(No Model.) 4 Sheets—Sheet 1.

F. G. BEACH & F. B. COOK.

TELEPHONE EXCHANGE APPARATUS.

No. 420,183. Patented Jan. 28, 1890.

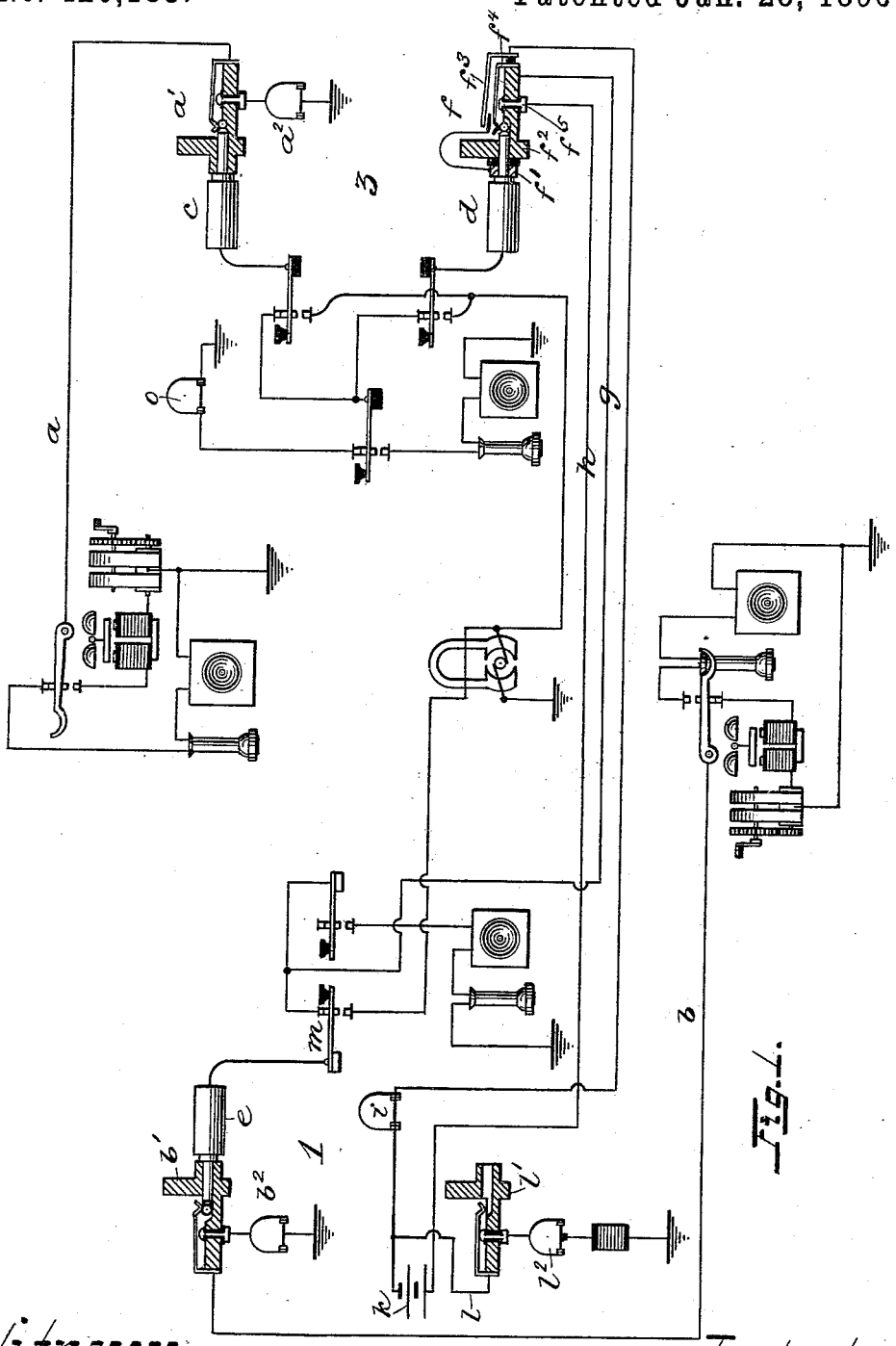

Fig. 1.

