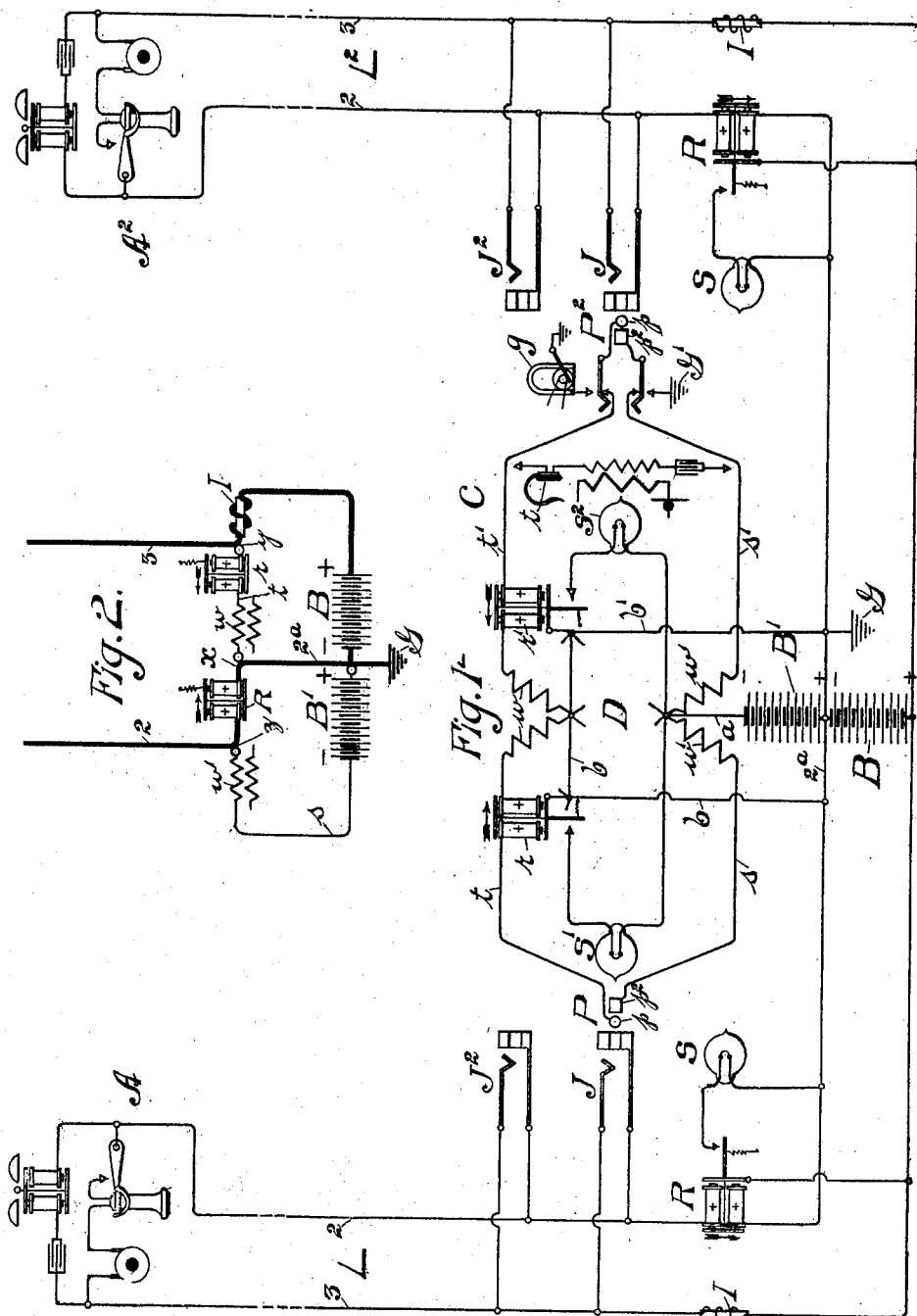


No. 830,575.

PATENTED SEPT. 11, 1906.

W. W. DEAN.
TELEPHONE SYSTEM.

APPLICATION FILED DEC. 6, 1901.



Witnesses.
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TELEPHONE SYSTEM.

No. 830,575.

Specification of Letters Patent.

Patented Sept. 11, 1906.

