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H. G. WEBSTER.

TELEPHONE SYSTEM.

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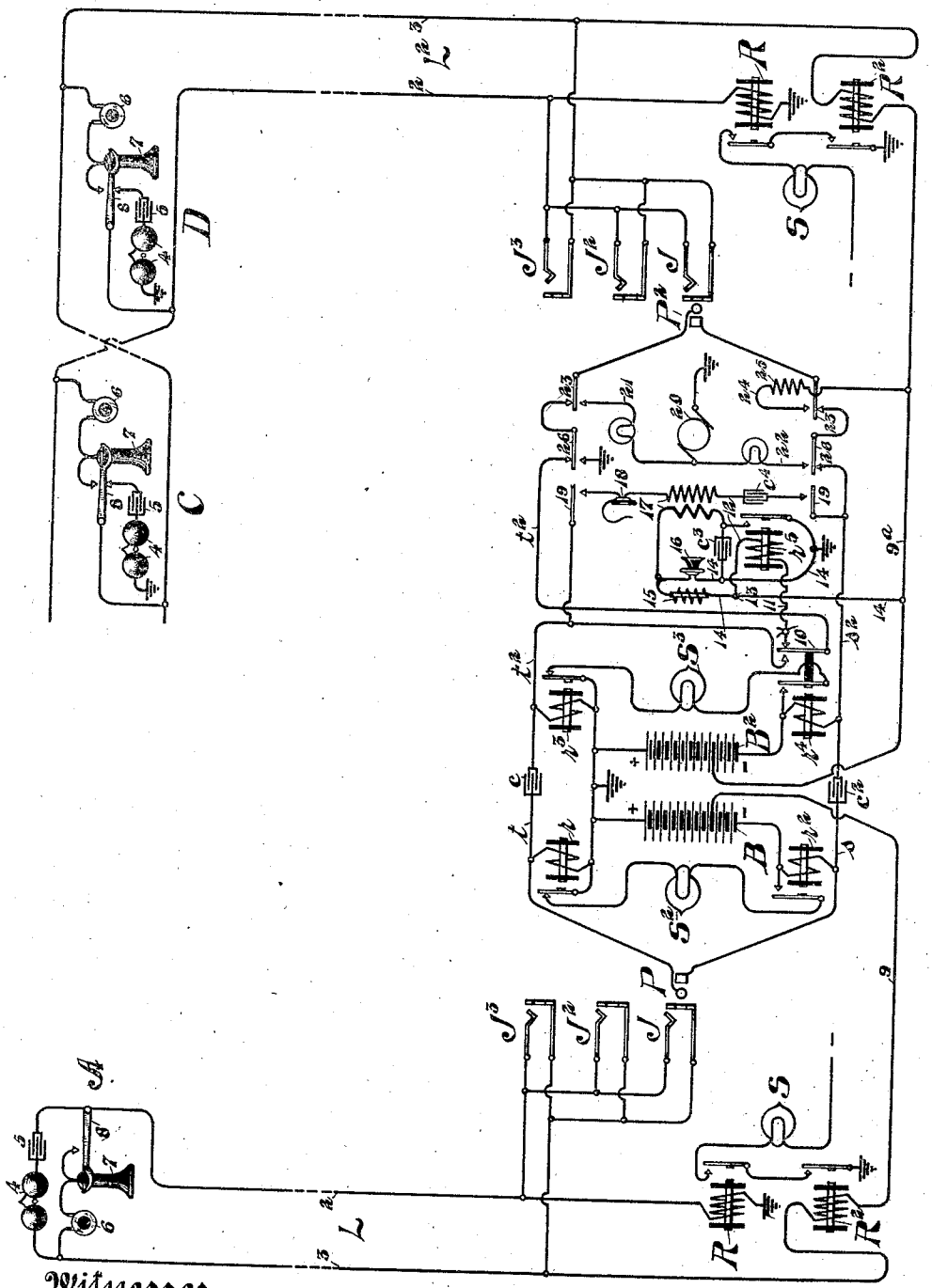

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TELEPHONE SYSTEM.

