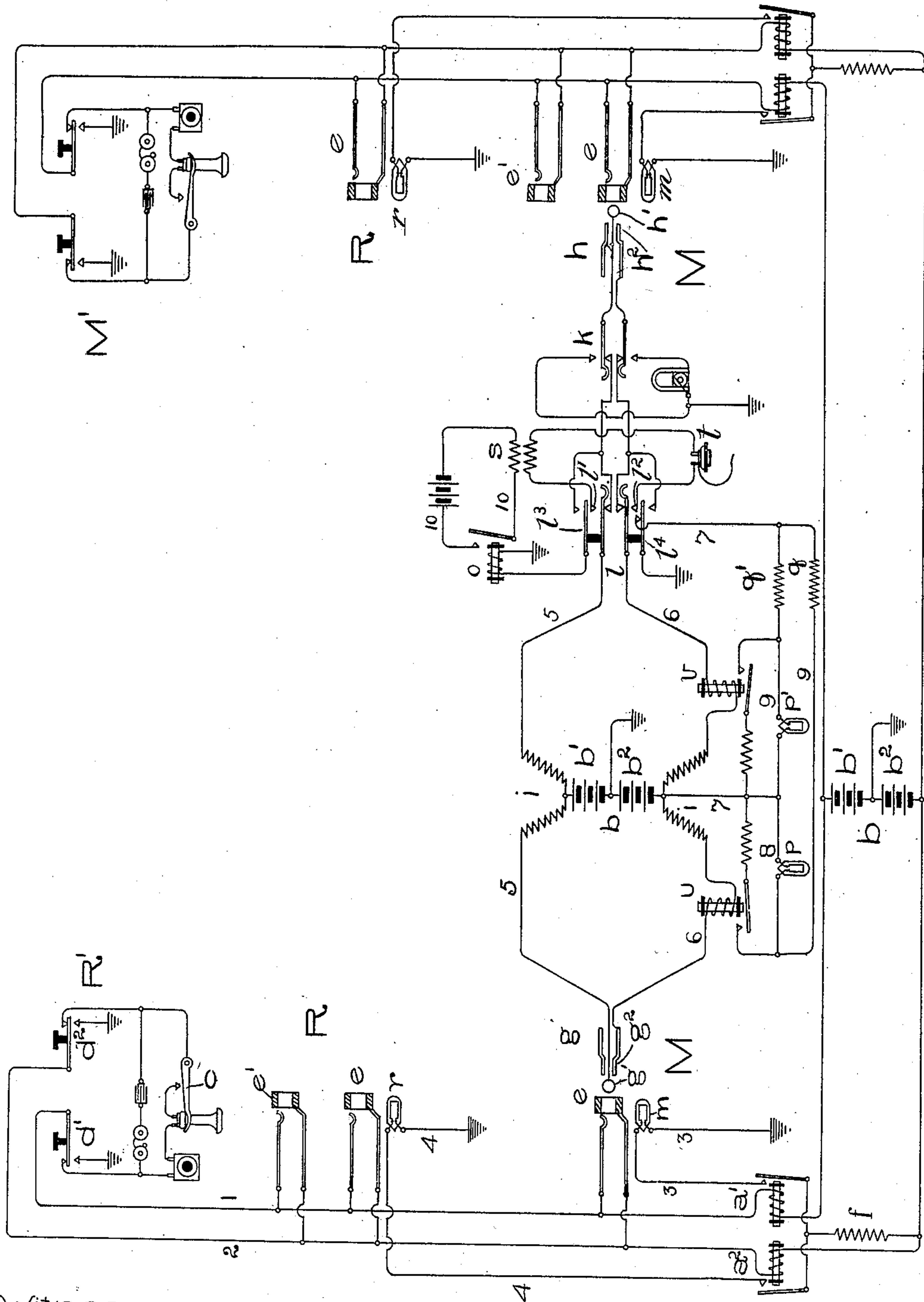


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F. R. McBERTY.
TELEPHONE EXCHANGE APPARATUS.
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TELEPHONE-EXCHANGE APPARATUS.

No. 829,724.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Apparatus, of which the following is a full, clear, concise, and exact description.

My invention relates to telephone-exchanges; and its object is to provide an improved and simplified system and apparatus by which a subscriber may quickly obtain connection with any other subscriber of the exchange whose line is not already in use.

