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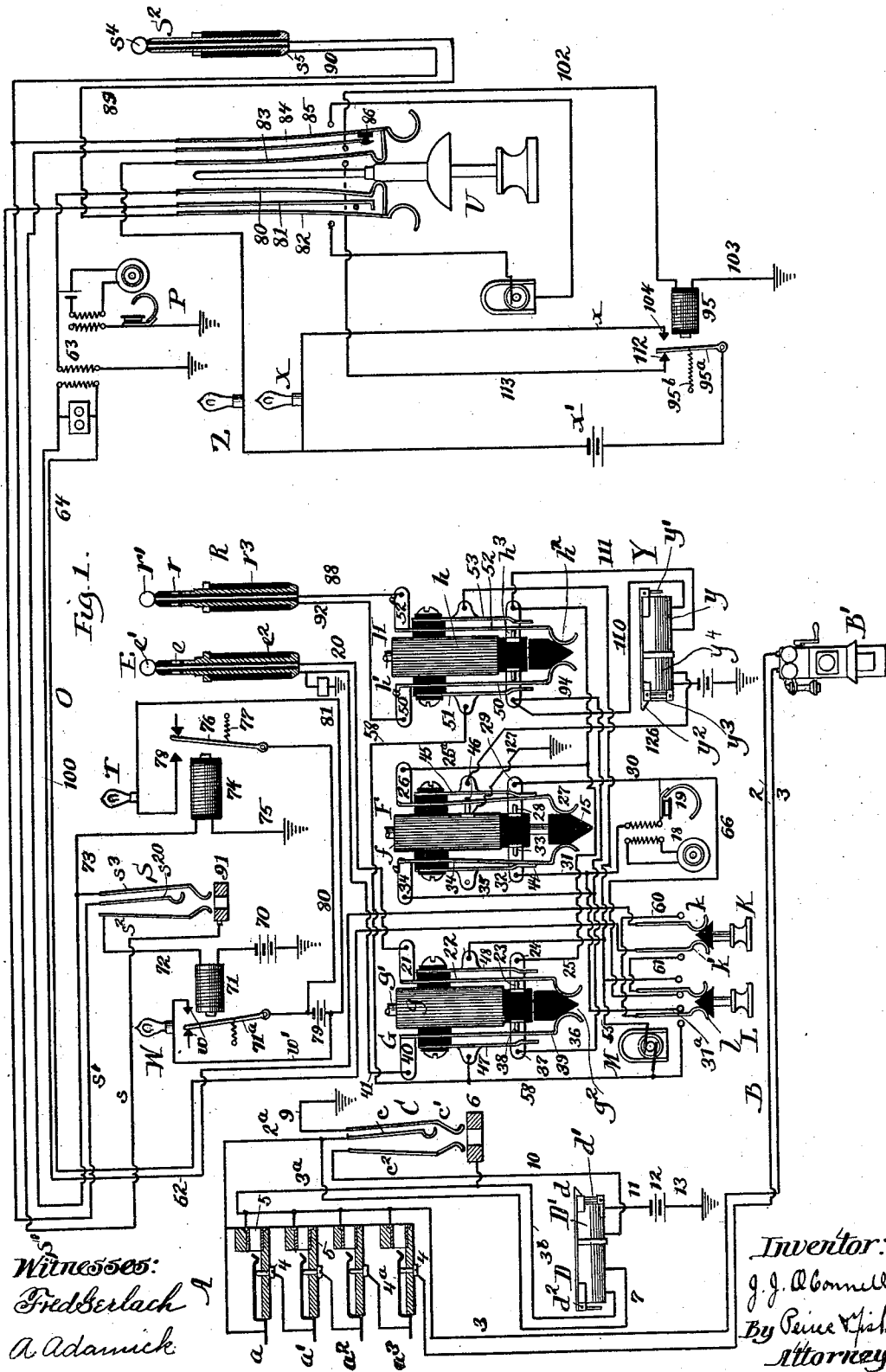
2 Sheets—Sheet 1.

J. J. O'CONNELL.

APPARATUS FOR TELEPHONE EXCHANGES.

No. 544,546.

Patented Aug. 13, 1895.