Witnesses.
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TELEPHONE EXCHANGE APPARATUS.

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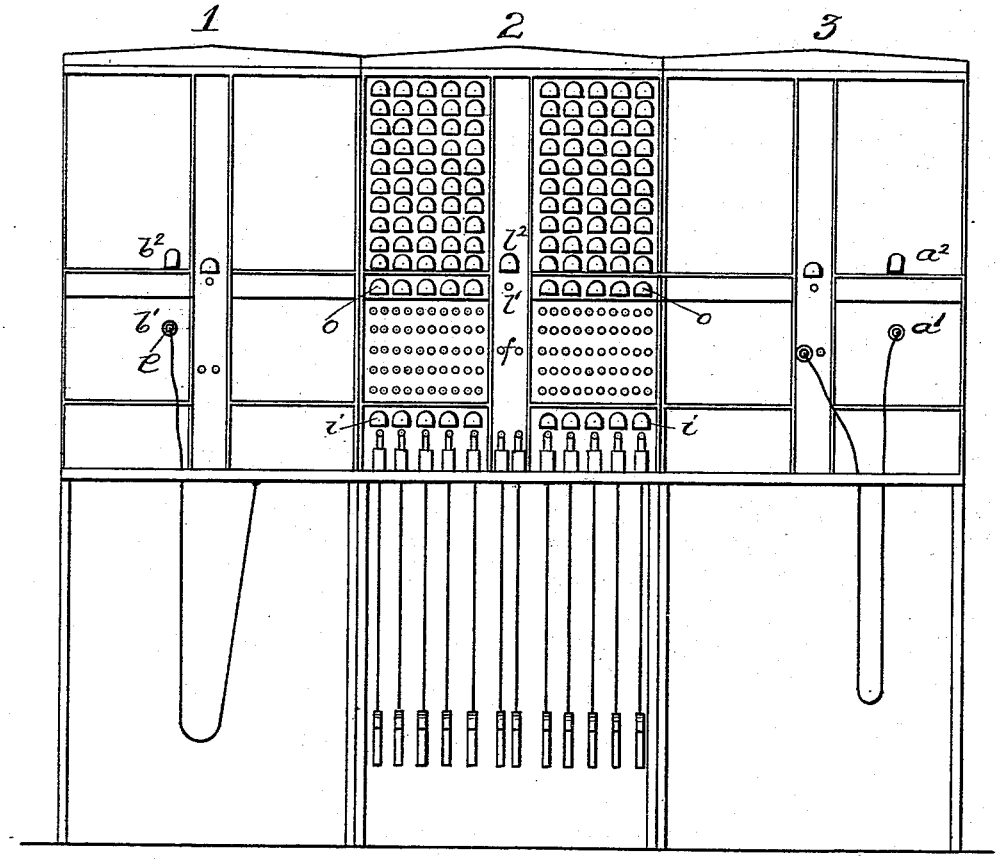

Fig. 2.

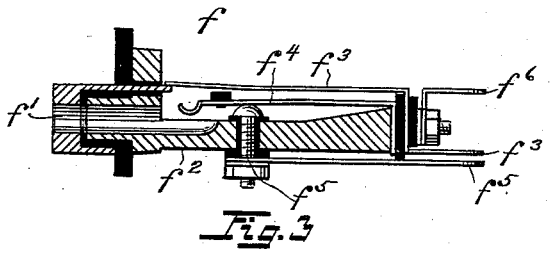

Fig. 3

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

F. G. BEACH & F. B. COOK.

TELEPHONE EXCHANGE APPARATUS.

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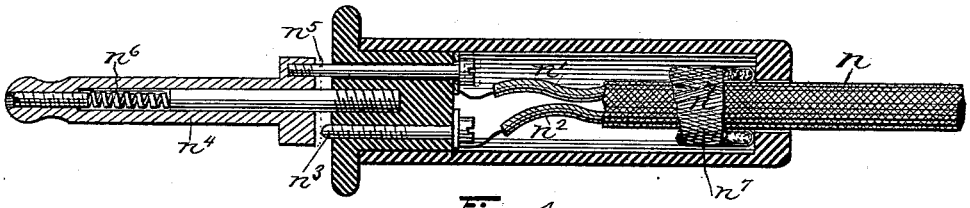

Fig. 4.