Application filed December 6, 1901. Serial No. 84,871.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, and a resident of Chicago, county of Cook, State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems, and has for its general object the provisions of means to simplify and improve the central-office apparatus and arrangement used in connection with common battery systems. More specifically stated, its objects are the dispensing with all cut-off relays in connection with the subscriber's line and at the same time to maintain all the beneficial results due to their use in the ordinary system, the simplification of the operator's connective means, and the provision of a complete supervisory system for established connections between the various lines for conversational purposes.

The invention further consists in the novel circuit connections, combinations, and arrangements hereinafter described, and particularly pointed out in the appended claims, reference being had to the accompanying drawings, forming part of this specification, in which the same reference characters designate like parts throughout both views, and in which—

Figure 1 is a diagrammatic view of two subscribers' stations and the apparatus at a central office, and Fig. 2 is a simplified diagram of a subscriber's line and a half of the cord-circuit connected therewith.

In Fig. 1, L and L² represent telephone-line circuits extending between their respective substations A and A² and the central office C. At the substation the telephone instruments are located in a bridge of the main conductors 2 and 3, the telephone-hook being adapted, as usual, to maintain the normal discontinuity of said bridge when the receiver is in place thereon and to close the same when it is displaced. A standard call-bell and a condenser are located in a parallel path to the telephone-bridge. At the central office the several lines are fitted first with the switch-sockets or jacks J J² and then are extended and provided with a polarized line-relay R, an impedance-coil I, and a battery

B, the line-relay being located in the main conductor 2 and impedance-coil I in conductor 3, while the battery B is in circuit between them. The battery B has its negative pole grounded at G, and the line-relay R is so polarized as to be operated by current from this battery when the line-circuit is closed, as by taking the receiver up. The line-signal S has its circuit closed by the armature of the line-relay R, said circuit including the battery B.

While the relay and the signal-lamp have been referred to, it is apparent that so far as the broad features of my invention are concerned any polarized electromagnet signaling device or drop could be employed in place of the relay R or that any other signaling device could be placed in the local circuit closed by the relay R instead of the incandescent lamp S.

The operator's connective means includes the switch cord-circuit D, adapted to form an operative union between any two circuits and is provided with the answering and calling plugs P and P², respectively. Each plug is provided with tip and sleeve contact surfaces *p* and *p*², adapted to register, respectively, with like contact-surfaces in the jacks J and J² of the lines. The tip-contact surfaces of the two plugs are joined by strands *t* and *t'*, while the sleeve-contacts *p*² are likewise joined by the strands *s* and *s'*, these strands being commonly known as the "tip" and "sleeve" strand, respectively. The windings *w* and *w'* of a repeating-coil are interposed in the respective tip and sleeve strand between the middle points of which windings the battery B' is connected by the conductors *a* and *b* or *b'*, the positive pole of this battery being grounded, as at G. Polarized supervisory relays *r* and *r'* are located, respectively, in the strands *t* and *t'* of the cord-circuit and control the circuits of supervisory signals S' and S², associated, respectively, with the plugs P and P². These relays are so polarized as to be operated only by positive current flowing through their windings in the direction of the arrows and are therefore not operated by current flowing from the battery B' through the strands of the cord-circuit to the substations.

The operator is furnished in addition with

a head-telephone t , which is adapted to be connected across the strands of the cord-circuit by any suitable key, the secondary winding of her induction-coil and a condenser being included in the same bridge. The operator's transmitter and primary coil are charged in any desired way. A ringing-generator g is also provided and is adapted to be connected with the calling-plug P^2 through the agency of a suitable ringing-key under the control of the operator.

Biasing-springs are attached to the armatures of both the line-relays and the supervisory relays to assist in maintaining the armatures tilted to one side. Suitable proportions are found to exist with the line-relays R and impedance-coils I , each of one thousand ohms resistance, the supervisory relay r or r' plus the winding w of the repeating-coil in series with it of ten ohms and the windings w' of the repeating-coil of ten ohms resistance.

