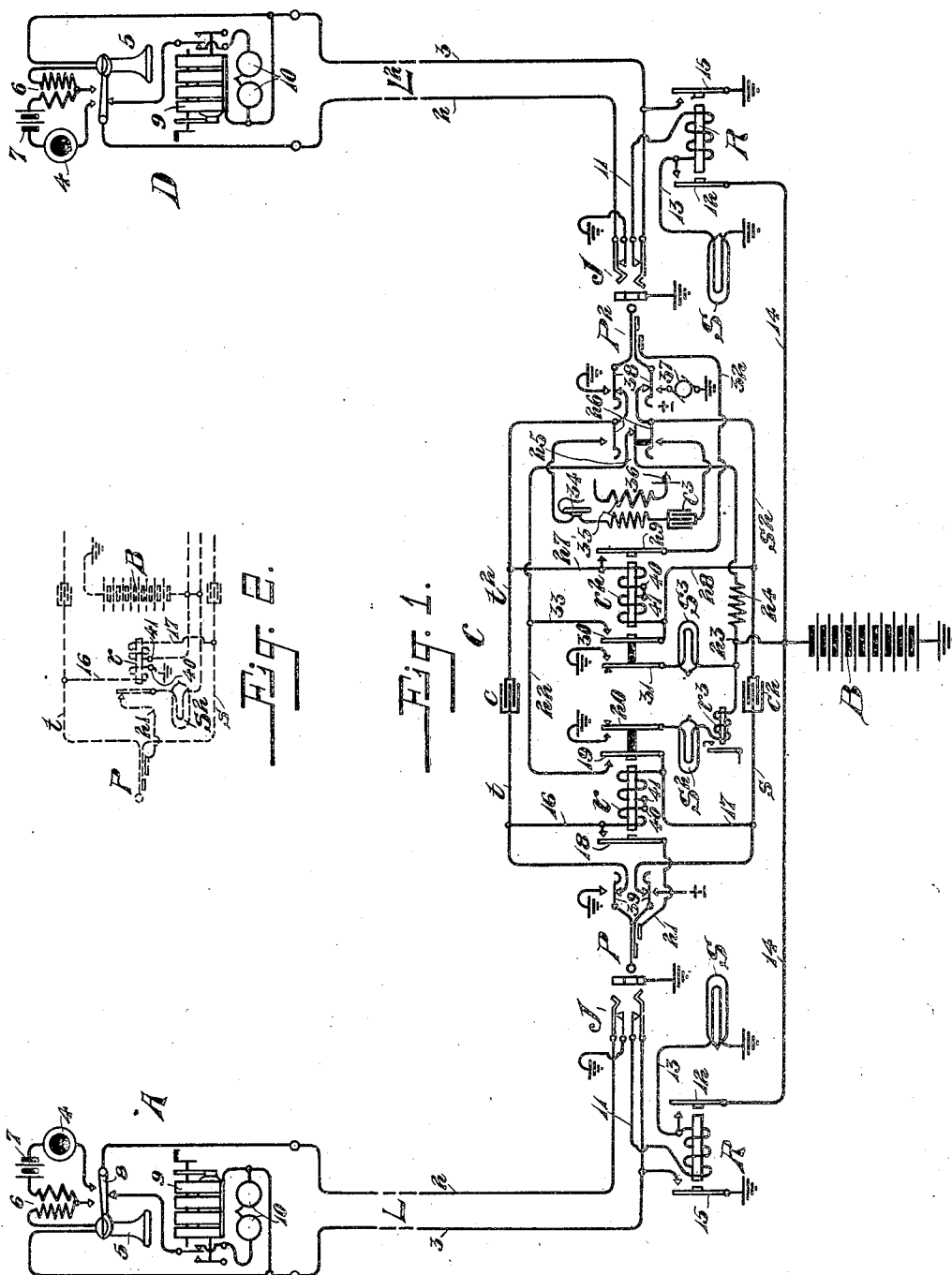


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A. D. T. LIBBY.
TELEPHONE CORD CIRCUIT.
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Witnesses.
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UNITED STATES PATENT OFFICE.