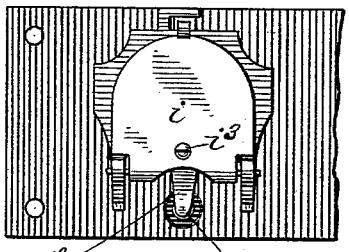

Fig. 5.

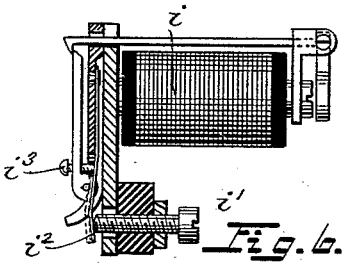

Fig. 6.

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

F. G. BEACH & F. B. COOK.

TELEPHONE EXCHANGE APPARATUS.

No. 420,183. Patented Jan. 28, 1890.

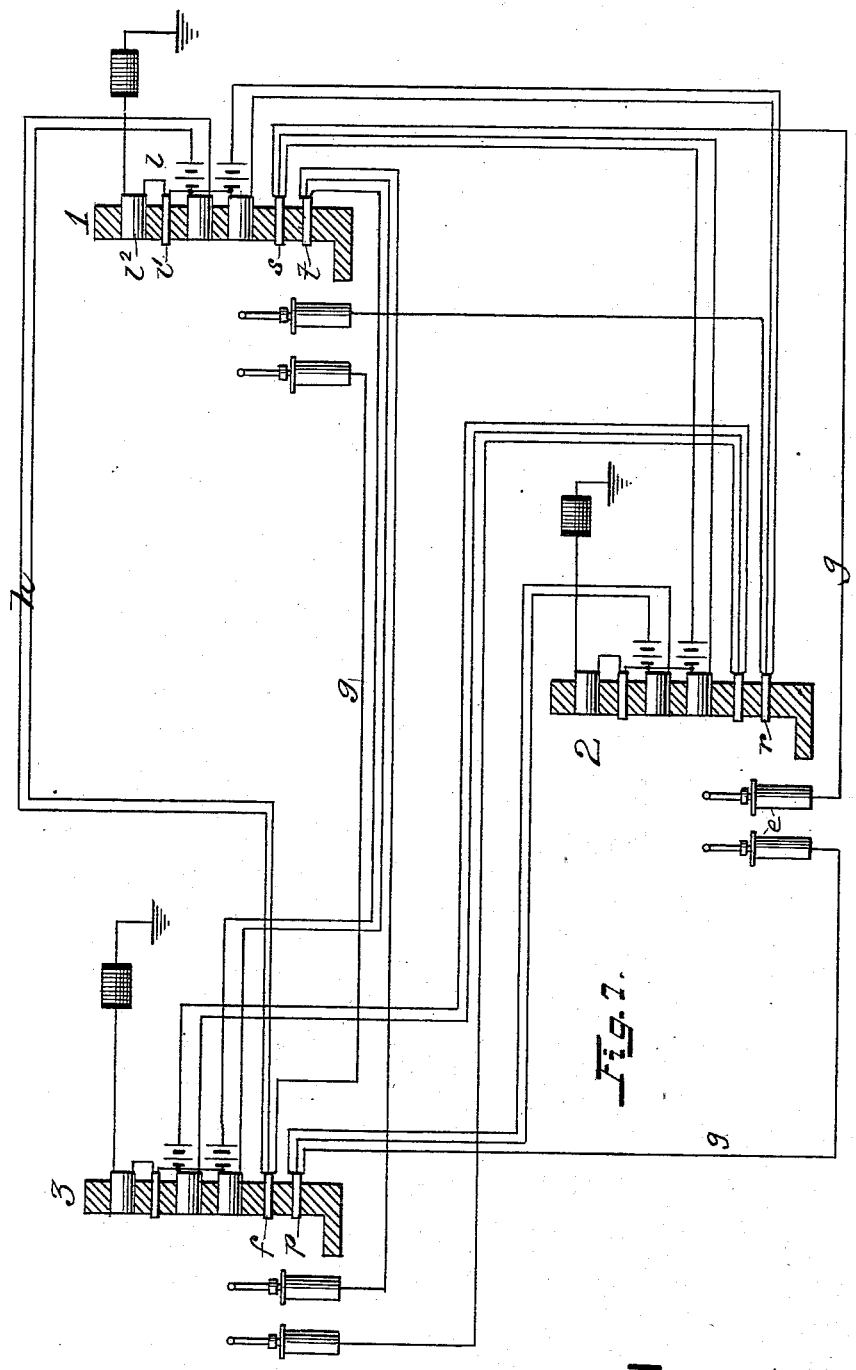

Fig. 1.

