(No Model.) 4 Sheets—Sheet 1.

J. J. O'CONNELL.

TELEPHONE EXCHANGE APPARATUS.

No. 430,747. Patented June 24, 1890.

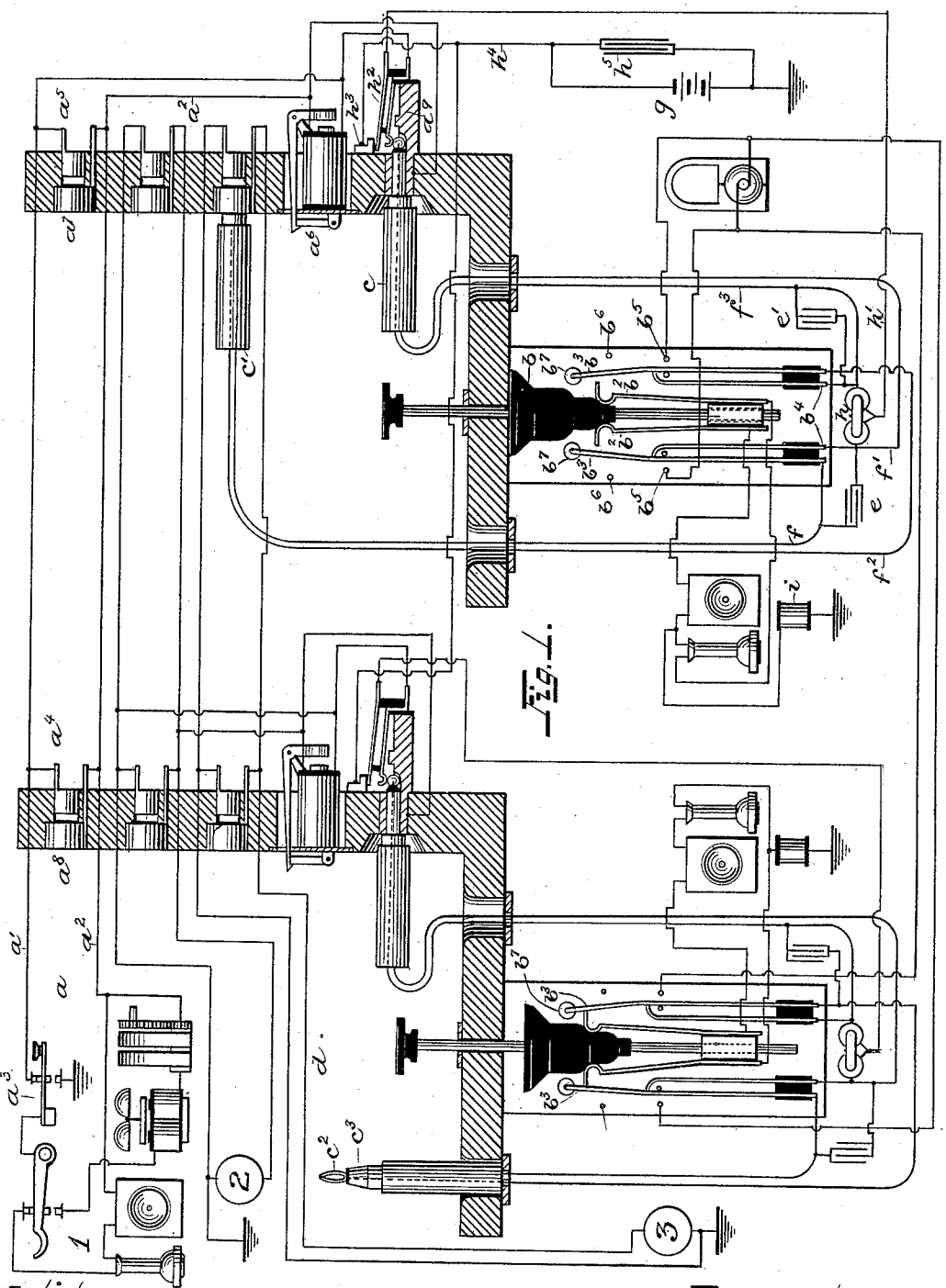

Fig. 1.

Witnesses.
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G. R. Parker.

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By George P. Barton
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(No Model.) 4 Sheets—Sheet 2.

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TELEPHONE EXCHANGE APPARATUS.

No. 430,747. Patented June 24, 1890.

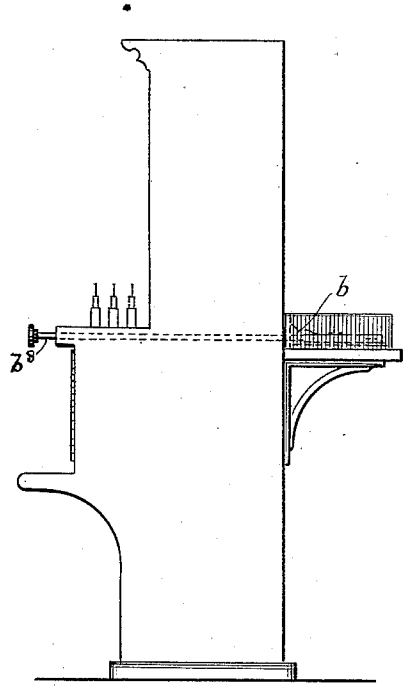

Fig. 2.