ALBION D. T. LIBBY, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE CORD-CIRCUIT.

No. 836,514.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ALBION D. T. LIBBY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telephone Cord-Circuits, of which the following is a specification.

My invention relates particularly to telephone cord-circuits adapted for use with magneto-signal telephone systems, and has for its principal objects the provision of clearing-out means that is positive in action in connection with the hand-generator outfit at the substation and that may be readily and conveniently changed over into a common-battery supervisory means whenever desired. In attempts heretofore made in this direction the supervisory or clearing-out relays were apt to be tripped or deenergized by the wave of the hand-generator at the substation in opposition to the common-battery current flowing through the locking-winding of said relay. Again, if a supervisory relay of too low resistance for common-battery work was provided it would not be of sufficient resistance and impedance to be bridged across the talking-circuit, as is common for magneto purposes. It is also sometimes desired for commercial reasons to provide only a comparatively weak battery—say of ten volts—for such magneto-work; but owing to the high resistance and complication of apparatus heretofore suggested for this use a much higher voltage was required.

My invention seeks to avoid the difficulties mentioned, and in one practical means which I have devised to accomplish the purpose I provide a relay mechanism which as soon as energized closes a shunt or short circuit for the generator-current, so that the relay-winding is thereafter unaffected by it, and in which each relay has two windings, say, of one hundred ohms resistance, each adapted to be connected directly in series for magneto-work, thus bringing a sufficient resistance and impedance across the circuit, and for common-battery work to be connected on either side of the battery, thereby making only one hundred ohms or the usual amount of resistance on each side of the battery through which to feed the talking-current. Also with this arrangement ten-volt lamps may be used for magneto-work and ten-volt battery. Other

advantages and objects will appear from the detail description and claims.

My invention is illustrated in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a diagram of a telephone system embodying my improvements; and Fig. 2 is a diagram of the cord-circuit of the system, showing the changes necessary for common-battery use.

In this figure, L and L² designate two telephone-lines extending in two limbs 2 and 3 from their respective substations A and D to the central office C, where they terminate in spring-jacks J upon the switchboards.

At the substation a transmitter 4 and a receiver 5 are adapted to be suitably connected in circuit with an induction-coil 6 and a local battery 7 through the medium of the hook-switch 8, upon which the receiver is normally hung. The usual hand-generator 9 and bell 10 are provided in such manner that they are normally connected across the telephone-circuit. These circuits are of the usual type and arrangement and further description of them is deemed unnecessary.

At the central office a line-relay R is provided for each line, the winding of which is connected upon one side by conductor 11 with the normal contact of the tip-spring of the jack J, while its other side is branched, first, to the forward contact of the spring 13 of said relay, and, secondly, by means of conductor 13 to one side of the incandescent lamp forming the line-signal whose other terminal is grounded. The spring 12 of said relay is connected, through a common lead 14, with the live pole of the central common battery B. A second grounded spring 15 of the line-relay is adapted to be connected with the line conductor 3 of the telephone-line. The sleeve-spring of the jack is likewise grounded through its normal contact, and the ring-contact of the jack is permanently grounded.

The cord-circuit which forms the particular feature of my invention includes an answering plug P and a calling-plug P², each having three contacts adapted to register, respectively, with the corresponding contacts of the spring-jacks. The tip-contacts of these plugs are normally joined by the flexible strands *t* and *t*² and the interposed condenser *c*, while their sleeve-contacts are similarly

