calling subscriber and, consequently, if a subscriber should call up a party on his own line (reverted call) the operator would find the corresponding multiple jack indicated busy and consequently be unable to handle such a call. The only way in which a reverted call can be handled with the present call distributing systems is that the operator upon finding the wanted subscriber's jack busy asks the calling subscriber for his number to ascertain that the wanted subscriber is not on the same line as the calling. This method will, of course, lead to delays in handling the business so that the advantages of using the distribution system would be more or less off-set.

One of the objects of my invention is now to remedy the defect mentioned by the employment of means adapted to automatically indicate to an operator that she is handling a reverted call as soon as she tests the jack of the calling subscriber.

In carrying out my invention in a complete telephone system other new objects and results have been accomplished. One of said new features is that the calling cord has been provided with only two indicators alternately serving as call, reversed call and supervisory signals. In systems heretofore devised a separate indicator has been employed for each signal.

Other objects of my invention will be in part obvious and will in part appear hereinafter in connection with the drawings accompanying this specification in which I

have illustrated one form or embodiment of my invention in a common battery exchange system with a combination of circuits and devices, many of which may be altered to meet the various requirements of telephone service and to adapt the same for use with other systems.

Figure 1 is a diagram showing the connections of an embodiment of my invention in a manually operated common battery system. Fig. 2 shows diagrammatically the connections of an embodiment where the distribution is performed by automatically operated means, that is without the help of a distributing operator.

In Fig. 1, at 1—2 is shown a party line having party stations 3 at the one end and carrying the local jack 4, and multiple jacks 5 at the other end. The line is normally supplied with current from the common battery 35 over the resistance 6 on the one side and the line relay 7 on the other side. The line relay and the resistance can be cut away from the line by means of the cut off relay 8, the winding of which is connected on the one side to the third conductor 9 in the multiple, on the other side to ground. This third conductor 9 is connected to the sleeves of the local jack 4 and the multiple jacks 5. In the diagram one cord circuit drawn in heavy lines connecting the answering plug 10 and the calling plug 11 is shown. The answering plug 10 is positioned in a separate distribution board having a number of answering cords 12 leading to different operators and a number of local jacks 4. The calling plugs 11 are situated at multiple boards having no local jacks. At each answering cord is a signal, in the drawing shown as a lamp 12, for indicating whether the operator controlling the calling end of said cord circuit is busy or not and a disconnection signal 13, also indicated as a lamp, is provided for signaling the distribution operator that the connection shall be taken down. The local jacks 4 are associated with signals shown as calling lamps 14. When a subscriber upon the line 1—2 calls up, for instance, at the station 3^A, current will go from the battery 35 over lead 15, resistance 6, contact 16 of the cut off relay 8 to the one side 1 of the line and back through the subscriber's instrument, the other side 2 of the line, the contact 17 of the cut-off relay and the line relay 7 to ground. The line relay will thus operate closing its contact 18 so

that current now goes through the line lamp 14 indicating the call. The distributing operator now lifts up a plug 10, leading to an operator that is not busy at the time, as indicated by the busy lamp 12, and places the same in a jack 4 thus connecting the subscriber's line to the cord circuit. On plugging into the calling line the relay 45 is energized by current over the circuit 19, 44 ring side of cord through the local station back through the tip side relay 45 to positive pole of battery. The contacts 52 and 50 are broken. The distributing operator's part in the connection is now performed and current goes from the battery over lead 19, winding 22 of a relay 23, sleeve conductor 24 of the answering cord to the sleeve of jack 4, third conductor 9 of the multiple and the cut off relay 8 to ground and back to battery, indicating all the multiple jacks 5 of said line busy and operating the cut off relay 8 and the relay 23. The cut off relay opens the contacts 16 and 17 breaking away the resistance 6 and the line relay 7 from the line so that the line relay ceases to operate and, consequently, the line lamp 14 goes out. The relay 23 when operating closes the contact 25 so that current goes from battery over lead 19, contact 25, lead 27 and the lamp 49, lead 26 and contact 51 of relay 47 to ground and back to battery, lighting the lamp 49 and thus indicating to the operator controlling the plug 11 that a call is upon the cord circuit. Now the operator controlling plug 11, notified by said signal connects her talking set to the cord circuit by throwing the key 34. The talking set and the parts of the key belonging to the same have not been shown in the diagram as they are unnecessary for understanding the operation of the invention. When key 34 was thrown contacts 39 and 40 closed, contact 40 connecting the battery lead 19 to a common lead 31 which branches to all the lamps 12 belonging to cords controlled by this particular operator. The other side of the lamps 12 are by means of the plug contact 33 connected to ground so that the lamps 12 at such cord circuits as have not had the plug lifted from the seat will light indicating that the operator is busy and that the cord should not be used.