In order to more clearly understand the operation of the system, the central office end of a telephone-line having a cord-circuit connected therewith is shown in simple diagram in Fig. 2, corresponding reference characters being used where possible to denote the same parts as in Fig. 1. The heavy lines indicate the parts belonging to the "line-circuit," so called, while the lighter lines indicate the cord-circuit connections and parts which are added when a connection is established with the line by the operator. From this figure it will be seen that before the parts in light lines are added the current from the battery B is adapted to flow in the portion of the diagram indicated by the heavy lines and that this current-flow is in a direction proper to operate the relay R . This condition corresponds to that of a line before the operator connects the cord-circuit therewith, so that the mere taking up of the receiver at the substation closes the circuit between the two line-wires 2 and 3, and current flows, as stated, to operate the line-relay R . It is also clear that with the light lines added as in the figure and with the circuit open between conductors 2 and 3, as shown, the entire current from both batteries B and B' will circulate in the rectangular path through both relays and in a direction proper to operate relay r and to render relay R inoperative. This path may be traced from the positive pole of battery B through impedance-coil I , relay r , winding w , relay R , winding w' , cord-strand s , and through both batteries B' and B . That the current does not flow through conductor 2^a at this time is evident from the fact that the resistance of the external circuit is equal on both sides of the point x , which is therefore at the middle point of the fall of potential in the external circuit, while the other end of the conductor 2^a is at the

middle point of the rise of potential in what may be termed the "internal circuit." The rise and fall of the potential in the two portions of the circuit being equal, it follows that both ends of wire 2^a are at the same potential, and consequently no current flows therein. This condition corresponds to that of a line which is connected to at the central office and when the subscriber's receiver is upon the hook. The desired result is thus attained—that is, the supervisory relay r is operated, while the line-relay R is rendered inoperative.

The third condition is where the line-conductors 2 and 3 are closed together at the subscriber's station through the talking apparatus. This corresponds to the talking condition of the line, at which time both relays should remain inoperative. In this condition the current from B' can flow in the local circuit through the conductor 2^a , the relay R , and winding w' back to the battery. The current in this path is of a suitable direction to prevent the relay R from operating. A second path for current from this battery B' and one of much lower resistance is through the conductor 2^a , the winding w , and the relay r , thence out to the substations, over line-wire 3, through the substation devices, and back over line-wire 2 to point z , and thence through winding w' to the other pole of the battery. This path, it will be noticed, is of comparatively low resistance, since the combined resistance in the two cord-strands s and t is under the proportions assumed only twenty ohms, while the only other resistance encountered is that of the line including the substation instruments. The path from the point x to the point z , through the relay R and that through the line are in parallel, that through R being of much higher resistance. It will thus be seen that a strong current is furnished the line for the purpose of talking.

Considering the battery B , its current is so reduced by the resistance of the thousand-ohm impedance-coil I that it is much smaller than that from the battery B' . The portion, therefore, that tends to flow in the local circuit through the relay r and winding w in a direction the reverse of that from battery B' through these parts is quite small and is not sufficient to overcome the other current, so as to operate relay r . A small amount of current from this battery B , however, will pass out from the point y to line through the substation devices and back over line-wire 2. At the point z two paths are open to it, one through the high-resistance relay R and the other through low-resistance winding w' . That part of the current through R is in a direction to operate it; but it is a very slight current in view of the high resistance of this path, which includes that of the impedance-

coil I, the line-resistance, and the resistance of the relay R. The current through R is still further reduced by the shunting effect of the branches through the cord-strand *s*, while that of the line is reduced by the shunt through cord-strand *t*, so that the relay R remains uninfluenced and does not expose its signal. It is thus seen that under this third condition both relays are maintained in inoperative position.

The operation is as follows: The subscriber A, desiring to communicate with subscriber A², displaces his receiver, and thereby permits currents from the battery B to flow in the line-circuit through the relay R, causing it to operate and close the circuit of the individual signal-lamp S, which is immediately lighted. The operator, noticing the signal, inserts the answering-plug P of her connector into the answering-jack of the line and connects her telephone with the circuit by means of her key, when she is enabled to ascertain the wants of the party calling. The insertion of the plug P causes the restoration of the line-relay R by reversing the current therethrough, as was explained with reference to Fig. 2. The line-lamp is thus extinguished. As was explained, also, the supervisory relay *r*, associated with plug P, does not operate, because current from battery B' flows through in the wrong direction and with considerable strength. Upon learning the number of the party wanted the calling-plug P² is used to test the line of that subscriber by touching its tip to the test-ring of the jack. If no connection exists with the line, the operator hears no "click;" but if the subscriber is busy his test-ring will be connected with the live side of a battery, and the tip of the calling-plug furnishes a path from the test-ring over the tip-strand *t'* of the cord-circuit to the other side of the battery, this causing a noise in the operator's receiver. It will be noticed that a busy test is furnished as soon as a subscriber calls from the line battery B over the tip-conductor of the telephone-line through the substation devices to the sleeve-conductor and test-rings connected therewith, but that as soon as a connecting-plug is inserted the cord-circuit battery B' directly raises the potential of all test-rings of the line above that of the earth. If found idle, the calling-plug P² is inserted in the switch-socket of the line and the ringing-generator *g* is connected therewith to signal the subscriber to his instrument. The ringing-current will divide, a part going to the substation end of the line to ring the subscriber's bell and part going through the battery B. The high resistance and impedance of the relay R and coil I, however, prevent the greater part flowing in the latter branch, and the portion of the current that does flow is shunted around the relay R by the grounds