connected through the medium of the strands s and s^2 and the condenser c^2 . A supervisory clearing-out relay r is connected upon one side by a conductor 16 with the strand t and upon the other side by conductor 17 with the strand s , thereby being bridged across the answering end of the cord-circuit. This relay is provided with contact-springs 18, 19, and 20, spring 18 being connected, through a flexible conductor 21, with the third or sleeve contact of the answering-plug P, while the forward contact of said spring is joined to the conductor 16. The spring 19 is electrically united with the conductor 17, and its forward contact is joined by a conductor 22 with the junction-point 23 and the live pole of the central-office common battery B, this conductor including a resistance 24 and a pair of normally closed contacts 25 in the listening-key 26. The other spring 20 of the relay r has its forward contact grounded and is itself connected to one side of the supervisory lamp S^2 , whose other terminal is connected with said junction-point 23 and includes the winding of a pilot-relay r^3 . A similar clearing-out relay r^2 is bridged across the calling end of the cord-circuit between the strands t^2 and s^2 by means of the conductors 27 and 28 and is likewise provided with three contacts, 29, 30, and 31, the first being joined by a flexible conductor 32 with the third contact of the calling-plug P^2 and its forward contact being connected with the conductor 27. The spring 30 of said relay is itself joined to conductor 28, while its forward contact has a branch 33 leading to the conductor 22. The third spring 31 controls the circuit in an obvious manner of the supervisory signal S^3 , associated with the calling-plug P^2 , and is likewise connected with the point 23 and the live pole of battery B. The operator's head-receiver 34, the secondary of her induction-coil 35, and a suitable condenser c^3 are adapted to be bridged across the calling end of the cord-circuit when the listening-key 26 is operated. Her transmitter 36 and the primary of the induction-coil 35 are energized from any suitable source of current, which may be the battery B. A ringing-generator 37 is adapted to be connected between ground and the ring-spring of the ringing-key 38, the tip side being at the same time grounded. A second ringing-key 39 is placed in the answering end of the cord-circuit to connect the said generator with the answering-plug in case it becomes necessary or desirable to ring the calling subscriber without withdrawing the plug.

The operation of my invention as so far described is as follows: The subscriber at station A operating his hand-generator to indicate a call at the central office causes current from said generator to flow over the ring side of the telephone-line, thence through

conductor 11 and the winding of the relay R, thence by way of conductor 13 to and through the lamp S, constituting the line-signal, and thence through the grounded tip line conductor 2 to the substation. The alternating current in this path is sufficient to operate the relay R, which immediately closes a locking-circuit for itself from the live pole of battery B over conductor 14, spring 12, relay-winding, conductor 11, ring-conductor 3, and thence through spring 15 to ground. The current in this path maintains the relay energized, while current flows from the spring 12 through conductor 13 and the lamp S to ground, thus lighting the same to indicate the subscriber's call. Upon observing this signal the operator inserts the answering-plug P of her cord-circuit in the jack J of the subscriber's line and connects her head-telephone with the cord-circuit to receive the order from the subscriber. The insertion of the answering-plug P lifts the tip and ring springs of the jacks from their normal contacts, deenergizing line-relay R, retiring the line-signal S and freeing the line from all ground connections. Upon learning the number of the party wanted and assuming it to be the subscriber upon the line L^2 , the plug P^2 is inserted in the jack J of that line and the ringing-key 38 is depressed. This operation of this ringing-key completes a path for ringing-current from the generator 37 over the ring side of the line, through the bell at the substation, and back to the central office over the tip side 2 of the telephone-line, and through the grounded tip-spring of the ringing-key. It is understood of course that the insertion of the plug P^2 in the jack of the called line disconnected the relay R and all ground connections from the line. When the called subscriber responds, the parties are in communication, the sources of current for the operation of the transmitters being local to each station and the voice-currents being propagated from one line-circuit to the other through the medium of the condensers c and c^2 in the strands of the cord-circuit. At the termination of the conversation the subscriber A, for example, hangs up his telephone and gives the hand-generator one or two short turns. This causes current from said generator to flow over the metallic telephone-line and through the bridged relay r in the answering end of the cord-circuit, which relay responds and closes its contacts, thereby providing a path for current from the battery B by the way of the point 23, conductor 24, spring 19, the winding of the relay, spring 18, conductor 21, and the grounded sleeve of the jack J of the telephone-line. This locking-circuit maintains the supervisory relay operated even after the hand-generator at the substation has ceased to send out current. The operation of this relay causes the supervisory signal S^2 to light,