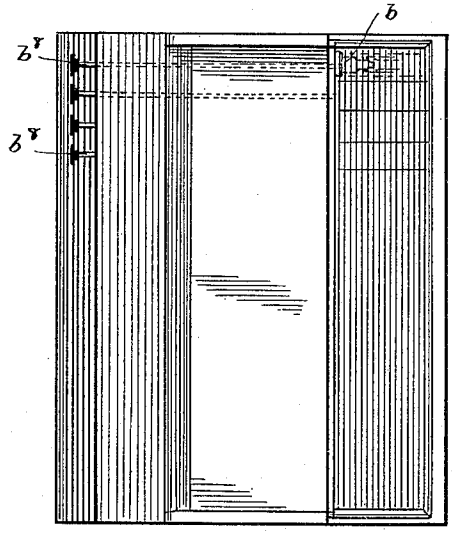

Fig. 3.

Witnesses.
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(No Model.) 4 Sheets—Sheet 3.

J. J. O'CONNELL.

TELEPHONE EXCHANGE APPARATUS.

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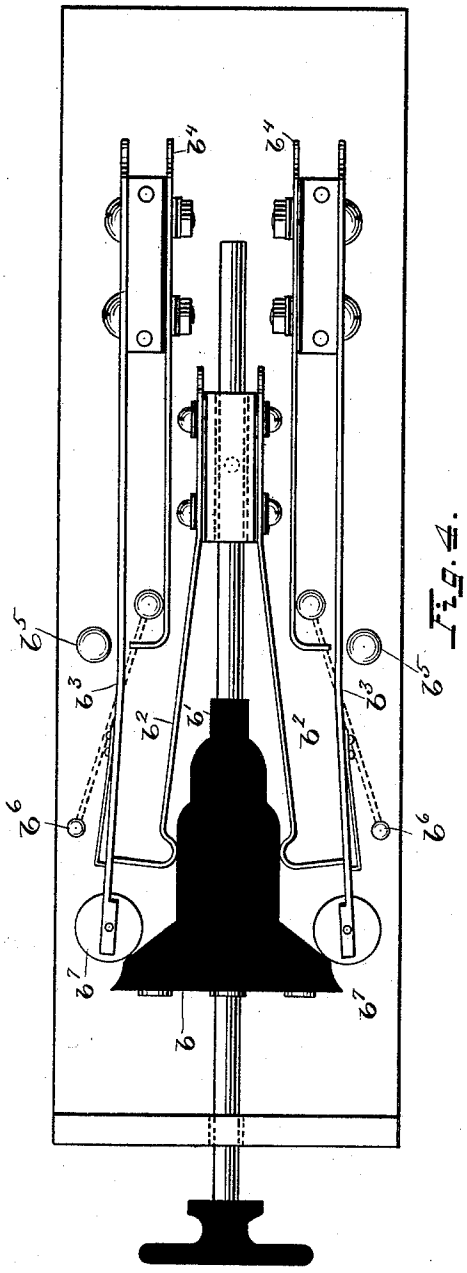

Fig. 4.

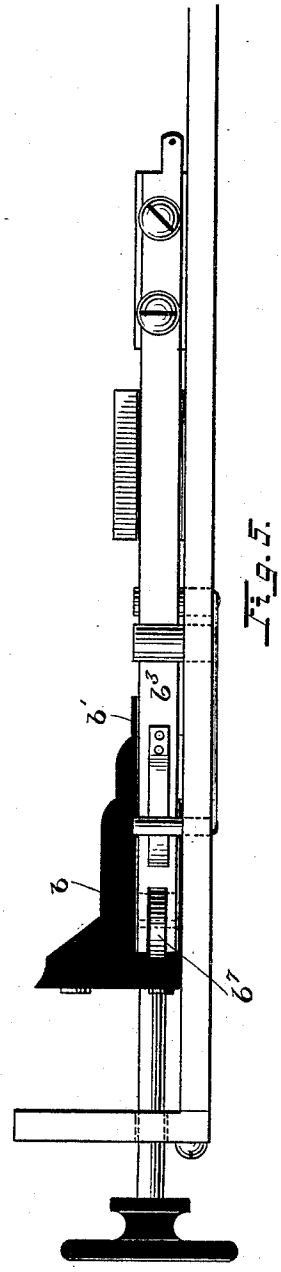

Fig. 5.

Witnesses.
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(No Model.) 4 Sheets—Sheet 4.

J. J. O'CONNELL.

TELEPHONE EXCHANGE APPARATUS.

No. 430,747. Patented June 24, 1890.