When contact 39 closed, current went from battery over lead 19, winding 36 of relay 23, resistance 37, lead 38 and contact 39 of the key 34 to ground and back to battery. This winding 36 is opposing the winding 22 of same relay and the resistance 37 is so selected that the current in winding 36 neutralizes the effect of winding 22 so that relay 23 ceases to operate, breaking contact 25 and thus causing the lamp to go out. The operator now asks for the number wanted and tests the corresponding jack in the multiple. Supposing now that the subscriber

wanted to talk to a party upon his own line, the operator would then find jack 5 busy as the same is connected to battery over the winding 22 of the relay 23, but at the same time the testing current would increase the current in 22 so that said winding is no longer balanced by the winding 36. The relay 23 will thus operate, again lighting lamp 49 indicating to the operator that she is handling a reverted call. The testing means have not been shown as they are unimportant for understanding the operation of my invention. It is only necessary to assume that the sleeve of the jack 5 is touched by a grounded conductor, for instance, the tip of the plug 11. Current will flow through the relay 47 to ground, completing a circuit from the conductor 9 in parallel with that through the relay 8, causing an increased flow of current in the winding 22 of the relay 23, but will not operate the armatures of the relay 47.

When the operator after having ascertained that the jack 5 is not actually busy places the plug 11 into the said jack current will go from battery over lead 19, relay 21, sleeve conductor 41 to the third conductor 9 of the multiple and through the cut off relay to ground, regardless of whether said jack 5 belongs to the same line as the calling subscriber or not. Now the relay 21 operates, closing its contact 20, which is in shunt with contact 25 of relay 23 so that said relay has no effect upon the signals as long as the connection is made. The relay 47 will be energized over the calling line, breaking contact at 51 and preventing the lighting of lamp 49. When the operator after having finished the connection throws back the key 34 all the lamps 12 connected to said key will go out so that the operator is indicated free to take a new call.

The cord circuit has been provided with well known means for supplying current to the subscribers' instruments during conversation, namely, the retardation coils 44 and 45 connected to the answering end of the cord circuit and the retardation coils 46 and 47 connected to the calling end of the cord circuit and the two sides of said cord circuit are connected by means of condensers. The two retardation coils 45 and 47 have been arranged as relays and serve as such for facilitating the supervision of the call and the disconnection. For supervising the call two lamps 48 and 49, of which 49 as before described also serves as calling and reversed call signal, are arranged at the calling plug both connected to battery over contacts 20 of relay 21 and 25 of relay 23 and connected to ground, over the contacts 50 of relay 45 and contact 51 of relay 47, respectively, so that if any subscriber should hang his receiver up, the corresponding lamp will light. The disconnection lamp 13 at the answering

end of the cord circuit is connected to battery over the contacts 52 upon relay 45 and 53 upon relay 47 in series and is connected to ground through the plug contact 54 when the plug 10 is up so that said lamp will light as soon as both subscribers have hung up their receivers.

It is not thought necessary to further trace the different circuits as the same will be evident from an inspection of the diagram.

The embodiment of my invention as shown in Fig. 2 is distinguished from the one just described only by the automatically operated means employed for connecting the calling line to the answering end of the cord circuit and for severing said connection after the conversation is finished:

By means of a device which I have designated as connector and which in Fig. 2 has been indicated diagrammatically by the movable arms 55 and 56 with associated means and the motor 57, a subscriber calling will be automatically connected to a switching circuit controlled by an operator that is not busy at the time of the call. Switching devices adapted to be used in this system have been fully described in my co-pending applications Ser. Nos. 339,521 and 386,901. Any other devices which fulfil the requirements of the system could, of course, be used instead of the aforementioned devices, as the mechanical arrangement of the connector is to a certain degree non-essential to the operation of the system and it is not thought necessary to describe the connector here further than to state that the pivoted arm 55 carries terminals 58 and 59 adapted to engage terminals 60 and 61 carried by another pivoted arm 56, there being as many arms 55 as there are subscribers to be accommodated by the device and as many arms 56 as there are cord circuits assigned to said group of subscribers. The different arms are so positioned that the terminals of any one of the arms 55 may engage the terminals of any one of the arms 56 under certain conditions. An electro-magnet 7, corresponding to the line relay of Fig. 1, operates the latch 62 to release the arm 55 which then will fall in the direction of the arrows. The terminals 60—61 are so positioned that the same are out of reach for the terminals 58—59 during this falling movement but the arms 56 can be moved in toward the center by means of electro-magnets 63 so that the terminals may be engaged by a falling member 55. The motor 57 operates in a manner fully described in the aforesaid applications to restore the arm 56 to its original position when disconnection shall take place.

