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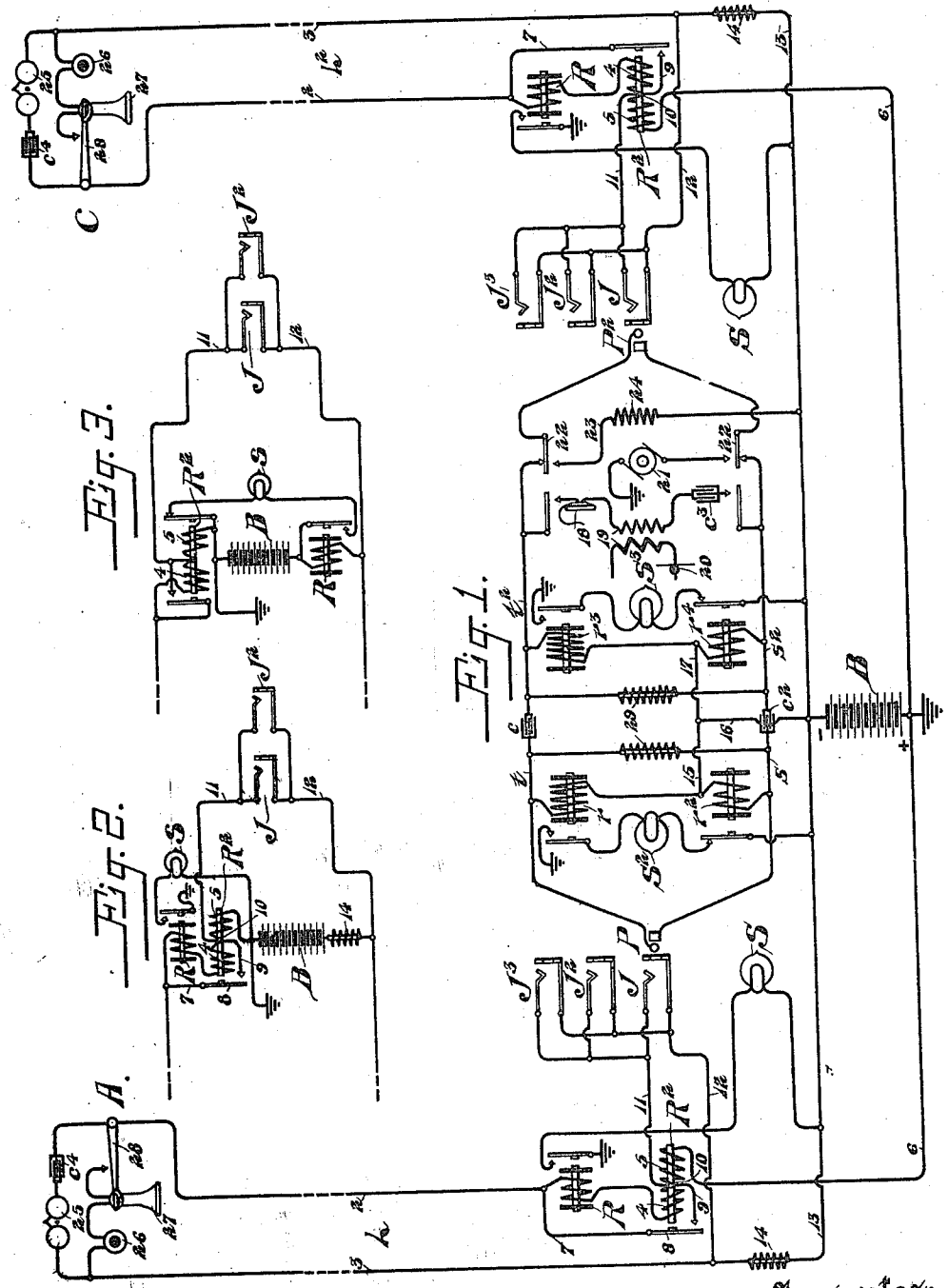
TELEPHONE SYSTEM.

APPLICATION FILED MAR. 7, 1903.

949,012.

Patented Feb. 15, 1910.



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TELEPHONE SYSTEM.

949,012. Specification of Letters Patent. Patented Feb. 15, 1910.

Application filed March 7, 1903. Serial No. 146,622.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States of America, and residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems, my object being to provide means in the line circuit and in the cord circuit whereby certain new and useful results are accomplished.