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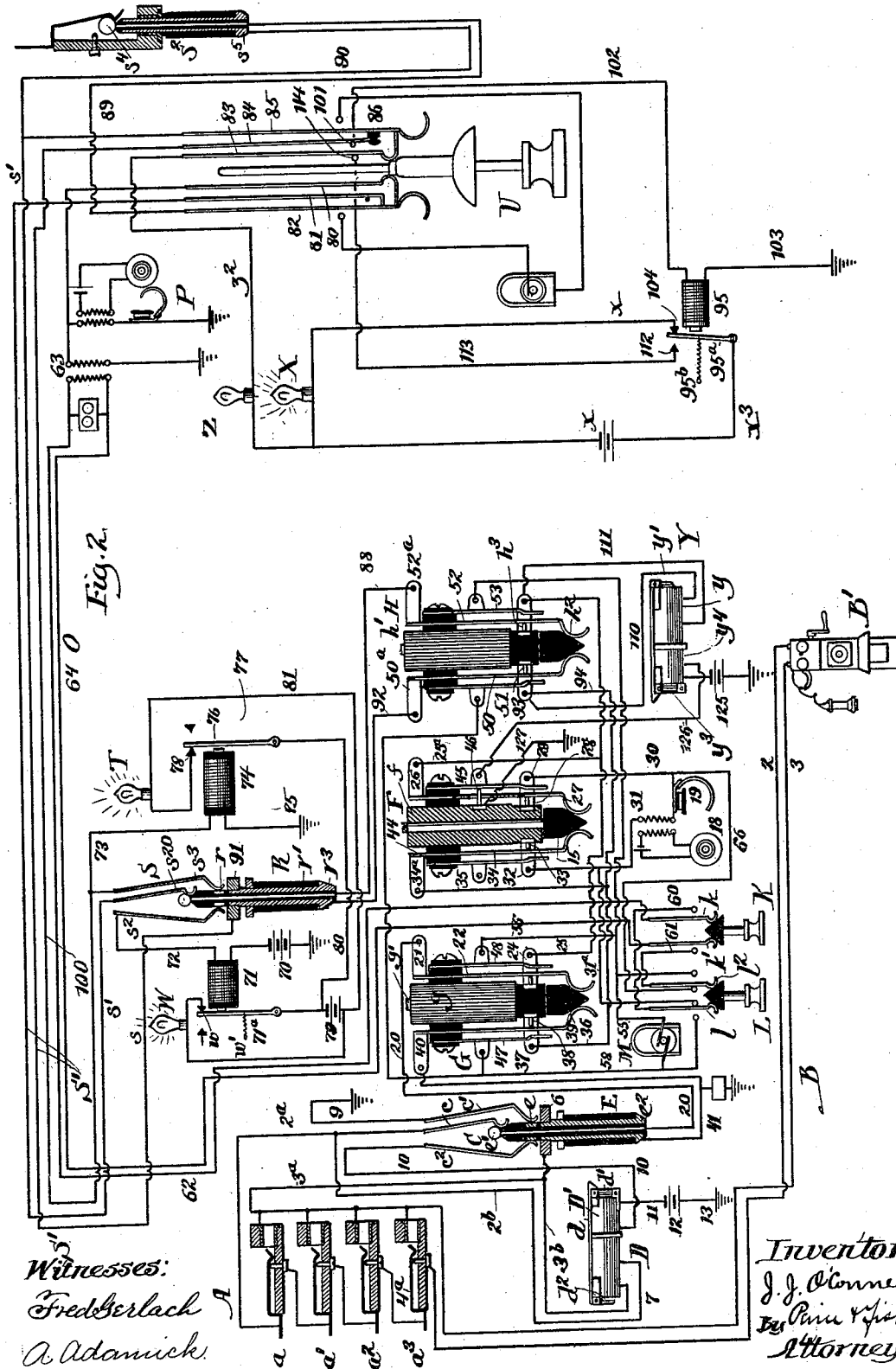
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2 Sheets—Sheet 2.

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UNITED STATES PATENT OFFICE.

JOSEPH J. O'CONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

APPARATUS FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 544,546, dated August 13, 1895.

Application filed April 17, 1893. Serial No. 470,598. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. O'CONNELL, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented certain new and useful Improvements in Apparatus for Telephone-Exchanges, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

In an application filed by me in the United States Patent Office on the 17th day of April, A. D. 1893, Serial No. 470,597, there is described and claimed signal apparatus for telephone-exchanges comprising a series of visible signals whereby the telephone-operator may determine at a glance when any desired line is busy without the necessity of making the usual test of the various lines to ascertain such fact, and in such application also there is described and claimed a series of visible signals whereby the operator at the calling office may be informed when the operator at the distant office has made the connection called for. So also in the above-mentioned application there is described and claimed a visible "disconnect" signal adapted to be controlled by passage of current over the line-wire, said current passing from a source arranged normally out of the circuit of the trunk-line. I do not wish, therefore, to be understood as claiming in this specification either of the above-mentioned features of the invention, although they are shown in the accompanying drawings and described in the following specification.