As in the diagram, Fig. 1, a party line 1—2 having party stations 3 extends in the exchange to multiple jacks 5 and is also connected to the terminals 58 corresponding to

the tip and ring contacts of the local or calling jack of Fig. 1. The line is normally connected to battery over the resistance 6 and contact 16 of a cut off relay 8 on the one side and over line relay or electro-magnet 7 and contact 17 upon the cut off relay on the other side. The cut off relay 8 is connected to ground on the one side and to the third conductor 9 of the multiple on the other side, which conductor is connected to the sleeves of the multiple jacks and to the contact 59 of the arm 55, which contact corresponds to the sleeve of the local jack 4 in Fig. 1.

The switching circuit which corresponds to the cord circuit of Fig. 1 is arranged similarly to said circuit. The contacts 60—61 of the arms 56 correspond to the local plug 10 of said circuit and the only difference lies in the means for automatically operating said terminals.

As before mentioned the terminals are normally out of reach of the terminals 58—59 when falling, but can be brought into an engaging position by means of the electromagnet 63 operating the arm 56. To this end the electromagnet 63 is on the one side connected to a contact 64 so situated that a contact maker or brush 65 upon the arm 55 sweeps over the same when the terminals of said arm approach the terminals of arm 56. If said arm, like the one of the drawing, is not busy at the time current will flow from battery 35 over the lead 19, the contact 66 of the "operator busy" relay 30, the contact 67 of the relay 21 and the lead 68 to the magnet 63 and from there over lead 69, contacts 64 and 65 to ground and back to battery so that the magnet 63 will operate moving the arm 56 to its inner position where the terminals 58 and 59 make contacts with the terminals 60 and 61. Now current flows, from battery over the lead 19, the winding 22 of the relay 23, the lead 24, terminals 61 and 59 to the third conductor cut off relay 8 to ground cutting off the battery over resistance 6 and relay 7 from the subscribers line. Relay 23 also operates, closing contacts 70, 71 and 72. Current now goes from the battery over lead 19, contact 71, lead 82, contact 73 of relay 21 and the lead 74 to the "operator busy" relay 30 and from there to ground. This relay 30 now operates breaking contact 66 thus cutting away the current from all leads 68 of the switching circuits controlled by this operator, so that the arm 56 goes back to its position of rest with its terminals still connected to the terminals of arm 55 and all the arms 56 belonging to said operator are made inaccessible for any subsequently calling subscriber. When contact 72 closed, current also went from battery over lead 83, contact 51 of the called subscriber's supervisory relay 47, lead 26, lamp 49, lead 75, and the contact 72 to ground and

back to battery. Thus the lamp 49 lights indicating to the operator that a call is upon the cord circuit having the plug 11. The operator now throws the corresponding listening key 34 which in addition to its connecting her talking set to the cord circuit closes the contacts 39 and 40. Current now goes from the battery over lead 19 and contact 40 to the "operator busy" relay so that the busy relay will still be operated when relay 22 ceases to operate, which happens as soon as current, upon throwing the key 34, flows through the compensating winding 36, the resistance 37, lead 38 and the contact 39 to ground. Now the lamp 49 goes out.

If in the case of a reverted call the operator should test the sleeve of a multiple jack 5, for instance, with the tip of the plug 11, additional current will flow over the winding 22 of the relay 23 so that the lamp 49 will light again, indicating the reverted call. When the operator after testing places the plug 11 into the jack 5, current will flow from the battery over lead 19, relay 21, lead 41, the sleeve of the plug 11 and jack 5 to the third conductor 9 of the wanted subscriber's line indicating the same busy and operating its line relay 8 if the same should not, as in the case of the reverted call, be already operated. The relay 21 now operating breaks the contacts 67 and 73 and closes the contact 76 which connects the lead 75 to ground, so that the lamps 48 and 49 now serve as supervisory signals governed solely by the operation of the relays 45 and 47.

When the operator throws back the talking key 34, the compensating winding 30 will be disconnected from ground and thus the relay 23 will again operate putting an additional ground on lead 75, but not operating the busy relay, as the contact 73 as before mentioned is broken. The "operator busy" relay 30 thus goes back to its position of rest closing the contact 66 so that the operator can receive another call upon another cord circuit. The busy arm 56 is, however, still unresponsive to any falling arm 58 as the battery is cut off at contact 67 and will remain so as long as the conversation goes on.

In order to facilitate the automatical disconnection of terminals 58—59 and 60—61 a special disconnecting relay 77 has been put in connected on one side over contact 70 of relay 23 to the battery and on the other side over contacts 52—53 of the supervisory relays 45 and 47 to ground so that when both subscribers hang up their receivers said relay 77 will operate. This relay then closes the contacts 78, 80 and 81, of which contact 78 connects the electro-magnet 63 to battery and contact 80 connects the other side of said magnet to ground so that it brings the arm 56 into its inner-position—where the

terminals 58 and 59 are disconnected from the terminals 60—61 by the action of the restoring motor 57, the action of which is started when contact 81 closes.