G and G' to prevent any possible chattering of the same, though the lamp S would not have time to light, even if the relay were allowed to vibrate. At this time the line-circuit to the substation is open, and current from both of the batteries B B', as was explained in connection with Fig. 2, flows through the impedance-coil I, the tip-strand *t'*, containing the supervisory relay *r'*, conductor *b'*, line-relay R, through the cord *s'* back to the battery B', thus causing relay *r'* to close the local circuit through the supervisory lamp S², which is lighted, and indicates to the operator that the subscriber has not yet responded. When the subscriber responds, the same conditions are established as were explained with reference to the subscriber A, with the attending result that the relay *r'* is no longer operated, and the supervisory lamp S² is extinguished, by means of which the operator is notified that the parties are in communication. During the connection the batteries charge the transmitters of both substations over their respective lines, while the fluctuating or voice currents travel over the same circuits and are repeated from one line to the other through the agency of the repeating-coil windings *w* and *w'* in the cord-circuit D. The line-relay R and impedance-coil I, which are in a bridge through the battery B of the talking-circuit, possess sufficient impedance to prevent the passage of voice-currents, while the supervisory relays *r* and *r'* are not of sufficient impedance to affect the transmission of such currents. At the termination of the conversation, when the receivers at the two stations are replaced, the current from the two batteries in series is sent through each of the supervisory relays *r* and *r'*, which are now in parallel circuits, from the combined batteries B and B' in the proper direction to operate them, and the lamps S' and S² are immediately lighted. The connection may now be taken down and all parts restored to normal position. A supervisory signal is thus under control of each subscriber.

It will thus be seen that I have provided a system for use in connection with central sources of current in which all cut-off relays are dispensed with, as well as a large part of the apparatus usually employed in connection with the operator's connectors.

It will be understood that the several ground connections referred to may be the common office return, also that the wire *b'* is not necessary in practice, and, further, that so far as the operation of the relays above described is concerned the ground connections are unnecessary. The operator's key may be of any well-known construction, such as the cam-key in extensive use.

While I have described the invention with particular reference to the details of the ar-

rangement and connections, I would have it understood that it is not to be limited thereto, as various changes, alterations, and modifications may be made therein and still come within its scope and principle; but

What I do claim, and desire to secure by Letters Patent, is—

1. The combination with a telephone-line, of a polarized line signaling device and a battery at the central office connected in series in the line, substantially as described.

2. The combination with a telephone-line, of a polarized line-relay and a battery at the central office connected in series in the line, and a signal, controlled by said relay, substantially as described.

3. The combination with a telephone-line, of a polarized line-relay and a battery permanently connected in series in the line and a signal controlled by said relay, substantially as described.

4. The combination with a telephone-line, of a polarized line-relay, a battery and an impedance-coil in series in said line, substantially as described.

5. The combination with a telephone-line, of a polarized line-relay, a battery and an impedance-coil permanently connected in series in the line, the battery being located between the relay and impedance-coil, substantially as described.

6. The combination with a telephone-line, of a polarized line signaling device and a battery at the central office connected with the line, and means to render said device inoperative when a connection is established with the line and to maintain the same inoperative as long as the connection exists.

7. The combination with a telephone-line, of a polarized line signaling device and a battery permanently connected with the line, and means to render said device inoperative when a connection is established with the line and to prevent its operation during the connection.

8. The combination with a telephone-line, a polarized line signaling device, and a battery at the central office in series in the line, and means to render the said device inoperative when a connection is established with the line.

9. The combination with a telephone-line, of a polarized line signaling device and a battery permanently connected in series in the line and means to render the said device inoperative when a connection is established with the line.

10. The combination with a telephone-line, of a polarized line-relay and a battery permanently connected in series in the line and means to render said relay inoperative when a connection is established with the line.