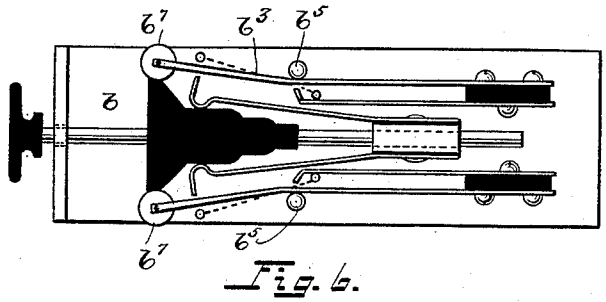

Fig. 6.

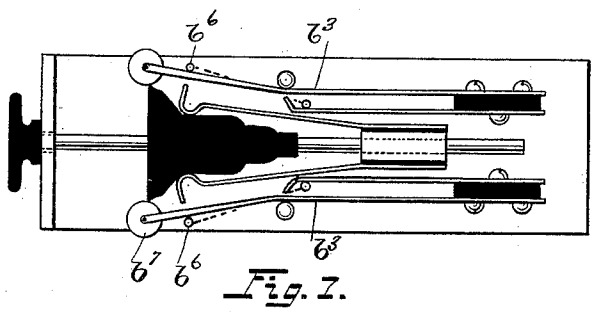

Fig. 7.

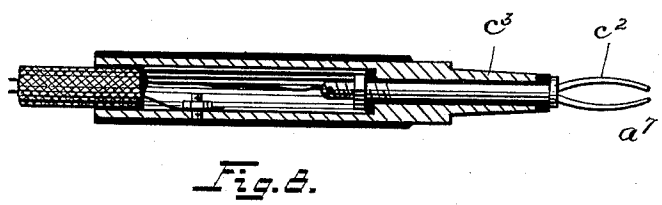

Fig. 8.

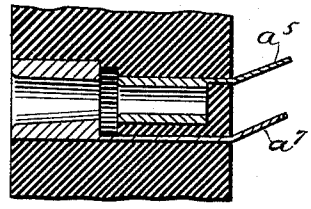

Fig. 9.

Witnesses.
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G. R. Parker.

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UNITED STATES PATENT OFFICE.

JOSEPH JOHN O'CONNELL, OF CHICAGO, ILLINOIS.

TELEPHONE-EXCHANGE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 430,747, dated June 24, 1890.

Application filed September 30, 1889. Serial No. 325,519. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH JOHN O'CONNELL, 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-Exchange Apparatus, (Case 7,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone-exchange systems, and is more especially designed for use in exchanges in which metallic telephone-circuits are employed in connection with multiple switch-boards. In such systems it is of importance to provide means for readily determining at one board whether any line is in use at any other of the boards. It is important, also, that when two subscribers' lines are connected together their united circuit shall be as free from resistance as possible. In order to accomplish these results and provide for receiving and answering the calls and making the connections and disconnections, I have devised apparatus and circuits adapted to accomplish these desired results in the most simple, satisfactory, and efficient manner.

My invention consists, first, in a double thimble-socket, with the different portions of which the different sides of the limbs of the metallic telephone-line circuits are connected, one of said double thimble-sockets being provided, when multiple switch-boards are employed, on each board for each line; second, in the pair of loop-plugs, one being adapted to be inserted in the answering spring-jack of a calling-subscriber's line, and the other being adapted to be used as a test-plug and to be inserted in the double thimble-socket of the line called for; third, in providing a high-resistance individual annunciator in each metallic circuit, so that when an instrument, as a telephone or annunciator, shunts this high-resistance annunciator it will be prevented from being operated by any of the currents liable to be thrown upon the line; fourth, in providing a condenser of considerable capacity in a shunt around the grounded test-battery, to prevent disturbances which might otherwise be caused by induced currents from the circuit containing the battery; fifth, in the key-board apparatus and circuits therefor; sixth, in a special shelf provided at the rear of the switch-board for supporting the different sets of key-board apparatus.

The operators at the different switch-boards are provided with pairs of loop-plugs, and in connection with each pair a switching device included in the flexible cords connecting the corresponding terminals of the plugs, this switching device being so constructed and arranged that after the answering-plug of the pair is inserted in an answering-jack the operator's telephone may be first bridged across the cords. The operator then, having received the order for another line, will first manipulate the key to disconnect her own test-battery connection, and will then test the line thus called for by applying the tip of the other plug of the pair—that is to say, the tip of the test-plug—to the front portion of the socket of the line called for. The line wanted having been thus tested and found free, the test-plug is inserted in the socket. Now, by again manipulating the key-board-switching device, the calling-generator is connected with the line wanted, and preferably with that line only, for a couple of seconds, and immediately thereafter the calling-subscriber's line may also be at the same time looped onto the generator, so that the calling-subscriber will know that the subscriber wanted is being called. Now, by bringing the switching device back to its first position, the two lines are left looped together.