My invention is applicable more particularly to a system in which the central-office switchboard is divided, each line having an answering spring-jack or connection-terminal on some one of the sections of each division, but having multiple spring-jacks or line-jacks only on the sections of one of said divisions. In systems of this character means are provided whereby the subscriber may selectively actuate the signal on either one of the divisions of the central-office switchboard, so that his call will receive attention at the division which has on it the multiple jack of the line wanted—that is to say, the subscriber who desires connection first learns by consulting his telephone directory to which division the line of the subscriber wanted belongs and then by manipulating the proper switching apparatus he brings about the display of a call-signal at that particular division where his call will receive proper attention, the call-signals at the other divisions of the switchboard remaining inert.

One feature of my invention is concerned with the call-signals and the means by which the subscriber may selectively operate them, more particularly in a system where the substation-transmitters are all supplied from the central battery located at the exchange-switchboard. I provide a signal-controlling device in each line conductor at the central office, means controlled from the substation for operating either signal-controlling device over the corresponding line conductor, a telephone-switch at the substation adapted to bring about the operation of both the signal-controlling devices, and means by which the simultaneous operation of both signal-

controlling devices prevents the display of either signal. For instance, incandescent lamps may be provided as signals in different branches of a local circuit, said branches being controlled by the respective signal-controlling devices, which may be relays in the limbs of the telephone-lines, so that when both branches are closed each lamp shunts the other and neither lamp is lighted, but when either branch alone is closed the lamp of that branch will receive sufficient current for its illumination.

In connection with this system I have provided improved means by which the operator can make a busy test. The signal-controlling instruments are of high resistance and are included one in each limb of the line between the poles of the battery and the several spring-jacks of the line. In testing, a device such as a relay, which will remain unresponsive to all currents of less than a given strength, is temporarily connected to a terminal of the spring-jack of the line in question. If the line is free from connections at other spring-jacks, the current flowing through the testing instrument will be so cut down by the presence of the high-resistance signal-controlling device in the circuit that the testing instrument will not respond; but whenever a connection is made with a line the central-office battery is applied to such line through the usual low-resistance repeating-coil of the circuit with which connection is made, whereby the potential at all the multiple spring-jacks of the line will be raised sufficiently so that the testing instrument when connected with the spring-jack of a busy line will respond and give the warning signal.

It is convenient in practice to insert the connecting-plug into the spring-jack of the wanted line if such line has been found to be free before disconnecting the testing instrument, and in order to prevent the actuation of one of the signals by current flowing through the signal-controlling device and the testing instrument I have provided means whereby the circuit through the other signal-controlling device will also be completed as long as the circuit through the testing instrument is completed, so that both signal-controlling devices will be operated and neither signal displayed. The testing instrument is

preferably controlled by a listening-key, which simultaneously connects the testing instrument to one terminal of the plug and applies a ground or return connection to the other terminal.

I will describe my invention particularly and explain further features thereof by reference to the accompanying drawing, which illustrates two telephone-lines extending from substations to a central-office switchboard, with a pair of plugs and their plug-circuit at one of the divisions of the switchboard, the system being organized and equipped in accordance with my invention.

Each line extends in two limbs 1 2 from the substation past the several multiple spring-jack connections at the central office, through the signal-controlling relays a' a^2 , respectively, to the poles of the central battery b . The middle of the battery b is connected to earth, so that the battery is divided into two portions b' b^2 . The usual telephone apparatus is included in a bridge of the line at the substation, said bridge being controlled by the usual gravity telephone-switch c . A signal-bell may be connected with a condenser in a permanent bridge of the line. Two keys d' d^2 are provided at the substation, said keys being connected, respectively, with the limbs 1 2 of the telephone-line, each key being adapted when depressed to open the metallic circuit and complete the circuit of the line with which it is connected to earth or other return-conductor. The metallic circuit is normally open at the contacts of the telephone-switch c ; but said telephone-switch closes the bridge containing the telephone instruments when the receiver is taken from the hook for use.