Witnesses.
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Inventors.
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Frank B. Cook.
By George H. Boston
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UNITED STATES PATENT OFFICE.

FRANKLIN G. BEACH, OF CHICAGO, ILLINOIS, AND FRANK B. COOK, OF TOLEDO, OHIO.

TELEPHONE-EXCHANGE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 420,183, dated January 28, 1890.

Application filed June 28, 1889. Serial No. 315,904. (No model.)

To all whom it may concern:

Be it known that we, FRANKLIN G. BEACH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, and FRANK B. COOK, a citizen of the United States, residing at Toledo, county of Lucas, and State of Ohio, have invented a certain new and useful Improvement in Telephone-Exchange Apparatus, (Case 8,) 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.

Our invention relates to apparatus for that class of telephone-exchange in which the telephone-lines are grouped upon different switch-boards and trunk-lines provided for making connection between any two of the switch-boards as occasion may require.

The object of our invention is to simplify the circuits and to enable the operators to signal between the different boards and to make the transfer-connections with fewer motions—that is to say, with greater facility—than heretofore, while at the same time obviating the trouble heretofore occasioned by one subscriber of a pair being left connected upon one board after the other subscriber upon another board has been disconnected, this trouble having frequently resulted from the operator at the switch-board containing the switch of the called subscriber either not being provided with a clearing-out signal or failing to distinguish the clearing-out signals from signals caused by the first operator attempting to call up the called subscriber. In brief, the delay in disconnecting the called subscriber has been usually the result of failure of the operators to understand one another, whether the signals between the operators were given orally or electrically. Mistakes and consequent delays also have frequently resulted from operators misunderstanding the directions to make the connections. By our invention all these delays are avoided, and the operators are enabled to work silently and more rapidly than heretofore.

Our invention consists, first, in a transfer switch or switches at each board connected with a local circuit, including a signaling device at the other boards and switching apparatus, whereby an operator at one board may signal the operator at any other of the boards and connect the line of the subscriber calling with the outfit of said other operator and repeat the call to said other operator or permit said other operator to receive the call as repeated by the calling subscriber; second, in such a construction of the transfer spring-jack switch as will cause the signal in the local circuit from said transfer-switch to another board to be operated when the disconnection has been made with the calling subscriber's line on pulling out the plug from the said transfer spring-jack; third, in providing at each board a special switch and annunciator in a high-resistance ground branch connected with the local circuit so arranged that any called subscriber who has been accidentally left connected may call up the operator by means of this special annunciator, and the operator connecting with the special spring-jack switch may find out what the trouble or want may be; fourth, in a special connecting and calling plug; fifth, in the special construction of the transfer spring-jack switch, and, sixth, in the construction of the signaling device or annunciator in the local circuit, whereby the said local circuit is maintained closed through the annunciator when the shutter is up and opened automatically to interrupt the circuit at said annunciator when the shutter falls, thus preventing the possibility of the annunciator being left in the closed circuit, even though the operator should fail to insert the connecting-plug into the transfer-switch far enough to open the local circuit at said transfer-switch.

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

Figure 1 is a diagram illustrative of two telephone-lines, each extending through its switch and annunciator upon two different switch-boards of the telephone-exchange, together with the connecting and signaling apparatus between the two boards. Fig. 2 is a front elevation of three such switch-boards, each having a capacity of one hundred lines and each being provided with the usual indi-

vidual and clearing-out annunciators, and in addition thereto with special signal devices or annunciators for receiving the signals from operators at other boards. Fig. 3 is a detailed sectional view of one of the transfer spring-jack switches. Fig. 4 is an enlarged sectional view of the connecting and signaling plug. Fig. 5 is a front elevation of the circuit-opening drop. Fig. 6 is a side elevation thereof, partly in section. Fig. 7 is a diagram of the trunk-lines and local circuits for three switch-boards.