I preferably provide in each cord of each pair of cords a condenser in a shunt across the corresponding strands—that is to say, between the strand connecting with the tip of one plug and the strand connecting with the tip of the other plug, and also between the strand connecting with the sleeve of one plug and the strand connecting with the sleeve of the other plug, so that when the key is manipulated to open the test-battery and the two cords of a pair are disconnected as to battery-circuits there may be a circuit completed through the condenser, so as to leave both of the telephone-lines with which connection

has been made connected together telephonically—that is, through the condensers—with the operator's telephone.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram illustrative of three metallic-circuit telephone-lines connected each with two multiple switch-boards with switch-board apparatus and circuits embodying my invention. Fig. 2 is an end view of a switch-board, showing a shelf at the rear for supporting the key-board switches. Fig. 3 is a plan view of the same. Fig. 4 is a detailed plan of one of the switching devices. Fig. 5 is a side elevation thereof. Fig. 6 is a plan view showing the switching device in position to loop the generator into the called-subscriber's line. Fig. 7 shows the plunger inserted farther, so as to separate the springs carrying the frictional wheels, so as to loop the calling-subscriber's line, as well as the called-subscriber's line, into the circuit of the calling-generator. Fig. 8 is a detailed sectional view of that one of the pair of loop-plugs which is used for testing, and which is especially adapted to be inserted in the double thimble-socket. Fig. 9 is a detailed sectional view of the socket.

Like parts are indicated by similar letters of reference throughout the different figures.

The telephone-line a consists of two limbs or sides a' a^2. These sides are united together in metallic circuit, as shown at station 1, through the telephone when the telephone is removed from the switch. When the telephone is on the switch, the circuit of the branch containing the telephone is opened and the generator and bell are included in the circuit. A grounding-key a^3 is provided in the limb a' near the switch, so that after the telephone is hung up the branch a^2 may be closed through the switch and said key a^3 to ground, while the limb a' is left open in order that the subscriber, by turning his generator, may clear out, as will be hereinafter more fully explained.

The limb a' extends to the rear portion a^4 of a thimble-socket on the first board and thence to the rear portion a^5 of a thimble-socket on the next board, thus being connected with the rear portion—that is to say, with one of the insulated connecting-pieces of each of the sockets of the line on each of the switch-boards. From thence the circuit may be traced normally through the individual annunciator a^6, and thence by the return portion a^2 of the metallic circuit to the other connecting-pieces of each of the thimble-sockets of the line of each of the boards—that is to say, as shown, to the front portion a^7 of the last board, and thence to the front portion a^8 of the first board, and thence to the telephone-switch through the branch containing the generator and bell when the telephone is on the switch and when the telephone is removed from the switch, as shown through the branch containing the telephone, to the switch. The answering spring-jack switch a^9 is provided in the circuit of telephone-line a, as shown. The circuit-connections of this answering spring-jack switch being novel will be described hereinafter in detail. The telephone-lines of the other stations, as 2 3, are each connected in the same way at their stations and with their switches upon the switch-boards, respectively.

As illustrated in Figs. 2 and 3, it will be seen that the operators are provided with a switching device in connection with each pair of cords, the springs and contacts forming the principal part thereof being supported upon a shelf at the rear of the switch-board. I will describe the construction of this switching device in connection with Figs. 1, 4, 5, 6, and 7, in which are illustrated the different positions thereof. The object of this switching device is to provide ready means, first, for bridging the operator's telephone across the strands of the cords, as shown at board 1, Fig. 1; second, to disconnect the test-battery from the test-plug by opening the contacts between the terminal springs of the different cords of the pair, as shown in Fig. 4; third, to send current from the generator over the called-subscriber's circuit by closing the springs or terminals of the strands of the cord of the test-plug to the generator-connections; and, fourth, to further move said springs to close upon contacts connected with the springs forming the terminals of the strands of the answering-plug, so as to send current over the calling-subscriber's line as well as over the line of the called subscriber, thus looping the two metallic circuits through the generator. All these different connections are made by manipulation of the wedge b. The thinnest portion b' of this wedge or plunger normally rests between the springs b^2 b^2, as shown at board 2, Fig. 1, these springs b^2 b^2 being the telephone contact-pieces. When the plunger is inserted a single step, as shown at board 1, Fig. 1, these springs b^2 are separated so as to come against the springs b^3 b^3, which are connected, respectively, with the different strands of the test-plug. The springs b^4 b^4, which form the terminals of the strands of the cord of the answering-plug, are still in contact with springs b^3 b^3, as shown at the first board of Fig. 1, and hence the telephone of the operator is now connected with the line of the called-subscriber, the answering-plug having been inserted in the answering spring-jack of the called-subscriber's line. The plunger is inserted a second step so as to disconnect springs b^2 b^2, respectively, from springs b^4 b^4, thus cutting off the calling-subscriber's line with which the operator's test-battery is connected, so as to enable the operator to test with the tip of her test-plug applied to the test-piece of the socket of the line called for. This position of the switching device is illustrated in Fig. 4, in which the springs b^2 b^2 are shown in contact with