At the central office the switchboard is divided into two divisions M R. Each line has an answering-jack e on each division and a corresponding line-signal associated with each answering-jack, and each line has, further, the usual multiple spring-jacks e' on one of the divisions. We may assume that the line leading to the substation R' is a line which has multiple jacks only on the division R and the other line is one which has multiple jacks only on the switchboard M. The spring-jacks are of a simple and well-known type, each comprising a line-spring connected to the limb 1 of the telephone-line and a test ring or thimble connected to the limb 2 thereof. The line-signal lamp m which is associated with the answering-jack of the line at the board M is included in a branch 3 of a local circuit from the portion b^2 of the central battery to earth, said branch being controlled at the armature and front contact of the signal-controlling relay a' . Similarly, the lamp r , which is associated with the answering-jack of the line at the switchboard R, is included in a branch 4 of said local circuit, said last-mentioned branch being controlled

at the armature and front contact of the relay a^2 . A resistance f is included in the undivided portion of said local circuit, and the two lamps and said resistances are so proportioned to one another and to the battery that when both branches 3 and 4 are closed neither of the lamps m r will receive sufficient current for its illumination, since each will be shunted by the other; but if one of the branches alone is closed the lamp included in that branch will be lighted.

A pair of plugs g h is provided for making connections. It is understood, of course, that each operator at each division of the board is provided with similar pairs of plugs and their accessory apparatus; but only one pair is shown in the drawings for the sake of clearness, each plug having the usual tip and sleeve contact-pieces which are adapted to engage, respectively, with the line-spring and the ring-contact or thimble of the jack into which such plug may be inserted. The tip and sleeve contacts g' g^2 of the plug g are united with the corresponding contacts h' h^2 of its mate by the link conductors 5 6 of the plug-circuit, which include the windings of the usual repeating-coil i . The central battery b is connected in a bridge of the link conductors 5 6 of each plug-circuit between the windings of the repeating-coil in the usual manner. While I have illustrated two batteries each marked b , it is understood, of course, that a single battery may be employed, connected as indicated. The usual ringing-key k is provided for connecting a source of signal-current in circuit with the contacts of the connecting-plug h .

The listening-key l has two main contact-springs which with their normal resting contact-anvils are included in the circuit of conductors 5 6, respectively, between the battery b and the connecting-plug. When the key is actuated, the springs thereof which form the terminals of the conductors leading from the battery are separated from their normal resting-contacts and thrust into engagement with outer contact-anvils l' l^2 , respectively, which form the terminals of the operator's telephone-circuit, so that when the listening-key is depressed the operator's telephone is connected with the right-hand half of the plug-circuit, and so connected inductively through the repeating-coil with the answering-plug g and the line into whose spring-jack such plug may be inserted. The listening-key l is further provided with special contact-springs l^3 l^4 , the spring l^3 being connected to earth through the testing-relay o and the spring l^4 being also connected to earth. The spring l^3 has no normal resting connection; but the spring l^4 normally rests against a contact-anvil which forms the terminal of a conductor 7, leading from the central battery b , said conductor being divided into two branches 8 9, which contain the

supervisory signal-lamps p p' and resistances q q' , respectively. When the listening-key is depressed, the spring l^4 is separated from its resting-anvil, and both springs l^3 l^4 are thrust into engagement with outer contacts, which are connected, respectively, with the tip and sleeve of the connecting-plug h . Briefly, then, the effect of depressing the listening-key is to connect the operator's telephone in circuit with the repeating-coil i and to connect both the tip and sleeve contacts of the plug h to earth, the path to earth from the tip h' being through the testing-relay o . The relay o controls a local circuit 10, which includes a battery and one winding of the operator's telephone induction-coil s , another winding of which coil is included in the circuit of the head-telephone t .

The usual supervisory relays u and v are provided in the link conductor 6 between the free pole of the battery b^2 and the plugs g and h , respectively. Said supervisory relays are thus sensitive to the closure of the circuit at the substation of the line with which the corresponding plug is connected, and each relay controls a shunt about the corresponding supervisory signal-lamp—that is to say, a shunt about the lamp p is controlled by the relay u and the shunt about the lamp p' is controlled by the relay v . When the circuit of the line to which the plug g is connected is open, the relay u will be inert and the lamp p excited, (assuming that the circuit of conductor 7 is completed at the contacts of the listening-key.) The lamp p' is similarly controlled through the agency of the telephone-switch at the substation of the line to which the plug h is connected.