11. The combination with a telephone-line, of a polarized line signaling device and a bat-

ttery connected therewith, and means to reverse the current through said device when a connection is established with the line, substantially as described.

12. The combination with a telephone-line, of a polarized line signaling device and a battery in series in the line, and means for reversing the current through the signaling device when a connection is established with the line, substantially as described.

13. The combination with a telephone-line, of a polarized line signaling device and a battery permanently connected in series in the line, and means for reversing current through the device to render the same inoperative when a connection is established with the line, substantially as described.

14. The combination with a telephone-line, of a polarized line signaling device and a battery in the line, a cord-circuit, a second battery, connected with said circuit and means for diverting the current from the first-named battery from the line-relay and sending current in the reverse direction through said relay from the second battery when a connection is established with the line, substantially as described.

15. The combination with a telephone-line, of an operator's cord connector, a polarized supervisory signaling device associated therewith, a battery in a bridge of the cord-circuit, and means to prevent the operation of said device when the subscriber's line is closed.

16. The combination with a telephone-line, of a cord connector, a polarized signaling device in the circuit of said connector, a source of current to send current over the metallic talking-circuit and means for rendering the same inoperative when the subscriber's line is closed and operative when the line is open.

17. The combination with a telephone-line and a battery connected therewith, of a cord-circuit, a polarized supervisory relay in one strand of the cord-circuit and a battery between the strands to charge the substation-transmitters, the said relay being unresponsive to the charging-current, and means for operating the said relay when the line is opened.

18. The combination with a telephone-line, of a polarized line-relay and a battery in series in the line, an operator's cord-circuit, a polarized supervisory relay and a second battery connected with said circuit and means for rendering the relays unresponsive when a connection is established and the subscriber's line is closed and for rendering the supervisory relay responsive when the line is open.

19. The combination with a telephone-line of a cord-circuit, a polarized supervisory relay associated with said circuit and means to send current through the same in one direction when a connection is established with

the line and the subscriber's line is open and in the reverse direction when the subscriber's line is closed, substantially as described.

20. The combination with a telephone-line, of a cord-circuit, a polarized supervisory relay associated with said circuit and a battery connected therewith, means for sending current from said battery through the said relay in one direction when the subscriber's line is closed and in the reverse direction when the line is opened, substantially as described.

21. The combination with a telephone-line, an operator's cord-circuit connected therewith, a polarized supervisory signaling device and a battery in the circuit, means for sending current through said device in one direction during conversation, and means for reversing the current through said device when the subscriber's telephone is not in use, whereby said device indicates the condition of the line during a connection, substantially as described.

22. The combination with a telephone-line, of a polarized line-relay, a cord-circuit, a polarized supervisory relay, means for sending currents through said relays when a connection is established with the line to render the line-relay inoperative and the supervisory relay operative or inoperative according as the telephone-line is open or closed.

23. The combination with a calling telephone-line, of a polarized line-relay, a cord-circuit, a polarized supervisory relay connected with the said circuit and means for sending reversing-current through both said relays when a connection is established with the line, whereby both are rendered inoperative.

24. The combination with a calling telephone-line, of a polarized line-relay, a cord-circuit, a polarized supervisory relay in said circuit, means for sending reversing-current through said line-relay and charging-current in an unresponsive direction through said supervisory relay to the substation of the line.

25. The combination with an idle telephone-line, of a polarized line-relay in the line, a cord-circuit, a polarized supervisory relay in said circuit and means for sending current in an unresponsive direction through said line-relay and in a responsive direction through said supervisory relay when a connection is established with the line.

26. The combination with a telephone-line, of a central battery for said line, a polarized line-relay responsive to continuous current in the line in one direction when the subscriber is calling the central office, and means for including said battery and line-relay in a local circuit to send current therethrough in an unresponsive direction when a connection is established with the line to render said relay inoperative as long as the connection exists, substantially as described.

27. The combination with a telephone-line, of a polarized line-relay responsive to continuous current in the line in one direction when the subscriber is calling the central office, a cord-circuit, a battery connected with said circuit, and means for including said battery and line-relay in circuit to send current in an unresponsive direction through said relay when a connection is established with the line and during the connection, substantially as described.

28. The combination with a telephone-line, of a cord-circuit, a polarized supervisory relay in said circuit, a battery, a local circuit containing said relay and said battery completed when a connection is established with the line, and means for causing current to flow in said local circuit to operate the relay when the telephone-line is open.