the springs b^3 b^3, which springs b^3 b^3 form the terminals of the strands of the test-plug. The test of the line having been made and the line being found free, the plunger is inserted the third step and current is sent over the line called for by throwing springs b^3 b^3 against the generator-contacts b^5 b^5, as illustrated in Fig. 6. Now, if it is desired to ring both ways, the plunger is inserted still farther, as shown in Fig. 7, so as to bring the springs b^3 b^3 against the contacts b^6 b^6, which are connected, as indicated by dotted lines, with the spring b^4 b^4. Thus when the plunger is inserted, as shown in Fig. 7, and the springs b^3 b^3 are thus most widely separated, the strands connecting with the springs b^4 b^4 are looped through the generator as well as the strands of the test-plug, which strands are connected with springs b^3 b^3, and in this manner, as before stated, the operator is enabled to ring both ways—that is to say, send current over the line called for and at the same time over the calling-subscriber's line, so that the calling subscriber may know that the operator is doing her duty. It should be noted, however, as before stated, that the signal-current is first sent over the called-subscriber's line only. Thus the whole current from the generator is utilized as a signal-current over the called-subscriber's line before any portion thereof is diverted over the calling-subscriber's line. The springs b^3 b^3 are preferably provided with friction-rollers b^7 b^7, so that the widest portion of the wedge may be at a considerable angle to the direction of said springs. Thus the springs will be separated a considerable distance by only a moderate movement or thrust of the wedge, while the friction between the wedge and the springs b^3 will be reduced to the minimum by means of said wheels or rollers b^7. As shown more clearly in Figs. 2 and 3, the principal parts of these switching devices are placed upon a shelf at the rear of the switch-board, the handles b^8 from the plungers extending to the front of the board and preferably being provided with knobs. The switching devices are thus placed out of the way of the operators and their weight sustained upon the shelf provided therefor, all the springs and contacts thereof being made readily accessible for inspection or repairs.

The form of the switch-connection or socket which I use upon the switch-boards is preferably that illustrated in detail in Fig. 9. The board may be of hard rubber or wood. This is bored out to receive the different metallic portions of the socket. I have found it most convenient to use thimbles of different diameters, the thimbles being insulated from one another and each provided with a different connection, extending to the rear of the switch-board. Thus, as shown in Fig. 9, the inner thimble a^5 is provided with the connection extending to the rear of the board, while the outer thimble a^7 is provided with a similar connection extending also to the rear of the board. The outer portion is sometimes spoken of as "the test portion of the socket." As heretofore described in connection with line *a*, Fig. 1, the limb a' is connected with the rear portion of the socket, and the limb a^2 with the test portion of the socket of the line upon each of the boards.

The operators at the different boards are provided with pairs of plugs and flexible double-stranded cords connected therewith. The plug of a pair, by means of which connection is made with the line of the calling subscriber, is termed the "answering-plug," while the other plug, which is used for testing the line called for and completing the connection therewith, is usually termed the "test-plug." Thus at the second board of Fig. 1 I have shown the answering-plug *c* inserted in the answering spring-jack switch a^9 of line *a*, while the test-plug c' is shown inserted in the socket of the line *d* of station 3, said socket being the socket of line *d* upon board 2. Thus at board 2 the telephone-lines *a d* of stations 1 and 3 are shown looped together by means of the pair of loop-plugs *c* c' and their cords, the different strands of cord *c* being connected with the springs b^4 of the switching device, and the different strands of the cord of plug c' being connected with the springs b^3 thereof, and the plunger being withdrawn allows these springs b^3 b^4 to rest in contact with one another, so that the two lines *a d* are looped together to form a single metallic circuit.

I preferably provide condensers *e* e' in a wire connected between the springs b^3 b^4 on each side of the switch—that is to say, the condenser *e* is placed in a wire between the strand *f*, connecting with the sleeve of plug c', and the strand f', connecting with the sleeve of plug *c*, while the condenser e' is connected between the strand f^2, connecting with the tip of plug c', and the strand f^3, connecting with the tip of the plug *c*. Thus I include a condenser across the strands connecting with the tips of the plugs, and also a condenser in a wire connecting with the strands leading to the sleeves of the plugs. No matter what may be the position of the plunger of the switching device, any two lines with which the plugs are connected will be connected together telephonically through the condensers. The condensers are of special utility when the plunger has been inserted to the position shown in Fig. 4 to disconnect the springs b^4 of the answering-plug, which has been inserted in the answering spring-jack, so as to connect the test-battery *g* with the said springs b^4. The battery *g* is thus cut off from the test-plug, while telephonic connection is maintained through the condensers.