The operation of the system is as follows:
 40 When a subscriber desires to communicate with some other subscriber of the exchange, he first consults his telephone directory and learns whether the connection can be made at division M or division R. If the line wanted belongs to division M, he presses key d' , thus closing the circuit of the limb 1 of his line from the battery b' through the relay a' over the line to earth at the substation, whereupon the relay a' will close the local circuit 3 and light the lamp m at the switchboard M. If, however, the line wanted belongs to division R, the calling subscriber will press his key d^2 , thus grounding the limb 2 of the line and causing the operation of the relay a^2 and the consequent lighting of the signal-lamp at the board R. The operator will respond to the call by inserting her answering-plug g in the answering-jack which corresponds to the lamp which is lighted, and her listening-key being depressed her telephone t is brought into inductive connection with the line of the calling subscriber. If the subscriber removes his telephone from its hook before depressing either of the calling-keys d' d^2 , the metallic

circuit will be closed by the switch c and both relays a' a^2 will be excited. Unless one or the other of the keys d' d^2 is depressed, however, neither of the signals m r will be displayed, because each of the signal branches 3 4 shunts the other branch, so that neither lamp receives enough current for its illumination. In the system shown either lamp can be lighted, whether the telephone-switch c be open or closed, by depressing the proper key d' or d^2 , which opens the metallic circuit and grounds the corresponding line conductor. When the operator has learned the number of the subscriber with whom connection is desired, she tests the spring-jack of that subscriber's line to see if it is free. This test is made by touching the tip h' of the connecting-plug to the ring-contact of the spring-jack of the line in question, while the operator's listening-key is depressed. If the line tested is free, the current flowing from the battery b^2 through the relay a^2 of such line to the thimble of the jack and thence by way of the tip of the connecting-plug to earth through the test-relay o is not sufficiently strong to cause said relay o to draw up its armature. If, however, a connection exists at some other spring-jack, the division b^2 of the battery b will be connected directly with the limb 2 of that line, and so with all the contact-thimbles of its spring-jacks, through only the low resistance of a repeating-coil winding. As the tip of the connecting-plug is touched to the thimble of the jack of a busy line, therefore, sufficient current will flow to earth through the relay o to cause the same to draw up its armature, whereby the local circuit 10 is closed and a click produced by induction in the operator's telephone t . The operator will thus be warned that the line called for is busy and will inform the calling subscriber of the fact. If the line tested is free, the operator will go on and insert the connecting-plug clear in the jack without waiting to change her listening-key, and to prevent the display of the line-signal r of such line at this time I have provided the contact l^4 , so that both contacts of the plug will be grounded, both signal-controlling relays a' a^2 being thus operated so that neither of the line-lamps is lighted. After inserting the connecting-plug the operator throws her listening-key into its alternative position and signals the called station by depressing calling-key k . Calling supervisory lamp p' remains lighted until the subscriber at the called station responds, when it is extinguished by the closure about it of the shunt-circuit controlled by calling supervisory relay v . The end of the conversation is signaled by both supervisory lamps lighting, whereupon the operator takes down the connection and extinguishes the lighted lamps by moving key l into the listening position, in which posi-

tion it is allowed to remain as long as the connecting-cords with which it is associated are not in use.

Having thus described my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. The combination with a metallic-circuit telephone-line, of a source of current, a magnet in each side of the line, a signal controlled by each magnet, an operating-key at the substation for each of said magnets, and a telephone hook-switch at the substation for effecting the simultaneous operation of said magnets to prevent the display of either signal.

2. The combination with a telephone-line extending in two limbs from a substation to a switchboard, of a signal-controlling magnet in each line conductor, a circuit containing a signal controlled by each magnet, means controlled by the simultaneous closure of both signal-circuits, adapted to prevent the display of either signal, a source of current, means at the substation of the line for controlling the circuit between either limb of the line and a return-conductor, to cause the display of either signal, and a switch *c* at the substation adapted to complete the metallic circuit including said source of current through both limbs, whereby the previously-displayed signal is effaced.

3. The combination with a metallic-circuit telephone-line, of a source of current, a magnet in one side of the line controlling a line-signal, a switch at the substation for completing the circuit of that side of the line alone, a magnet in the other side of the line controlling a line-signal, a switch for completing the circuit of that side of the line, means controlled by each signal for preventing the display of other line-signal by its magnet, and a telephone-switch at the substation for closing the metallic circuit to excite both magnets simultaneously.