as well as the pilot-signal controlled by means of the pilot-relay r^3 , and the operator is notified that the subscriber at station A has hung up his receiver. The closing of the
 5 springs 18 and 19 upon their contacts furnishes a shunt path for the generator-current, so that the supervisory relay r is not deenergized by the waves of generator-current that are in opposition to the battery B. For in-
 10 stance, assuming the generator-current to have been flowing over the conductor 16 toward the relay r , it is now directed through the spring 18, conductor 21 to ground, thence through the battery B to point 23, over con-
 15 ductor 22, containing resistance 24 and contacts 25, to spring 19, conductor 17, and out over the ring side of the telephone-line, this path being of less resistance and retardation than that of the relay r . Likewise when the
 20 subscriber at station D hangs up his telephone and operates his generator to give the operator the disconnect-signal the relay r^2 is energized and is locked in position by means of the springs 29 and 30, the supervisory signal S^3 being lighted through spring 31 and
 25 its forward ground-contact. The generator-current is shunted in a similar manner to that described with reference to the relay r .

It is to be understood that the condensers
 30 c and c^2 are of a low enough capacity to obstruct the current from the low-frequency alternators and prevent its passage to operate the relay bridged across the cord-circuit beyond the condensers, but of a high enough
 35 capacity to allow the high-frequency voice-currents to pass practically unobstructed, thus allowing relay r to be actuated only by one subscriber's generator and relay r^2 to be actuated only by the other subscriber's gen-
 40 erator.

Should the relays r and r^2 become operated in the act of plugging in, they are deenergized by the opening of the conductor 22 through the contacts 25, included in the listen-
 45 ing-key 26, this key being of course actuated soon after the plug P is inserted by the act of listening in. The generator-key 39 serves to call the answering subscriber without withdrawing the plug P.

Inasmuch as an object of this invention is to provide a cord-circuit which may be readily changed over for common-battery purposes, the relays r and r^2 are preferably made
 55 with two windings, each winding of one hundred ohms resistance, and said windings have their inner terminals 40 and 41 brought to the outside, so that suitable connections therewith may be readily made. For mag-
 60 neto-work, therefore, these terminals are connected directly together, as shown in the drawings, by means of which the combined resistance and impedance of the two windings of the relay is secured and which is a sufficient amount for this class of work.

65 In order to change the same for common-

battery work, all that is necessary is to separate said two terminals 40 and 41 and to connect one with one terminal of the battery and the other with the other terminal of the battery, which will thus place a winding of
 70 one hundred ohms upon each side of the said battery, this being the usual and preferred amount of resistance and retardation to be used for common-battery work, since the
 75 substation-transmitters are fed through said windings by current from said battery. This feature is indicated in dotted lines in Fig. 2.

It is apparent that a ten-volt battery is sufficient to operate the relays r for magneto-work. Hence the system may be cheapened
 80 by employing only ten-volt lamps and a ten-volt battery for signaling purposes. It is also evident that in giving the clearing-out signal the closure of the low-resistance path around the clearing-out relay puts a partial
 85 load on the subscriber's generator, which will tend to indicate to him that he has operated the supervisory relay. This feature, however, is unnecessary, but is believed to be an
 90 advantage rather than a disadvantage.

It will be understood that the several grounds mentioned may be one and the same or the common office return and that various other changes in the details of construction and arrangement may be made
 95 without departing from the spirit or scope of my invention; but,

Having thus described the invention and one practical means of carrying the same into effect, what I claim, and desire to secure
 100 by Letters Patent, is—

1. In a telephone system, the combination with subscribers' lines provided with magneto-generators at the substations for signaling purposes, of a cord-circuit to establish
 105 connections therewith, a relay bridged across the cord-circuit, a signal controlled by said relay, a common source of current at the central office, a locking-circuit for said relay including said source and closed by itself when
 110 energized by current from the substation, and means for diverting the generator-current from said relay when once energized, substantially as described.