No. 869,119. Specification of Letters Patent. Patented Oct. 22, 1907.

Application filed December 13, 1902. Serial No. 135,028.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, 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 wherein subscribers' lines terminate at the central office or offices and at which provision is made for inter-connecting the various lines for conversational purposes. It has special reference to those systems employing central sources of current supply, by reason of which the signaling to the central office by the subscriber is automatic, whereby current for transmission purposes is supplied from the central office and whereby the supervisory apparatus is all actuated by current from the said central source.

This invention has for its object the simplification of the circuits, connections and arrangements by which the above operations are accomplished, and the provision of a system that is at once rapid, positive and efficient.

In the accompanying drawing, in which the same reference characters indicate like parts throughout, the figure is a diagram of two subscribers' lines leading to a central office and the apparatus at the central office for initiating and completing connections for conversational purposes.

In this figure L and L^2 represent subscribers' lines extending from their respective substations to the central office. Upon the line L a single sub-station A is located, at which is provided an ordinary signaling bell 4, and a condenser 5, preferably permanently connected between the two line conductors and a transmitter 6 together with a receiver 7, in a bridge of said line conductors, which bridge is normally open at the switch-hook 8. This apparatus, it will be understood, is intended merely to typify any desired common battery subscriber's set.

At the central office the line is provided with an answering jack J, and with any number of multiple jacks, such as J^2 and J^3, which are preferably permanently connected with the line conductors 2 and 3 of the telephone line. The line is also fitted at the central office with two line relays, one, the relay R, being connected in the line conductor 2 which is grounded or connected with the common office return and the other, the relay R^2, connected in the line conductor 3 which is conductively joined with the omnibus bar 9 leading from an intermediate pole of the battery B. These line relays are of high resistance relatively, say 1000 ohms each, and control through their normally open contacts the local circuit of the line signal S, which is preferably in the form of a small incandescent lamp.

I have shown upon the line L^2, two substations C and D, each of which is provided with a transmitter 6, a receiver 7 and a switch-hook 8 in the same relation as described with reference to the sub-station A located on the line L. As before, these parts may represent any type of common battery subscribers' sets. The signaling bells at these stations, however, are not bridged across the line but are shown connected with the different line conductors and with ground. That at the station C is connected with the sleeve side of the line 3, while that at station D is normally joined through the switch-hook with the tip side of the line 2. At the central office a line signal S is provided, the local circuit of which is controlled through the normally open contacts of the two high resistance line relays R and R^2 located respectively in the tip and sleeve conductors of the line, the sleeve conductor of this line being shown as united through a conductive path over the omnibus bar 9^a with an intermediate pole of the battery B^2. These batteries B and B^2 are preferably grounded at one pole and are ordinarily of the storage battery type, having a voltage of 24 volts, the bars 9 and 9^a being joined with said batteries at a point to include about 18 volts. These proportions may be varied without departing from the principle of the invention, but are such as I now prefer to employ.

The operator's apparatus comprises a cord circuit, provided with an answering plug P and with a calling plug P^2, the tip and sleeve contacts of which are adapted to engage with corresponding contact surfaces in the jacks of the lines. The tip contacts of the plugs are joined together through the flexible strands t and t^2, and the interposed condenser c, while the sleeve contacts of said plugs are joined by the strands s and s^2 and the interposed condenser c^2. The battery B is bridged across the answering end of the cord circuit and includes upon the tip and sleeve sides thereof the supervisory relays r and r^2, each preferably of about 100 ohms resistance, and which control the local circuit of the supervisory lamp S^2, which is preferably energized from the same battery B and whose said local circuit is normally open at the contacts of relay r^2 and normally closed by the contacts of relay r. The calling end of the cord circuit is likewise connected with the battery B^2 and is provided with the supervisory relays r^3 and r^4, which similarly control the local circuit of the supervisory lamp S^3.