In my above-mentioned application the current whereby the signals were controlled passed between the calling and receiving offices over the trunk-line. In some cases it is desirable that the trunk-line should not be used for the signal-current, and one of the features of my present invention consists of a supplemental signal-wire extending between the exchanges and connected and arranged as hereinafter defined, and over which the signal-current will be passed.

A further feature of my invention consists in connecting to the trunk-line wire and to the separate signal-wire a special style of

spring-jack in the section of the multiple board at which the subscribers' calls are answered, whereby I am enabled to employ in the remaining sections the ordinary "two-line" spring-jacks of the multiple switch-board.

A further feature of this invention is the employment of relays of differing resistances for controlling the signal-circuits, as hereinafter defined.

The invention also consists in providing at the receiving office a trunk-line signal (hereinafter termed the "sentinel" signal) whereby the operator at such office will be informed that the operator at the calling office has been notified that the desired connection between the subscribers' telephones has been made.

My present invention consists also in various other improvements relating to the features above named, all of which are hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the claims at the end of this specification.

Figure 1 is a diagrammatic view of a telephone-exchange system embodying my invention, the parts and connections being shown in position assumed when the various lines are idle or in their normal position. Fig. 2 is a similar view showing the parts and connections in position assumed when two subscribers' telephones are connected by means of a trunk-line.

The calling office is shown as provided with a subscriber's multiple switchboard A, with the various sections of which a single subscriber's line B is shown as connected, this line B consisting of two wires 2 and 3 to form a metallic circuit for the subscriber's telephone B'. The several sections a , a' , a^2 , and a^3 of the switchboard A are of usual construction, the wires 2 and 3 of the subscriber's line B being connected, respectively, to the contact-screws 4 and the spring-jack rings 5 of these sections. That section, however, of the multiple switchboard at which all the calls of the subscriber's telephone B' are answered will be preferably provided with spring-jacks C of the construction shown. It will be readily understood that when the

operator having charge of the section of the multiple board comprising the spring-jacks C does nothing but answer subscribers' calls, the remaining sections a , a' , a^2 , and a^3 of the multiple board may be located at a distance more or less remote. Each of these answering-spring-jacks (the one for telephone B' only being shown) comprises a contact-plate c , which by means of the wire 2^a , and by means of the springs and contact-screws of the switchboard sections a a' a^2 a^3 , are connected with the wire 2, and comprises also a casing-ring 6, which by means of a wire 3^a and by means of the casing-rings 5 of the sections a , a' , a^2 , and a^3 , will connect with the wire 3 of the subscriber's line B. The wire 3^a will connect also by a branch wire 3^b with a calling drop or annunciator, a return-wire 7 leading from the releasing-coil D of the annunciator to the contact spring or plate c of the jack C. This jack C is furnished also with the plate c' , that is grounded by the wire 9, and with the plate c^2 , which connects by means of a wire 10 with the restoring-coil D' of the calling drop or annunciator, this coil D' being connected by a wire 11 with the battery 12, from which a wire 13 leads to ground. The calling drop or annunciator is of the type commonly known as a "self-restoring drop," this drop having a retaining-hook d for the shutter d' , this hook being pivoted, as at d^2 , and having its rear end arranged as an armature that will be shifted by the releasing-coil D of the drop. The coil D' will serve to return the shutter d' into engagement with the hook d , in manner well understood in the art.

Assuming that the spring-jack is in its normal position, as shown in Fig. 1, at which time no plug will be therein, it will be seen that if the subscriber at the telephone B' rings current will pass from the generator of the telephone B' over wire 2, and through the several spring-jacks of the switchboard A, and by the wire 2^a and its branch 2^b to the releasing-coil D of the calling-drop, thereby attracting the armature d^2 and causing the hook d to release the shutter d' . From the releasing-coil D current will pass by wires 3^b and 3^a through the rings 5 of the switchboard-sections to the wire 3, and by such wire to the telephone B'. The operator at the calling office having charge of the switchboard-section at which the calls of the telephone B' are answered will then insert the plug E into the spring-jack C, and will at the same time retract the plunger 15 of the listening-key F to the position shown in Fig. 2. When the plug E is thus inserted in the jack C, it will be seen that current from battery 12 can pass by wire 11 through restoring-coil D' of the calling-drop, thence by wire 10 to the plate c^2 of the jack C, thence by contact-ring e of the plug E to the contact-plate c' , and thence by wire 9 to ground, thus energizing the coil D' and causing it to retract the shutter d' into engagement with the hook d of the calling-drop. It will also be seen that when the plug E is in the jack C,