2. In a telephone system, the combination
 115 with subscribers' lines provided with magneto-generators at the substations for signaling purposes, of a cord-circuit to establish connections therewith, a relay bridged across the cord-circuit, a signal controlled by said
 120 relay, a common source of current at the central office, a locking-circuit for said relay including said source and closed by the relay itself when energized by current from the substation - generator, means for shunting
 125 the generator-current from said relay as soon as it is energized, said circuit including a portion of the said locking-circuit, substantially as described.

3. In a telephone system, the combination 130

with subscribers' lines provided with magneto-generators at the substation, of a cord-circuit to establish connections between the lines for conversation, a condenser in each talking-strand of the cord-circuit, a relay bridged across each end of the cord-circuit upon opposite sides of the said condensers, telephonic apparatus controlled by the relays, a source of current at the central office, locking-circuits for said relays to maintain them actuated by current from said source when once energized by current from the substation-generators, and means for shunting the generator-current away from said relays as soon as they are energized, substantially as described.

4. In a telephone system, the combination with telephone-lines having magneto-generators at the substations for signaling purposes, of a cord-circuit for establishing connections with said lines, clearing-out relays associated with each end of the cord-circuit and adapted to be operated by current from said generators, supervisory or clearing-out signals controlled by said relays, said relays having two windings, and means for connecting said windings in series for magnetowork and for separating said windings and connecting them with the central source of current for common-battery work, substantially as described.

5. In a telephone system, the combination with a cord-circuit at the central office of the system, of a supervisory signal for said cord-circuit, a relay bridged across said cord-circuit and adapted to be energized by current from the substation-generator to display said signal, a central source of direct current, a locking-circuit for said relay including said source, the continuity of said locking-circuit depending upon either the connection of said cord-circuit with the line or upon contacts of the listening-key, whereby the relay may be deenergized either by the actuation of the listening-key or by severing the connection with a telephone-line, substantially as described.

6. In a telephone system, the combination with telephone-lines having magneto-generators at the substations for signaling purposes, of a cord-circuit for establishing connections with said lines, condensers in each limb of said cord-circuit separating the ends thereof, a relay bridged across each end of said cord-circuit each adapted to be energized by current from the generator of the subscribers' lines to which its end of the cord-circuit is connected, a direct-current source

associated with the cord-circuit and adapted to send current through said relay to lock it in its energized position, the course of said current being through contacts of the plug and jack such that the removal of the plug from the jack will sever the locking-circuit of the relay associated with that end of the cord-circuit, substantially as described.

7. In a telephone system, the combination with a telephone-line terminating at the central office in a spring-jack, of a cord-circuit adapted to be connected with the line by means of a connecting-plug, a signal associated with said cord-circuit, and a relay for the control of said signal, said relay being adapted to be actuated by current over the telephone-line and having a locking-circuit adapted to be energized over a local circuit, said locking-circuit including contacts of said plug and jack adapted to be broken when the plug is removed from the jack to release said relay, substantially as described.

8. In a telephone system, the combination with a telephone-line terminating at the central office in a spring-jack, of a cord-circuit adapted to be connected with the line by means of a connecting-plug, a signal associated with said cord-circuit and a relay for the control of said signal, said relay being adapted to be actuated over the telephone-line and having a locking-circuit adapted to be energized over a local circuit, said locking-circuit including contacts of said plug and jack adapted to be broken when the connection is severed with the line, and also contacts under the control of the operator adapted to be broken without severing the connection of the cord with the line, substantially as described.

9. In a telephone system, the combination with a cord-circuit at the central office of the system, of a disconnect-relay permanently bridged between the talking-strands of said cord-circuit, a signal adapted to be displayed by the actuation of said relay, a locking-circuit for said relay adapted to be severed to release the relay by disconnecting said cord-circuit from the telephone-line, a key associated with the cord-circuit, means for also severing said locking-circuit by the actuation of said key, substantially as described.

In witness whereof I hereunto subscribe my name in the presence of two witnesses.

ALBION D. T. LIBBY.

Witnesses:

ROBERT LEWIS AMES,
EDITH F. GRIER.