The sleeve supervisory relay r^4 is provided with an additional set of contacts, the spring 10 serving in its forward position to complete the tip strand t^2 for conversational purposes, but in its normal position to connect the forward portion of said strand with conductor 11 leading to a high resistance and high impedance test relay r^5, the opposite pole of which is connected by conductor 12 with the junction point 13 located upon conductor 14 which is connected with the lead 11

9^a. The conductor 14 contains a retardation coil 15 and is thence led through the operator's transmitter 16 to ground. In shunt of the transmitter 16 is connected the primary winding of the operator's induction coil 17 and a condenser c^3. The forward contacts of the test relay r^5 complete a path to ground from a point on said shunt between the said winding and the condenser c^3. The operator's receiver 18, the secondary helix of her induction coil 17 and a condenser c^4 are adapted to be connected in a bridge of the calling end of the cord circuit by means of a pair of springs 19 of a listening key which may be any of the usual or desired types.

A ringing generator 20 having one pole grounded is arranged to deliver alternating current through suitable branches 21 and 22 containing resistance lamps to the tip and sleeve sides respectively of the cord circuit. For example, pressure upon the springs 23 of a suitable ringing key connects the tip spring of the pair with the generator and impresses upon the tip conductor of the telephone line a suitable ringing current which is arranged to operate the subscriber's bell 4 at the station D. At the same time the sleeve spring connects in its forward position with a conductor 24 containing a 50 ohm non-inductive resistance 25, and leading to the bar 9^a. The operation of the other pair of springs 26 connects on the other hand the ringing generator with the sleeve conductor of the line and thereby operates the bell located at the station C, the tip spring being simultaneously grounded.

The operation is as follows: The subscriber A desiring a connection takes up his receiver with the result that current flows from the main portion of the battery B serially over conductor 9, line relay R^2, the sleeve conductor of the telephone line, through the transmitter and receiver at the substation and thence back to the central office over tip conductor 2, the line relay R, and through ground back to the grounded pole of the battery. The relays R and R^2 are energized by this current and close the local circuit of the signal lamp S which is lighted to indicate the fact of the call at the central office. Upon observing the signal the operator inserts the plug P in the answering jack of the line L, thereby establishing other paths for current from the battery B. Instead of flowing through the tip high resistance line relay R, a shunt path is now provided for the current through the tip supervisory relay r, which is of comparatively low resistance and which is now placed under the control of the subscriber, since it is responsive to current flowing over the telephone line. Similarly, the current which before followed the path through the high resistance line relay R^2 now finds an easier path through the sleeve supervisory relay r^2 and thence over the telephone line. Either the relay R^2 or R, or, in case of certain line resistances, both, will fall back now to render the line signal inoperative. The sleeve relay r^2 will therefore be operated to close the local circuit of the lamp S^2. Owing to the fact that the subscriber's receiver is off the hook, the tip relay r is now energized so that the lamp S^2 remains dark even though the sleeve supervisory relay r^2 be operated. The operator connects her receiver with the cord circuit to converse with the calling subscriber. Her transmitter is now charged by current from the battery, B^2, which finds a path through the retardation coil 15 and through the transmitter 16 to earth. The sound waves impinging the diaphragm of the transmitter 16 set up variations in the current flow and effect the charge upon the condenser c^3 which causes a flow of current through the primary winding of her induction coil corresponding to speech waves. Upon learning that a subscriber upon the line L^2 is desired the operator tests the condition of the wanted line in the usual manner by touching the tip of her calling plug to the test ring of one of the multiple jacks. If the line is busy the said test rings are connected through the sleeve strand of the inserted plug with the live pole of one of the batteries B or B^2, and will be raised to a potential of about 24 volts. The tip of the testing plug, however, is only at 18 volts so that a flow of current through the said test relay results, which relay attracts its armature and closes a path for current through the primary helix of the operator's induction coil 17. This causes a click in the operator's receiver and indicates to her that the line is busy.