It has been sought heretofore to provide telephone circuits with differential cut-off relays in the line and in the path of calling current so that when the subscriber calls the central office the cut-off relay does not respond. In such prior systems, however, the two windings of the cut-off relays have been placed in the opposite sides of the line circuit and the battery at the central office is included between said windings. This arrangement has the disadvantage that the line circuit must be maintained in a balanced condition or the current flowing through the two windings will not have equal and opposite effects on the cut-off relay and the same will be undesirably actuated.

My invention seeks to avoid this difficulty and one method for accomplishing the desired result consists in placing the cut-off relay wholly in one line conductor so that whether the line is balanced or not, the current flowing through its two coils always produces equal and opposite effects therein so that under all conditions of use the said relay does not respond to the current in the line when the subscriber is calling the central office.

Another feature of the invention resides in the novel cord circuit which is more particularly designed to coöperate with the line circuit or circuits shown and described.

The invention is illustrated in the accompanying drawings in which the same reference characters are used throughout the several figures to designate like parts and in which—

Figure 1 is a diagram of the system embodying my improvements; Fig. 2 is a simplified diagram of the line circuits, and Fig. 3 is a simplified diagram of a modified form of the line circuit.

Referring particularly to Fig. 1, L and L^2 indicate subscribers' lines extending in two limbs 2 and 3 from their respective substations A and C to the central office. At the latter they are each provided with a calling signal S, preferably in the form of a small incandescent lamp, and with a plurality of connection terminals or spring jacks J, J^2 and J^3. The line conductor 2 includes the winding of the line relay R and the differential windings 4 and 5 of the cut-off relay R^2, and is thence connected by conductor 6 with the grounded pole of a central common battery B. The line relay R controls through its normally open contacts the local circuit of the signal S, while the cut-off relay R^2 controls through its normally open contacts a shunt of line relay R and of the winding 4 of itself, said shunt consisting of the branch conductor 7, the spring 8 of the cut-off relay R^2 and the branch 9 connected with the conjunction point 10 of said two differential windings 4 and 5 of the cut-off relay. The point 10 is joined by conductor 11 with the tip contacts of the several jacks, while the sleeve contacts of said jacks are permanently connected by conductor 12 with the line conductor 3. The latter conductor is connected by a lead 13 with the live pole of said battery B and includes a retardation coil 14.

The central office equipment includes the cord circuit having an answering plug P and a calling plug P^2 provided with tip and sleeve contacts adapted to register respectively with the corresponding contacts of the jacks when the plugs are inserted therein. The tip contacts of said plugs are connected by means of flexible strands t and t^2 and the interposed condenser c, while the sleeve contacts are joined by similar strands s and s^2 and the interposed condenser c^2. Supervisory relays r and r^2 are bridged across the answering end of the cord circuit and control through their contacts the local circuit of the supervisory lamp or other signal S^2 associated with the answering plug P, the contacts of the former relay being normally open and those of the latter relay being normally closed. An intermediate point of the bridge of said relays is joined by conductors 15 and 16 with the live pole of battery B. A second supervisory lamp

S^3 is associated with the calling plug P^2, and has its local circuit controlled in a manner similar to that of lamp S^2 through the normally open contacts of supervisory relay r^3 and the normally closed contacts of supervisory relay r^4, which relays are bridged across the calling end of the cord circuit and are connected through conductors 17 and 16 with the live pole of the battery B.

The operator's receiver 18, the secondary of her induction coil 19 and a condenser c^3 are adapted to be connected across the calling end of the cord circuit through the medium of any suitable listening key, her transmitter 20 and the primary of her induction coil 19 being charged from any suitable source and which may be the said battery B. A suitable ringing generator 21 is adapted to be connected between ground and the sleeve strand of the cord circuit by means of the sleeve spring 22 of any suitable ringing key, while the tip strand is simultaneously connected through the spring of said key with the conductor 23 containing a resistance coil 24 and leading to the conductor 13 and thence to the battery B.

At the substation a bell 25 and condenser c^4 are included in a permanent bridge of the line conductors, while the transmitter 26 and receiver 27 are adapted to be included in a bridge of said line conductors, whose normal discontinuity is maintained by the switch hook 28. This apparatus is intended merely to typify any usual or desired common battery substation apparatus.