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

Telephone-line a is shown extending from ground at its station to the central office and to its spring-jack switch a', and thence normally through its individual annunciator a^2 to ground. Telephone-line b in like manner is shown extending from ground at its subscriber's station to the central office and to its spring-jack switch b', and thence normally through its individual annunciator b^2 to ground.

Referring now to Fig. 2, we will assume that the switch a' and the annunciator a^2 are those indicated upon board 3, and that the spring-jack switch b' and the individual annunciator b^2 are those indicated by like letters upon board 1 of Fig. 2. We will assume, too, that the subscriber of line a has called for the subscriber of line b, and that the two lines have been connected, as illustrated in Fig. 1. This connection is made by the pair of cords and plugs c d at board 3 and the connecting-cord and connecting-plug e at board 1, the plug c being inserted in spring-jack switch a', and the plug d in the transfer spring-jack switch f at board 3, and the connecting-plug e inserted in switch b' at board 1, as shown more clearly in Fig. 1. This transfer-switch f, I will describe more in detail, as illustrated in Fig. 3. It will be seen that the front portion f' thereof is insulated from the frame f^2. The spring f^3 normally rests in contact with said front portion f'. The lever f^4 normally rests upon the insulated contact f^5, said lever f^4 being provided with a stud of insulating material, which, when said lever is lifted by the insertion of the plug and after it is separated from its contact f^5, takes the spring f^3 from its normal contact with the portion f' of the switch. It will be understood that the connection f^6 is with the frame f^2 of the switch. Now on inserting a plug (as, for example, plug d, as shown in Fig. 1) in the transfer-switch f the front portion f' and the frame f^2 will be connected together through the shank of the plug, and the tip of the plug coming against the lever f^4 said lever will be lifted from its contact with contact-piece f^5 and closed to the plug, and the plug being fully inserted the lever f^4 will be lifted far enough to bring the block of insulating material thereon against the spring f^3 to lift and separate said spring f^3 from the front portion f' of the switch. Each board is provided with, say, twice as many such transfer-switches as there are other boards, so that several lines may be connected together between any two of the boads. A trunk or transfer line g extends from the frame or portion f^2 of the transfer-switch at board 3 to the plug e at board 1, and it is this wire g that forms part of the talking-circuit of telephone-lines a and b. The local circuit h is connected from the contact f^5 through the operator's signal-drop i and battery k, and thence back to spring f^3 of the transfer-jack. Now when the plug is inserted it closes the local battery-circuit h momentarily as the plug first forms connection between the front portion f' of the switch and the frame thereof; but this circuit is opened immediately thereafter by the further insertion of the plug, as before described. Now in case of failure of the transfer-switch to open the local circuit the battery will not be left on short circuit, since the annunciator-drop in falling operates to automatically open the circuit. This signal-drop i will be more readily understood by reference to Figs. 5 and 6. When the drop is up, the circuit h will be closed between contact i' and spring i^2 of the annunciator, spring i^2 being pressed against said contact i' by a stud i^3 upon the drop. This stud is preferably in the form of a screw, so as to be adjustable. The tension of the spring i^2 is such that when the shutter is released and falls away the spring will by its own resiliency move away from connection i', so as to open the circuit at said contact. A high-resistance branch l is connected from this local circuit through a spring-jack switch l' and an annunciator l^2 to ground, this branch having a resistance of, say, one thousand ohms, so as not to short-circuit the battery k. The signal-drop i may have a resistance of, say, three ohms, and the annunciator l^2 a resistance of, say, seventy-five ohms, and hence the current from battery k, passing through branch l at any time, will not be sufficient to operate the annunciator l^2 in any event.

Suppose the plug d to be withdrawn from the transfer-switch f and that for some reason the connection is left at switch b' with line b. The subscriber of line b by means of his generator may send current over his line to operate the annunciator l^2, and the operator at the board containing said switch b'—in this instance board l—will see the shutter of annunciator l^2 fall, and this will be a signal of trouble, and she will connect her telephone with the spring-jack switch l', and thus place herself in communication with the subscriber of line b.