If the line is idle, the test rings are at the same potential as the tip of the plug, that is 18 volts all being connected with the intermediate poles of the batteries, and no click is received. The calling plug P^2 is therefore inserted and the set of springs 23 or 26 operated to ring the desired subscriber. If the subscriber located at station C is wanted, ringing springs 26 are operated to connect the generator 20 with the sleeve conductor. It is apparent that the ringing current has two paths, one being over the sleeve conductor to the sub-station, and the other being back through the line relay R^2 and the larger portion of battery B^2 to ground. The latter path, however, is of high resistance so that a sufficient current will flow over the former path to operate the subscriber's bell. The lamp S does not light during ringing, even though the ringing current might tend to operate the relay R^2 for the reason that the coöperating relay R is shunted by the tip ringing spring 26. In case the subscriber responds during the sending of the calling current therefore, the line relay R does not respond for the reason that it is shunted by the tip spring 26.

In case the subscriber D is wanted, the springs 23 of the ringing key are depressed, the tip spring serving to connect the generator with the tip conductor, while the sleeve spring connects a shunt path through the non-inductive winding 25 around the line relay R^2. The resistance and impedance of the line relay R prevents the passage of the ringing current to such an extent as to deprive the sub-station of sufficient current to operate its bell, while the said shunt path prevents the operation of the line relay R^2 in case the subscriber responds during calling.

In case of the release of the ringing key before the called subscriber's response, the supervisory relay r^4 is included in a local circuit which consists of the sleeve strand s^2, the sleeve conductors of the jacks, the portion of the sleeve conductor 3 including the winding of the line relay R^2, the omnibus bar 9^a and the smaller portion of the battery B^2 included between the said bar 9^a and the branch containing the said supervisory relay. This supervisory relay is therefore operated to close the local circuit of the supervisory lamp S^3, which owing to the fact that the tip supervisory relay r^3 is not yet operated, is lighted and indicates to the operator that the

called subscriber has not yet responded. At the same time the spring 10 of the relay r^4 closes its forward contacts, thus completing the tip strand t^2 of the trunk circuit for conversational purposes. Upon the response of the called subscriber, the tip supervisory relay r^3 is operated by current from the battery B^2 flowing over the line circuit and thus extinguishes the supervisory lamp S^3. The subscribers are now in communication and the battery B is furnishing current over the line L for transmission purposes and for the operation of supervisory relays r and r^2. The battery B^2 is simultaneously providing the subscriber upon line L^2 with current for transmission and for the operation of relays r^3 and r^4.

At the termination of the conversation the subscribers return their receivers to the hooks with the result that the line circuits are opened and the tip supervisory relays are deprived of operating current, thereby closing the circuits of the supervisory lamps S^2 and S^3 which are lighted to indicate the fact of the end of the conversation to the operator. The sleeve supervisory relays are not deënergized at this time owing to their inclusion in the local circuits with the smaller portions of the batteries B and B^2. Even though the relays R^2 which are also included in these local circuits be now energized, the line signals S do not operate owing to the fact that the relays R remain deënergized. Upon observing the supervisory signals the operator takes down the connection and restores all parts to normal condition.

It will be understood that the several grounds mentioned may be the common office ground or the common office return and that the proportions of the relays and other parts mentioned herein are not intended to be arbitrary and may be varied according to the conditions of practice.

Instead of the special party line shown and described, other types of line may be employed and additional parties may be placed thereon. The generator may be arranged to deliver pulsating current of different character to the line, or it may send current of different frequencies thereover and the substations may be suitably arranged to respond to such currents of different characters. It will be noted that whenever the ringing generator is connected with one side of the line a shunt is suitably arranged around the line relay associated with the opposite side of the line. In case the generator is employed for metallic ringing the return path for current would be provided through the said shunt paths.

I claim:

1. In a telephone system, the combination with a telephone line, of two line electro-magnets therefor, one in series with each limb of said line, a line signal controlled by said electro-magnets, a source of current associated with the line, means at the subscriber's station for causing current from said source to traverse said electro-magnets to actuate said signal, and means for shunting one of said magnets to retire said signal or prevent its operation when a connection is established with the line, substantially as described.

2. In a telephone system, the combination with a telephone line, two high resistance electro-magnets one serially connected in each limb of the line at the central office, a line signal controlled by said magnets, means controlled from the substation for operating said magnets jointly to operate the said signal, one or both of said magnets being deprived of current without opening the circuit thereof to render the line signal inoperative when a connection is established with the line for conversation, substantially as described.