The line relay R may have a resistance of 100 ohms and the windings 4 and 5 of the cut-off relay R^2 may each be of 100 ohms resistance. The retardation coil 14 may have 500 ohms resistance, the supervisory relays r and r^3 500 ohms each and the coöperating supervisory relays r^2 and r^4 may be of 100 ohms each. For the purpose of accomplishing the busy test retardation coils 29 may be bridged across each end of the cord circuit and may be from 2000 to 4000 ohms resistance. It will be understood that these resistances are not meant to be arbitrary and may be varied to any suitable degree.

In the operation of the system, the subscriber A for example takes up his receiver and completes a path for current over the metallic line from the battery B. This current flows serially through the two windings 4 and 5 of the cut-off relay R^2, which does not respond and thence through the line relay R which is actuated to close the local circuit of the line signal S. Upon observing this signal the operator inserts the answering plug P of her cord circuit and connects her telephone in the cord circuit to receive the order from the subscriber. The insertion of the answering plug P completes a local path for current through the winding 5 of said relay R^2, over conductor 6, through winding 5, conductor 11, tip strand t, supervisory relay r, conductor 15 and conductor 16 to the live pole of said battery. The current in this path is sufficient to unbalance the magnetism of relay R^2 which is actuated and closes a shunt about the line relay R which is de-energized and rendered inoperative throughout the remainder of the connection. The current in this path is also sufficient to actuate the supervisory relay r, thus closing the local circuit of supervisory lamp S^2, but said lamp does not light owing to the fact that the supervisory relay r^2 is also energized by current from said source flowing over the telephone line to the substation and in parallel through the branches 12 and 13 to the live pole of said battery B, that in the branch 12 and over the sleeve strand s of the cord circuit being sufficient to operate the relay r^2. The supervisory lamp S^2 therefore remains inert. Upon learning the subscriber wanted the condition of that line is tested in the usual way by touching the tip of the calling plug to the test ring of the multiple jack of the line that is located upon the operator's section. It will be observed that normally the sleeves or test rings of the jacks are connected to the live pole of battery B and since the tip of the plug is likewise connected through the supervisory relay r^3, and conductors 17 and 16 with the live pole of said battery, no flow of current takes place when an idle line is tested and the operator knows that the line is not busy. If, however, connection is established at some other section of the switchboard, a cord circuit of the type shown in the drawing is inserted in one of the jacks of the line, and a flow of current is taking place from the live pole of the battery B over conductor 16, through either supervisory relay r^2 or r^4 to the corresponding sleeve strand s or s^2 and thence through the retardation coil 29 bridged across that end of the cord circuit and thence over the proper tip strand of the inserted cord circuit over tip conductor 11 of the jacks of the line, and thence through the winding 5 of the cut-off relay and over conductor 6 to ground. This results in a fall of potential with respect to the live pole of the battery at the sleeve strand s or s^2 of the inserted cord circuit and since the sleeve contact of said inserted plug and therefore the test rings of the jacks are at the same potential as the said sleeve strand s or s^2, said test rings are also at a lower potential than that of the live pole of the battery B. When, therefore, the tip of the testing cord circuit is brought into contact with one of said test rings, a flow of current results and a click is received by the testing operator, who then knows that the line is busy.

Upon finding the line idle the calling plug P^2 is inserted in the jack of the line and the