In Fig. 1 we have shown a usual calling-key m, whereby current may be sent to any line with which plug e is connected to call up the subscriber thereon. We preferably, however, place this calling-key upon the connecting-plug e. The device thus formed we have termed a "connecting and calling plug," this

being illustrated in detail in Fig. 4, which we will now describe: This connecting and calling plug is provided with the double-stranded cord n, one strand n' being normally connected with the tip of the plug and the other strand n^2 being connected with the calling-generator. The strand n^2 is provided with a terminal n^3, against which the base of the metallic sleeve n^4 of the plug is adapted to be closed. The screw or stud n^5, extending back within the rubber handle, has its head normally pressed against a contact-piece, with which the strand n' is connected by the tension of a spring n^6. The opening for this screw n^5 in the said connecting-plate is so large that when the sleeve n^4 is pressed back, so as to separate the head of screw n^5 from said plate, the connection between said plate and said screw-head, and hence the connection between the strand n' and the sleeve n^4, will be broken, while a new contact will be made between said sleeve n^4 and the contact n^3. The strands n' n^2 are shown slack, the strain of the cord coming entirely upon the cloth forming the band or stop n^7. The strain is thus entirely removed from the strands. This plug, as shown in Fig. 4, may take the place of the plug e and the calling-key m and generator-connection shown in Fig. 1. The plug, being inserted, will make proper connection with the telephone-line, and by simply pressing upon the handle, so as to compress spring n^6, current from the generator will be sent to line. Thus the act of inserting the plug may serve also to ring up the subscriber wanted. The tension of spring n^6 may be adjusted by means of the screw which is shown inserted in the top of the plug—that is, into the front end of the sleeve containing said spring. The shank of the plug, being hollow, makes room for the spring n^6, which is fully protected thereby. The contact between strand n' and the stud n^5 is covered by the rubber handle. In short, there are no electric contacts of this plug exposed, so as to be either liable to injury or to be brought into contact with the hands of the operator.

Only one branch l, containing a switch and annunciator l^2, will be required at each board, since all the local circuits extending to a given board may be connected with the same high-resistance branch.

We have shown the usual clearing-out annunciator o in Fig. 1. Ten such clearing-out annunciators are shown provided on each board containing one hundred connections. These may be placed conveniently in a horizontal row at the center of the board. The signal device i in the local circuits may be placed under the switches in a row, as shown. The transfer-switches f are most conveniently placed between the panels containing the individual switches. The special switch l' for each board may be conveniently placed, as shown, in the panel between the boards, and the annunciator l^2 may be placed immediately above the special switch l'.

As shown in Fig. 7, the switch-board 3 is provided with a transfer-switch f, a trunk-line circuit g, and a local circuit h, extending to board 1. A similar trunk-line circuit extends from transfer-switch p to board 2, a local circuit extending also to board 2 being connected with this same transfer-switch p. In like manner board 2 has a transfer-switch, with which are connected a trunk-wire and local circuit extending to board 1, switch-board 2 being provided also with a transfer-switch r, with which are connected the trunk-wire and local circuit extending to board 3. In like manner the transfer-switches s and t are connected, respectively, with boards 2 and 3, each by a local circuit and a trunk-wire.

The high-resistance circuit l, including the special switch and annunciator l^2 at board 1, is connected not only with the local circuit h from board 3, but also with the local circuit from board 2. The high-resistance circuit at each board may thus be common to all the local circuits extending to the particular switch-board thereof.

We do not limit our invention to the details of construction shown, since the arrangement of the annunciators and switches upon the switch-board and the particular form of the transfer-switches and signal-drops and connecting and calling plugs may be varied according to circumstances, as may be desired by different constructers.

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

1. The switch consisting of the front portion thereof insulated from the frame, a spring insulated from the frame and normally resting in contact with the said front insulated portion, the switch-lever and the contact-piece upon which said lever normally rests, said contact-piece being insulated from the frame, said lever carrying a piece of insulating material normally separated from the said insulated spring, and a plug adapted to be inserted in said switch to first lift said lever from its contact and then force the piece of insulating material carried by said lever against said insulated spring to lift the said insulated spring from its normal contact with said front portion of the switch, whereby the plug forms a momentary connection between the front portion of the switch and the frame thereof before the insulated spring is lifted from said front portion, substantially as and for the purpose specified.