29. The combination with a telephone-line, of a line-relay and battery in the line, a cord-circuit, a supervisory relay and a battery connected with the cord-circuit, and means for connecting the two relays and the two batteries in series in a local circuit when the cord-circuit is connected with the line.

30. The combination with a telephone-line, of a polarized line-relay and battery permanently in series in the line, a cord-circuit, a polarized supervisory relay and a battery in the circuit, and means for connecting said line-relay in a local circuit with the cord-circuit battery and both relays and both batteries in a second local circuit, when a connection is established with the line.

31. The combination with a telephone-line, of a line-relay and a battery connected therewith, a cord-circuit connected with the line, for conversational purposes, a supervisory relay and a second battery in said circuit, said batteries being adapted to both charge the telephone-line when the line is closed and to both send current through said relays when the line is open, the supervisory relay being responsive and the line-relay unresponsive to such current.

32. The combination with a telephone-line, of a polarized line-relay and a battery in series in the line, a cord-circuit, a polarized supervisory relay in one strand thereof, and a second battery connected between the strands, the said batteries having unlike poles connected together.

33. The combination with the line, a high-resistance polarized relay, a battery and an impedance-coil in series in the line in the order named, of a cord-circuit, a low-resistance supervisory relay and a second battery in series in the circuit, a connection terminal for the line on the substation side of the relay and coil with which the said cord-circuit is adapted to be connected, the unlike poles of said batteries being connected together.

34. The combination with a plurality of

telephone-lines, of operators' cord-circuits, and a battery, a portion of said battery being common to the telephone-lines and another portion common to the cord-circuits, and polarized line and supervisory relays, associated respectively with the telephone-lines and cord-circuits.

35. In a telephone system, the combination with a telephone-line, of a polarized line signaling device connected with the line at the central office responsive to continuous current over the line in one direction when the subscriber is calling the central office, and means when a connection is established with the line in response to the call for sending current through said device in the reverse direction to render the same inoperative and to maintain it inoperative during the connection, substantially as described.

36. In a telephone-exchange system, a subscriber's station and a central station and a line-circuit interconnecting them, a source of current connected to the line, and a signal-magnet connected to said source at a point intermediate its terminals, so as to divide it, together with means controlled by the subscriber to close a circuit through the signal-magnet and one side or division of the source, and means under the control of the central office to close a circuit through the magnet and the other side or division of the source, whereby the signal may be controlled and restored as desired.

37. In a telephone system, a subscriber's station and a central station and a metallic circuit connecting them, a source of current bridged across the metallic circuit at the central station and means at the subscriber's station to determine the flow of current therefrom in the line, a signal-magnet connected from one side of the line to a point intermediate of the terminals of the source of current in making connection with the line, means at the subscriber's station to determine the flow of current in the line from the source, a signal controlled by the magnet, and means to keep said signal normally retired, substantially as described.

38. In a telephone-exchange system, a subscriber's line, a spring-jack for said line, a

source of current, a polarized line signal-magnet connected between the spring-jack and the source of current in a circuit from one side of the line to a point of supply intermediate of the terminals of said source, a connection from one terminal of the source to the other side of line, and means operable in making connection with the line to connect the other terminal of the source to the first side of line on the jack side of the signal-magnet, together with means at the subscriber's station to close the sides of the line together in the use of his telephone, whereby the potential difference at the terminals of the polarized signal-magnet may be reversed at will, substantially as described.

39. In a telephone-exchange system, a subscriber's line, a centralized source of current connected to line, an operator's connective circuit, a polarized signal-magnet connected between the source and line, and means whereby an operator, in making connection with the line, may reverse the direction of current through the polarized signal-magnet without reversing that on the line, substantially as described.

40. In a telephone system, a subscriber's line, a source of current, an operator's connective circuit, a polarized signal-magnet connected between the line and source and a second polarized signal-magnet connected between the connective circuit and the source, together with means under the control of the subscriber to cause a flow of current from the source through the first polarized signal-magnet to set the same, means under the control of the operator to reverse the flow through the same to unset it and to cause a flow of current through the second polarized signal-magnet to set it, and means under the control of the subscriber to reverse the direction of current-flow through the second polarized signal-magnet to unset it during use of the line, substantially as described.

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

WILLIAM W. DEAN.

Witnesses:

J. C. BELDEN,

ROBERT LEWIS AMES.