4. The combination with a metallic-circuit telephone-line, of a battery *b* connected in a bridge of the line at the central office, the middle of said battery being grounded, a relay in each side of the line, a local circuit having two branches which are controlled respectively by said relays, a line-signal in each branch, each line-signal being adapted to be shunted out by the other branch when closed, keys *d'* *d*² at the substation adapted to close either side of the line to ground, to cause the display of the corresponding signal at the central office, and a telephone-switch adapted to close the metallic circuit, whereby both relays are excited and the previously-displayed signal effaced.

5. The combination with a telephone-line extending in two limbs to the poles of a central-office battery, which is also connected to a third or return conductor, a high-resistance signal-controlling device being perma-

nently connected between one limb of the line and the free pole of said battery, of multiple spring-jacks for the line, plugs and their plug-circuits for uniting lines, a source of current being connected in a bridge of each plug-circuit and being applied to the test-contacts of a line through the low-resistance repeating-coil when the plug is inserted in a spring-jack of such line, each spring-jack having a test-contact connected through the high-resistance signal-controlling device with the free pole of the battery, a testing instrument and means for connecting the same between said return-conductor and a testing-contact of one of the plugs of each pair said testing instrument being adjusted to respond when receiving current through the resistance merely of another plug-circuit, but not to respond to current received through the resistance of one of said signal-controlling devices.

6. The combination with a telephone-line extending in two limbs from a substation to the poles of a divided central battery, which is also connected to a return-conductor, of high-resistance signal-controlling devices one in each side of the line, and means at the substation for controlling said signal devices independently of one another, multiple spring-jacks for the line, plugs and their plug-circuits for making connection therewith, each plug-circuit having a source of current connected therewith, which is applied to all the test-contacts of a line when connection is made with one of the spring-jacks of such line, a testing instrument connected between the aforesaid return-conductor and the tip of the testing-plug, and another connection from said return-conductor to the other contact of the testing-plug, whereby the complete insertion of the testing-plug into the spring-jack of a line completes the circuit through both of the aforesaid signal-controlling devices of such line.

7. The combination with a telephone-line extending in two limbs from a substation to the poles of a divided central battery, which is also connected to a return-conductor, said telephone-line having high-resistance signal-controlling devices one in each side thereof, and means at the substation for controlling said signal devices independently, of multiple spring-jacks for the line, plugs and their plug-circuit for making connection therewith, said plugs having two contacts adapted to be brought into connection with the two sides of the line respectively, each plug-circuit having a source of current connected therewith which is applied to all the test-contacts of a line when connection is made with one of the spring-jacks of such line, an operator's telephone apparatus and a listening-key for the plug-circuit, a testing instrument associated with the operator's tele-

phone apparatus, and special contacts for the listening-key adapted to connect both contacts of the testing-plug to the aforesaid return-conductor, the testing instrument being interposed by said contacts in the circuit between said return-conductor and the tip of the testing-plug.

8. The combination with a metallic-circuit telephone-line, of a source of current, a magnet in one side of the line controlling a line-signal, a switch at the substation for completing the circuit of that side of the line alone, a magnet in the other side of the line, and means controlled thereby for preventing the display of the line-signal by the first-mentioned magnet, a switch at the central station for making connection with the line, a signal device associated with the switch, and a bridge of the line including the signal device, completed in contacts of the switch, whereby the display of the line-signal is prevented when the signal device is connected with the line.

9. The combination with a metallic-circuit telephone-line extending from a substation to a central-office battery, of a magnet in each side of the line, a signal and a circuit therefor controlled by each magnet and means at the substation for operating either

or both of said magnets to close either or both of said signal-circuits, said circuits when both closed shunting each other to prevent the display of either signal.

10. The combination with a metallic-circuit telephone-line, of a source of current, magnets in the limbs of said line having independent circuits controlled by keys at the substation of the line, a signal controlled by one magnet, and a shunt about said signal controlled by the other magnet.

11. The combination with a metallic-circuit telephone-line extending in two limbs from a substation to a central-office battery, said battery being grounded at its central point, a magnet in each limb of the line, a signal controlled by each magnet, keys at the substations adapted to ground the limbs of the line to operate the respective magnets, and a telephone-switch at the substation adapted to bridge the limbs of the line to effect the operation of both magnets and prevent the display of either signal.

In witness whereof I hereunto subscribe my name this 28th day of July, A. D. 1902.

FRANK R. McBERTY.

Witnesses:

EDWIN H. SMYTHE,

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