ringing key 22 operated. The insertion of the calling plug results in closing the winding 5 of the cut-off relay of said line in a local circuit, which actuates said relay to completely shunt about the line relay R and thus to prevent its operation. The actuation of the ringing key does not alter this condition for although the tip strand t^2 is severed, an auxiliary path for current thereover is provided through the tip spring 22 of said key and over conductor 23 to the live pole of said battery B. The ringing current passes out over the sleeve conductor of the cord circuit and line to the substation and back to the central office, through the shunt of the line relay and winding 4 of the cut-off relay, and thence over the tip conductor 11, tip strand t^2, conductor 23 containing resistance 24, conductor 13, and thence through the battery B to ground. The subscriber's bell is thus operated. After calling the subscriber and before his response the supervisory relay r^3 associated with the calling plug P^2 is included in said local circuit of winding 5 of the cut-off relay R^2 and is actuated to close the circuit of supervisory lamp S^3 which is now lighted owing to the fact that the sleeve supervisory relay r^4 is not yet operated. Upon the subscriber's response said latter relay receives current over the metallic line and is actuated to open its normally closed contacts to render said lamp inert. The subscribers are now in communication and the battery B is feeding current out over the telephone lines for transmission purposes. Tracing the path for this current from the positive pole of said battery B, it flows out over conductor 6 through winding 5 of said relay and thence through the shunt of the winding 4 of said relay and of the line relay R, thence over line conductor 2 and through the substation devices, back to the central office over line conductor 3 where it divides between the branches 12 and 13, a greater portion flowing through the branch 12 owing to the low resistance of the supervisory relay r^2 as compared with the retardation coil 14. The return current thus reaches the live pole of battery B. The path through the tip strand of the cord circuit and supervisory relay r is, as is apparent, in parallel with the line circuit, but owing to the high resistance of said relay the line circuit receives a sufficient supply. The voice currents thus pass directly from the conductor 11 to the line conductor 2 over the shunt of said winding 4 and the relay R and thus suffer no impedance therefrom. The resistance of these windings and the line relays are also removed from the talking circuit. During conversation the retardation coils 29 prevent the passage of the voice currents across the cord circuit.

Fig. 2 illustrates the same line circuit as Fig. 1, but in a simplified form. With this arrangement it will be observed that a common return may be used for the subscribers' lines since both the line and cut-off relays are placed on the same side of the battery in one of the line conductors.

Fig. 3 shows an arrangement of line circuit in which the line signal S has its circuit controlled through normally closed contacts of the cut-off relay R^2 and the normally open contacts of the line relay R, the latter being placed upon the other side of the battery B and taking the place of the retardation coil 14 in the other figures. Said relay is provided with a shunt of its winding 4 as in the prior circuits, but said shunt does not include the line relay. The operation in connection with this figure is thought to be obvious. The relay R responds to the calling current in the line when the subscriber is calling the central office, and the cut-off relay R^2 does not respond. The lamp S is thus lighted. When the operator answers the call the cut-off relay R^2 is unbalanced as before described and the local circuit of lamp S is opened to render the same inert. At the same time the winding 4 of said cut-off relay R^2 is shunted to remove its resistance and retardation from the line circuit. The resistance of said line relay R would, in this instance be 500 ohms, the same as the retardation coil 14 in the prior circuits. Otherwise the operation is the same as before described.

Although I have described several forms of my invention and have shown several ways of carrying the same out, various other modifications may be made therein without departing from its scope or principle.

I claim:—

1. In a telephone system, the combination with a telephone line having multiple jacks at the central office, of a cord circuit to connect therewith, a source of current, one pole of said source being connected with the sleeves of said multiple jacks and with the tip and sleeve strands of the cord circuit, the tip contacts of the multiple jacks being connected with the other pole of said source, and an impedance connected between the tip and sleeve strands of the cord circuit to establish a change of potential of the sleeve contacts of the jacks when the cord is connected with one of said jacks, whereby the busy condition of the jacks may be ascertained from the condition of the test contacts of the multiple jacks in the various positions, substantially as described.

2. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a source of current, one pole of said source being permanently connected with the sleeve of the line jack and with the tip and sleeve strands of the cord circuit, the tip contact of the line jack being permanently connected with the other pole of the source, and a path for current between

the tip and sleeve strands of the cord circuit to establish a change of potential of the sleeve contact of the jack when the cord is connected with the line, whereby the busy condition of the line may be ascertained by connecting with the test contacts of the multiple jacks, substantially as described.

3. In a telephone system, the combination with a source of current, of multiple jacks having their sleeve contacts permanently connected with a pole of said source, a cord circuit having tip and sleeve contacts connected with said pole of said source, the tip contact of said jacks being permanently connected with the other pole of said source, and a path for current between the tip and sleeve strands of the cord circuit, whereby when the cord is connected with one of the multiple jacks, the potential of the sleeve contacts of the jacks will be changed to indicate the busy condition of said jacks, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a source of current having one pole permanently connected with the sleeves of the line jacks and with the tip and sleeve strands of the cord circuit, and the other pole connected with the tip of the line jacks, and a high resistance and impedance connected in a bridge between the tip and sleeve strands of the cord circuit, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 26th day of February 1903.

HARRY G. WEBSTER.

Witnesses:
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