I have described the strands *f* and f' as connected with the sleeves of their respective plugs, and the strands f^2 and f^3 as connected with the tips of their respective plugs. Thus the springs of the switching device with which strands *f* f' are connected, respectively, may be considered as the springs leading to the

sleeves of the plugs, respectively, and may be spoken of as the sleeve-springs, while the springs on the opposite side of the switching device corresponding thereto—that is to say, the springs with which strands f^2 and f^3 are connected—may be considered as tip-springs of the switching device. These terms are used, however, only for clearness in description, since it is evident that the connections of the plugs and the sockets or switches into which they are inserted might be reversed so that the tip contacts would have the function of the sleeve-contacts, and vice versa. I have shown the ground branch from the operator's telephone on the proper side thereof to be operative with the circuits, as illustrated and explained.

The test-plug, as shown in Fig. 8, is adapted to be inserted in the double thimble-socket in Fig. 9. The tip c^2 thereof, which is in the form of two springs, makes connection with the portion a^5, while the sleeve c^3 thereof makes connection with the portion a^7 of the socket.

The individual annunciators of the different lines, as annunciator a^6 of line a, should be of high resistance—say one thousand ohms or over—so that its resistance will be, say, twice that of any circuit, and thus an instrument, as a telephone or annunciator shunting this high-resistance drop, will prevent the drop from being operated by any of the currents liable to be thrown upon the line.

In each pair of cords is provided a high-resistance clearing-out annunciator—that is to say, the annunciator is bridged in between the strands of the cord of the answering spring-jack, and a branch from between these coils extends to a contact-spring of the answering spring-jack. A ground-connection from a contact with which this spring is adapted to be closed extends through the test-battery to ground, a shunt containing a condenser being preferably placed around the test-battery. Thus when the answering-plug of a pair is inserted in the answering spring-jack of a line the branch containing the test-battery is closed to ground, the circuit thus closed being from between the coils of the clearing-out annunciator to a special spring of the answering spring-jack, and from this spring to the contact against which it is closed when the plug is inserted, and from this contact through the battery to ground. Thus, as shown at board 2 of Fig. 1, the clearing-out annunciator h, which may be of six hundred ohms resistance, is connected between the strands $f' f^3$ of the answering-plug c. The branch h' extends from between the coils of the annunciator h to the spring h^2 of the answering spring-jack a^9. The plug c being inserted, this spring h^2 is closed upon the contact h^3. From this contact h^3 the circuit is completed by wire h^4 from the battery g to ground. The condenser h^5 is included in a shunt around this test-battery g, and should be of considerable capacity—say five micro farads or over—and its object is to permit of a free-talking circuit to ground—that is to say, a circuit which shall not be impaired by the resistance of the battery g. In my system, however, this battery is never included in a direct talking-circuit. Since, however, the same test-battery is used for many lines, several may at the same time be branched through their respective clearing-out annunciators and the common test-battery g. The resistance of this test-battery, which may consist of only one cell of storage-battery, would in such case be so small as not to injuriously interfere with the conversation going on over several lines that might be at the same time branched through their respective clearing-out annunciators to this common ground branch containing the test-battery—that is to say, a battery consisting of a single cell would not cause appreciable cross-talk between several lines thus branched through the same. Sometimes, however, it is found desirable to use as many as five cells of storage-battery or other battery, in which case I find the condenser very useful, since current which would otherwise be diverted by the resistance of the battery, so as to occasion slight cross-talk, would be dissipated to ground through the condenser.

I will now describe briefly the operation of my telephone system and apparatus. I will suppose that the subscriber at station 1 wishes connection with some other subscriber. With his telephone still remaining upon the switch so as to bring his generator and bell into the circuit of line a, he will turn the generator, thus sending current through the individual annunciator a^6 and operating the same. The operator at board 2, where the annunciator a^6 is placed, seeing the drop a^6 fall, will know that a signal has been sent over line a and will at once insert answering spring-jack c into the answering spring-jack a^9 of line a, as shown. Immediately thereafter she will insert the plunger of the switching device one step, so as to bridge the telephone into circuit. Listening, then, at her telephone, she will receive the order from subscriber 1, he having taken down his telephone immediately after operating his generator. The subscriber thus gives his order, say, for a connection with station No. 3—that is to say, with line d. The specific order for the connection has thus been received by the operator, and it is her duty to make the connection with line d. It must, however, first be determined whether line d is or is not busy. If the line were busy, battery current would be present at the test-sockets of the line at each of the boards. The operator therefore proceeds to make the test for such battery-current at the front portion of the socket of line d upon her board—that is to say, upon board 2. Before making this test, however, she must insert the plunger a second notch—that is, to the position shown in Fig. 4—in