3. In a telephone system, the combination with a telephone line, of two line electro-magnets therefor, one connected in each line conductor at the central office, a line signal controlled by said electro-magnets, a source of current associated with the line, means at the subscriber's station for causing current from said source to operate said electro-magnets to operate the signal, means for rendering one of said electro-magnets inoperative when a connection is established with the line for conversation to thereby render the line signal inoperative, and means for sending current over one of said electromagnets whereby said signal is not operated substantially as described.

4. In a telephone system, the combination with a telephone line, of two high resistance relays therefor at the central office, one connected with each line conductor, a line signal having its circuit closed through normally open contacts of both said relays, a source of current associated with the line at the central office, means at the substation for closing the circuit of said source over the metallic line to energize said relays and thereby to operate said signal, and means to deprive one of said relays of operating current when a connection is established with the line for conversation to thereby render the line signal inoperative while sending current over the other of said relays, substantially as described.

5. In a telephone system, the combination with a telephone line, of two line relays therefor at the central office, one in each limb of said line a line signal operated by the joint action of said relays, and means for shunting one of said relays by the act of making a connection with the line for conversational purposes whereby said shunted relay serves to render said line signal inoperative, substantially as described.

6. In a telephone system, the combination with a telephone line, of two line relays therefor, a cord circuit, a pair of supervisory relays associated therewith, and means for connecting said relays in shunt of said line relays when a connection is established with the line, substantially as described.

7. In a telephone system, the combination with a telephone line, of two line relays associated therewith, a cord circuit, a pair of supervisory relays associated with said cord circuit, and means for including one of said supervisory relays in parallel with one of said line relays when connection is established with the line by said cord circuit, the other supervisory relay being arranged to be actuated by current flowing over the line circuit, substantially as described.

8. In a telephone system, the combination with a telephone line, of a separate electro-magnet associated with each line conductor, a line signal controlled by said electromagnets, and means for sending ringing current over the path of one of said magnets without actuating said signal, substantially as described.

9. In a telephone system, the combination with a telephone line, of an electro-magnet associated with each line conductor, a signal for the line operated whenever both of said electromagnets are energized, and means for sending ringing current out over the path of either of said magnets without operating said signal, substantially as described.

10. In a telephone system, the combination with a telephone line, of an electro-magnet associated with each line conductor, a line signal controlled by both said electromagnets, the calling generator, and means for connecting said generator with one line conductor and sending ringing current through one of said magnets and at the same time rendering said electro-magnet in the other line conductor inoperative, whereby the said line signal is not actuated, substantially as described.

11. In a telephone system, the combination with a telephone line, of an electro-magnet associated with each line conductor, a line signal controlled by said electro-magnets, a calling generator, means for connecting said generator with the line to call a wanted subscriber, and at the same time shunting one of said electro-magnets to prevent the operation of said signal, substantially as described.

12. In a telephone system, the combination with a telephone line, of a line relay associated with each line con-

ductor, a line signal having its circuit controlled through contacts of both said relays, a ringing generator, means for connecting said generator with either side of the line, and at the same time shunting the line relay connected with the other side of the line, whereby said signal is prevented from operation during ringing, substantially as described.

13. In a telephone system, the combination with a telephone line, of a line relay associated with each line conductor, a line signal having its circuit controlled through contacts of both said relays, a ringing generator, means for connecting said generator with either side of the line, and at the same time rendering the line relay connected with the other side of the line inoperative, whereby said signal is prevented from operation during ringing, substantially as described.

14. In a telephone system, the combination with a telephone line, of a pair of relays, one in series with each limb of said line, a central source of current permanently connected to said line through the coils of said relays, a line signal controlled by said relays, a cord circuit adapted to be connected with said line for conversation, a supervisory relay associated with the cord circuit, means for connecting said supervisory relay in series with one of said line relays and a portion of said central source of current when a connection is established with a telephone line, and means thereafter, when current flows in the telephone line, for depriving said line relay of its actuating current without opening its circuit, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 10th day of December 1902.

HARRY G. WEBSTER.

Witnesses:
ROBERT LEWIS AMES,
GAZELLE BEDER.