2. The combination, with telephone-lines grouped upon different switch-boards at the central office of a telephone-exchange, of transfer spring-jack switches, one or more on each board for each of the other switch-boards, each transfer-switch being provided with a local signal-circuit extending to one of the other boards and including a signal device or signal-drop, and each transfer-switch being provided also with a trunk-line extending to the same board as the said local cir-

cuit, and switching apparatus whereby the operator at one board receiving a call from one of her group of subscribers for a subscriber of another group may transfer the connection of said calling subscriber to the proper operator and signal said operator in so doing automatically.

3. The combination, with two or more switch-boards, each provided with switches for a different group of telephone-lines, of transfer-switches, one or more, each with a trunk-connection and local circuit extending to another of the boards, the boards being thus provided with a trunk and local connection extending reciprocally from each board to all the other boards, and plugs and cords at each board, whereby any line of one board may be connected with any line of another board and signals made between the operators noiselessly and expeditiously, substantially as and for the purpose specified.

4. A high-resistance ground branch, including a switch and annunciator at one board, said high-resistance branch being connected with two or more circuits leading to different transfer-switches each on another different board, each of said transfer-switches being provided with a trunk-circuit extending to the board upon which are placed the switch and annunciator of said high-resistance local circuit, whereby a subscriber connected with either of said trunk-lines upon the board containing the said annunciator and switch in the local circuit may by sending current over his line signal the operator, and the operator, seeing the signal, make connection with the said subscriber's line, substantially as and for the purpose specified.

5. The sleeve of the plug provided with the contact-piece n^5, inserted through an opening in the plug, said connecting-piece n^5 passing through a contact-plate having an opening larger than the portion of said contact n^5 passing through the same, the head of said contact-piece n^5 being held against the said contact-plate by the tension of a spring, and the contact-piece n^3 near the rear or base of said sleeve, whereby the connections of said sleeve may be changed from the said contact-plate to the contact n^3, substantially as and for the purpose specified.

6. The combination, with the transfer-switch f, constructed as described, of the trunk-circuit g, extending from the frame of said switch to a connecting and calling plug at another board, the local circuit h, including a battery k and signal-drop i, said local circuit being connected with the spring f^3 of said transfer-switch and the contact f^5 thereof, whereby on inserting a plug in said transfer-switch the circuit of battery k will be closed momentarily through signal-drop i to operate the same, while the tip of the plug thus inserted will be connected with the lever of the switch and thence with the trunk-line, the local circuit being open when the plug is fully inserted by the lifting of spring f^3 from contact with the front portion f' of the switch, substantially as and for the purpose specified.

7. The local circuit h, connected with a transfer-switch, including a battery k and signal-drop i, said signal-drop being provided with a circuit-opener included in said circuit h, said circuit-opener being operated to open the circuit of said battery k upon the falling of the shutter, substantially as and for the purpose specified.

8. The combination, with the shutter provided with the adjustable stud or screw i^3, of the spring i^2, against which said screw is forced when the shutter is up to close said spring against a contact i', said spring i^2 being adjusted to fall away from said contact i' when the shutter is thrown down, thus removing the pressure from the contact-spring i^2, thereby opening the electrical connection between said contact-spring i^2 and the contact i', substantially as and for the purpose specified.

9. Switch-boards, each provided with switches for different groups of telephone-lines, and a local circuit extending reciprocally from each board to all the other boards, said local circuits containing each a battery and a signal-drop, the signal-drop in each local circuit being adapted to open the circuit thereof when thrown down, substantially as and for the purpose specified.

10. Two telephone-lines, each provided with a spring-jack switch on different switch-boards and connected together between the two boards by a trunk-line connection, the circuit at one of said boards including a clearing-out annunciator and a transfer-switch, said transfer-switch being connected with a local circuit having a signal-drop at the other board, whereby when the connecting-plug is withdrawn from said transfer-switch the said signal drop will be operated as a clearing-out signal to the operator at the other board.

In witness whereof we hereunto subscribe our names this 18th day of June, A. D. 1889.

FRANKLIN G. BEACH.
FRANK B. COOK.

Witnesses:
ELLA EDLER,
C. G. HAWLEY.