order that the test-battery g may be disconnected, so as not to find circuit through the strand f^2 and the tip of the test-plug when the tip of plug c' is applied to the front portion of the socket in making the test. Now, if a connection had been made with line d, we will say at the first board, battery-current would be present at the test portions of the sockets of the line, and hence current would be directed through the tip of the test-plug and by strand f^2 to the spring b^3, with which said strand f^2 is connected, and thence through the telephone contact-spring b^2, and thence through the telephone and to ground through high resistance i, of, say, from three hundred to five hundred ohms. I will assume, however, that the line is found free, in which case there will be no current directed through the operator's telephone, and the operator, hearing no sound in her telephone, will at once insert the plug c' into the socket, as shown, thus completing the connection. She will then at once press in the plunger, first, to the position shown in Fig. 6, so as to direct the whole current over the called-subscriber's line, and then immediately thereafter insert the plunger as far as it will go—that is to say, to the position shown in Fig. 7—so as to send current from the generator in both directions—that is to say, over the calling subscriber's line as well as over the line of the called subscriber. The called subscriber is thus rung up, and the two subscribers being thus placed in communication the operator will withdraw the plunger to the position indicated at board 2 of Fig. 1, leaving the two subscribers thus connected together. Now, when the subscribers are through talking either may send in a clearing-out signal by depressing the grounding-key of his particular station and turning his generator. Thus by depressing key a^3 and turning the generator of station 1 current will be sent over a circuit which may be traced from the ground thus formed at station 1 through the bell and generator over limb a^2 to the spring of answering-switch a^9, and thence to the tip of plug c, and thence through one coil of the clearing-out shutter h, and thence by wire h', spring h^2, contact h^3, and wire h^4 to ground. Thus either of two connected subscribers by simply hanging up his telephone, closing the grounding-key, and turning the generator may clear out.

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

1. A socket for switch-boards, consisting of two insulated portions, in combination with a metallic-circuit telephone-line connected therewith, one side to one portion of the socket and the other side to the other portion thereof, and a loop-plug having two terminals inserted in said socket, one terminal of the plug being closed to one portion of the socket and the other terminal to the other portion of the socket, said sides of the telephone-circuit extending beyond the socket and including a high-resistance annunciator, and the terminals of the inserted plug being connected together through an electric instrument of low resistance as compared with the resistance of the said annunciator, whereby the said annunciator is shunted, substantially as and for the purpose specified.

2. The combination of two metallic-circuit telephone-lines, each having the different sides thereof connected with a different portion of its metallic socket on each of two or more switch-boards, one of said lines extending to an answering spring-jack, a pair of loop-plugs and their double-stranded cords, the answering-plug of the pair being inserted in the said answering spring-jack and the other plug of the pair being inserted in the socket of the other line on the same board, and a switching device included in said pair of cords, said switching device having connecting-springs, one pair of springs for the strands of each cord, the different springs of one pair being connected each with a different spring of the other pair, whereby the two telephone-lines are looped together.

3. The combination, with a battery in a ground-circuit, of a condenser in a shunt around said battery and several metallic telephone-circuits having each a branch connected through high resistance to the said ground-circuit which contains the battery, substantially as and for the purpose specified.

4. The combination, with two metallic-circuit telephone-lines looped together for conversation, of a high-resistance clearing-out annunciator bridged across said circuit at the central office and a branch circuit from between the two coils of said clearing-out annunciator to ground, and a grounding-key and generator at each of the two connected stations, whereby either of the two connected subscribers may open the circuit on one side and close the same to ground on the other side to include his generator and one coil of the clearing-out annunciator in a grounded circuit.

5. The combination, with a metallic-circuit telephone-line having its different sides connected each with different corresponding parts of different connecting-sockets, the sockets being distributed on different boards, of a high-resistance individual annunciator permanently included in said telephone-line back of all of said sockets, and a loop-plug at each of the boards, the plug at any board being adapted to be inserted in the socket of the line at the same board to loop the said line with a circuit connected with the plug thus inserted, and a battery in a ground branch connected to said circuit connected with the plug, whereby the individual annunciator is shunted when the plug is inserted, while at the same time the ground branch containing the battery is connected with the line to put the line in condition to indicate the busy-test.

6. The combination, with two metallic circuits connected together by a pair of loop-plugs at one of two or more boards with which both lines are connected, of a ground branch containing battery connected with the talking-circuit formed by the united circuit of the two lines, and a test-plug at one of the other boards connected through the operator's telephone and thence through a resistance-coil to ground, whereby on applying the test-plug to the test portion of the switch or socket of either connected line upon said board current will be directed from the test-battery through the telephone to indicate the busy-test.

7. The test-plug consisting of the insulated sleeve and the tip extended in the form of two springs and the cord having two strands connecting each with a different terminal of the test-plug, a telephone looped into the circuit of said strands, and a branch circuit to ground through a resistance-coil on the side of the telephone opposite the tip of the plug.

8. The combination, with two metallic telephone-circuits looped together, of a switching device at the central office, having two pairs of connecting-springs and a wedge or plunger adapted to be inserted between said springs to open the circuit in one direction, and a generator and its contacts with which the line in the opposite direction is connected at the same time to send signaling-current thereon from the generator.

9. The combination, with two telephone-lines connected together by a pair of loop-plugs and their cords, of a switching device included in the circuit of the said cords, said switching device having four springs, one for each strand of each of the two cords, and a wedge or plunger having different thicknesses or steps, said plunger being adapted to be inserted different distances to change the circuit-connections between the springs, substantially as and for the purpose specified.