Details regarding this restoring operation are fully explained in the above mentioned co-pending applications. As soon as the contact between 59 and 61 is broken the current in relay 23 ceases to flow and thus the contact 71 is broken so that the disconnecting relay ceases to operate and accordingly current is cut off from the electro-magnet 63 so that the arm 56 goes back to its position of rest. The supervisory lamps 48—49 still continue to light on account of the relay 21 still being operated, but when the operator severs the connection between plug 11 and jack 5 this relay also goes back to rest so that everything is restored to the initial conditions.

From the foregoing description of embodiments of my invention it will be seen that in a distribution system manually or automatically operated in accordance with the ideas herein set forth the operator at the multiple board is automatically notified in case of a reverted call so that she may tell the calling subscriber to hang up his receiver and thus be able to properly signal the wanted subscriber.

As many changes could be made in the above construction and many apparently widely different embodiments of my invention designed without departing from the scope thereof, I intend that all matter contained in the above description or shown in the accompanying drawings shall be interpreted merely as an illustrative embodiment of my invention and not in a limiting sense.

What I claim is:

1. In a telephone system, the combination with a multi-party line, of a switching circuit extending between two differently located switching devices and adapted to be connected to said line at one of the switching devices when said line is calling and at the other switching device when to be called, and means including a supervising indicator which is also arranged and adapted to indicate a reverted call at said last named switching device.

2. In a telephone system, the combination with a multi-party line, of a switching circuit extending between two differently located switching devices and adapted to be connected to said line at one of the switching devices when said line is calling and at the other switching device when to be called, and means including a supervising indicator which is also arranged and adapted to automatically indicate a reverted call at said last named switching device.

3. In a telephone system, the combination with a multi-party line, of a switching circuit extending between two differently lo-

cated switch boards and adapted to be connected to said line at one of said switch boards when said line is calling and at the other switch board when to be called, and means including a supervising indicator which is also arranged and adapted to indicate a reverted call at said last named switch board.

4. In a telephone system, the combination with a multi-party line, of a switching circuit extending between two differently located switch boards and adapted to be connected to said line at one of said switch boards when said line is calling and at the other switch board when to be called, and means including a supervising indicator which is also arranged and adapted to automatically indicate a reverted call at said last named switch board.

5. In a telephone system, the combination with a line, of a switching circuit, automatically operated means adapted to connect said line with one end of said switching circuit, means for connecting the other end of said switching circuit with another circuit, and means including a supervising indicator which is also arranged and adapted to indicate at said last named end of the switching circuit whether said circuit is connected to said line.

6. In a telephone system, the combination with a line, of a switching circuit, automatically operated means adapted to connect said line with one end of said switching circuit, means for connecting the other end of said switching circuit with another circuit, and means including a supervising indicator which is also arranged and adapted to indicate at said last named end of the switching circuit whether said circuit is connected to said line when an attempt to connect said last named end with said line is made.

7. In a telephone system, the combination with a multi-party line, of a switching circuit, automatically operated means for connecting one end of said switching circuit with said line, manually operated means for connecting the other end of said switching circuit with another circuit, and means including a supervising indicator which is also arranged and adapted to indicate a reverted call.

8. In a telephone system, the combination with a line, of means adapted to indicate said line busy by current flowing over said

means from another circuit, means for shunting said busy indicating means, a switching circuit adapted to connect with said line, means associated with said switching circuit and adapted to allow current to flow over said first named means and its shunt, a relay adapted to be energized by said current, a compensating winding upon said relay adapted to prevent the shunt current from energizing said relay, and a signal operated by said relay.

9. In a telephone system, the combination with a line, of means adapted to indicate said line busy by current flowing over said means from another circuit, a relay shunting said busy indicating means, a switching circuit adapted to connect with said line, means associated with said switching circuit and adapted to allow current to flow over said first named means and its shunt, a relay adapted to be energized by said current, a compensating winding upon said relay adapted to prevent the shunt current from energizing said relay, and a signal operated by said relay.

10. In a telephone system, the combination with switching circuits extending between two differently located switching devices and adapted to be connected with a calling line at the one switching device and with a line to be called at the other device of means including an indicator adapted to indicate that a calling line is connected or is going to be connected to said switching circuit, and means including the same indicator as that of the foregoing means for supervision of the call.

11. In a telephone system, the combination with a switching circuit extending between two differently located switching devices and adapted to be connected with a multi-party line at the one device when said line is calling and at the other device when to be called, of means including an indicator for supervising the call, and means including the same indicator adapted to indicate a reverted call.

Signed at the city of New York in the county of New York and State of New York this 28th day of Oct. A. D. 1907.

FRANS GUNNAR AGRELL.

Witnesses:

LEWIS J. DOOLITTLE,
B. W. COULDOCK.