10. The combination, with two telephone-lines looped together in metallic circuit, of a switching device included therein at the central office, said switching device having four springs, two normally in contact on each side of the metallic circuit, and a wedge for separating said pairs of springs, and a shunt around each of said pairs of springs, each shunt containing a condenser, whereby the lines are maintained closed for telephonic communication when the springs are separated.

11. The combination, with two metallic telephone-line circuits, each extending from the subscriber's station thereof to two or more switch-boards at the central office and each being connected with each of said switch-boards, of a pair of loop-plugs, one of said loop-plugs being inserted in the answering-switch of one of said telephone-lines and the other of said plugs in the socket of the other line upon the same switch-board to loop said telephone-lines together in metallic circuit, a switching device being included in the circuit of the cords of said loop-plugs, said switching device having six circuit-changing springs, said springs being in the same plane, and a plunger or wedge having different thicknesses or steps adapted to be inserted different distances between said springs to bridge the telephone connected with the inner springs across the circuit, to disconnect the outer springs forming the terminals of the strands of the test-plug from the springs next to the same, forming the terminals of the strands of the cord of the answering-plug, or to disconnect all of said springs from one another, substantially as and for the purpose specified.

12. A switching device having the circuit-changing springs b^2 b^2 placed centrally, the outer springs b^3 b^3, and the intermediate springs b^4 b^4, all in the same plane and insulated from one another, in combination with the plunger b, of insulating material, said plunger being provided with steps and mounted upon a longitudinally-movable handle between said springs, whereby the inner springs may be closed upon the outer springs on inserting the plunger the first step, and whereby said inner springs may be separated and crowded against the outer springs to force said outer springs away from the intermediate springs when the plunger is inserted a second step, while on inserting the plunger a third step the outer springs are lifted from the inner springs, leaving all the springs disconnected the one from the other, substantially as and for the purpose specified.

13. The switching device having six insulated springs placed in the same plane, the two springs intermediate between the outer springs and the inner springs normally pressing outwardly to close upon the outer springs, respectively, stops for limiting the outward movement of said intermediate springs, and contacts, one on the outside of each of the outside springs and at a short distance therefrom, in combination with a movable plunger provided with steps, whereby the circuits between said springs and the said contacts may be changed, substantially as and for the purpose specified.

14. The switching device consisting of six insulated springs placed in the same plane, the inner springs being curved at their free ends and bent outwardly, springs intermediately placed between the outer springs and said inner springs, said intermediate springs each normally pressing outwardly against an opposing outer spring, and the connections b^6 b^6, one outside of each of the outside springs, these contacts b^6 being each connected with a contact forming a stop for its proximate intermediate spring, in combination with a plunger having steps thereon, said plunger being adapted, first, to close the inner springs respectively against the outer springs; second, to separate said outer springs from the intermediate springs, and, third, to separate

the inner springs from the outer springs and force the outer springs against the contacts b^6 b^6, thereby again connecting the outer springs each with its proximate intermediate spring.

15. A switch-board provided with switches for the different telephone-lines connected therewith and pairs of plugs and cords, said plugs normally resting upon a shelf or support in front of the board, and a switching device in connection with each pair of plugs and cords, said switching device being mounted upon a shelf provided at the rear of the board, substantially as and for the purpose specified.

16. A switch-board consisting of an upright portion in which are placed the switches for the telephone-lines, a shelf or support at the rear of the board which supports the key-board switching devices, said switching devices being each provided with a rod or handle extending to the front of the board, and pairs of plugs and cords also accessible from the front of the board, substantially as and for the purpose specified.

17. The combination, with a metallic-circuit telephone-line having its different sides connected each with different corresponding parts of different connecting sockets, the sockets being distributed on different boards, of a high-resistance individual annunciator permanently included in said telephone-line, and a loop-plug at each of the boards, the plug at any board being adapted to be inserted in the socket of the line at the same board, to loop the said line with a circuit connected with the plug thus inserted, and a battery in a ground branch connected to said circuit connected with the plug, whereby the individual annunciator is shunted when the plug is inserted, while at the same time the ground branch containing the battery is connected with the line to put the line in condition to indicate the busy-test.

18. The combination of two metallic-circuit telephone-lines, each having the different sides thereof connected with a different portion of each of its metallic sockets on the different switch-boards, one of said lines after passing through its different sockets extending to an answering spring-jack switch, a pair of loop-plugs and their double-stranded cords, the answering-plug of the pair being inserted in the said answering spring-jack, and the other plug of the pair being inserted in the socket of the other line on the same board to loop the two telephone-lines together in metallic circuit.

19. In a switching device, the combination, with the connecting-springs b^3 b^3, of rollers b^7 b^7 provided thereon, and a wedge having a considerable angle to the direction of said springs, adapted to be inserted between said rollers to separate said springs, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 26th day of September, A. D. 1889.

JOSEPH JOHN O'CONNELL.

Witnesses:
GEORGE P. BARTON,
ELLA EDLER.