and the plunger 15 of the listening-key F is in the retracted position shown in Fig. 2, the calling operator, by means of her transmitter 18 and head telephone 19, can communicate with the subscriber at the telephone B', the circuits at such time being as follows, viz: From the telephone B' by wire 2 to the contact-screw 4 and springs 4^a of the switchboard A; thence by wire 2^a to the contact-plate c and tip e' of the plug E, from which tip current passes by the wire 20 to the projecting arm 21 that connects to a contact-plate 22 of the ringing-key G; thence by contact-point 23 and plate 24 to wire 25 and branch wire 25^a to the arm 26 of the contact-plate 27 of the listening-key F; thence by the contact-point 28 of plate 29 to the wire 30 that leads to the head telephone 19, from which current passes by wire 31 to the plate 32 and contact-point 33 to the contact-plate 34; thence by the arm 34^a and wires 35 and 36 to the contact-plate 37 and contact-point 38 of the ringing-key G; thence by contact-plate 39 and its arm 40 and the wire 41 to the sleeve e^2 of the plug E; thence by casing-ring 6 and wire 3^a to the rings 5 of the switchboard A, and, finally, by the wire 3 back to the telephone B'. It will thus be seen that the operator at the calling-office will be in communication with the telephone B' to receive the order.

The calling office is shown as provided with a listening-key F, the ringing-key G, and the ringing-key H, and as well, also, with the keys K and L. The ringing-key F comprises an insulating-sleeve f , through which passes in manner free to slide the shank of the plunger 15, the head of this plunger being formed of non-conducting material. Upon one side of the sleeve f is mounted the contact-plates 34 and 44, and upon the opposite side of the sleeve f are mounted the contact-plates 27 and 45, these plates being suitably insulated from each other. From one side of the sleeve f projects a contact-point 46 that extends through a slot formed in the plate 27 to avoid contact therewith, the outer end of this contact-point 46 extending into position to touch at proper time the contact-plate 45.

The ringing-key G, whereby the operator at the calling office can ring the bell of the subscriber's telephone B', comprises a sleeve g of insulating material, upon one side of which are mounted the contact-plates 39 and 47, and upon the opposite side of which sleeve are mounted the contact-plates 22 and 48, the plates being suitably insulated, as shown.

The ringing-key H, whereby the operator at the calling office can ring the bell of the distant subscribers connected with the receiving office, comprises a sleeve h of insulating material, at one side of which are mounted the contact-plates 50 and 51, and upon the opposite side of which are mounted the plates 52 and 53, these plates being suitably insulated, as shown. The ringing-key G has a plunger g' , held in manner free to slide through the sleeve g and furnished with the

head g^2 of insulating material, and in like manner the ringing-key H has a plunger h' , arranged to slide within the sleeve h , and provided with a head h^2 of insulating material.

5 It will be readily seen that if the operator at the calling office desires to ring up the subscriber at the telephone B' she can do so by merely depressing the plunger g' of the key G, thereby causing the plunger head g^2 to force outward the contact-plates 39 and 22 until these plates contact, respectively, with the contact-plates 47 and 48. By this means current will be caused to pass from the generator M, by wire 55 and its branch 56, to the extension of the contact-plate 48; thence to the contact-plate 22, and by this plate and its extension 21, by wire 20, to the tip of the plug E, whence it will pass by the connection shown to the telephone B' and back from such telephone, through the connection shown, to the ring 6 of the spring-jack C; thence to sleeve e^2 of the plug E; thence by wire 41 to the extension 40 of the contact-plate 39; thence by contact-plate 47 and its extension 25 to wire 58 that leads to the generator M.

When the operator of the calling office has ascertained from the subscriber at the telephone B' the number of the desired subscriber, she will force in the order-wire key K in order to throw her head telephone in circuit with that of the operator at the distant exchange. The forcing inward of the key K will cause the plate k to contact the with terminal of the wire 60, will cause the plate k' to contact with the terminal of the wire 61, and it will be seen that a circuit will then be established between the two operators' telephones as follows, viz: from head telephone 19, by wire 31 and its branch 31^a, to the contact-plate l of the key L; thence by wire 60 to the contact-plates k , by order-wire 62 of the order-line O through the induction-coil 63, back by wire 64 of the order-line O to the plate k' of the key K; thence by wire 61 to the contact-plate l' of the key L, to the terminal of wire 66, to the head telephone 19. By the induction-coil 63 current will be established in the circuit of the head telephone P of the receiving operator. The calling operator, as she thus gives the order to the receiving operator, will insert the plug R into the trunk-line spring-jack S in order to establish communication between the subscriber's spring-jack C and the trunk-line S', which trunk-line consists of two wires s and s' to form a metallic circuit. By inserting the plug R in the jack S the busy-signal lamp T (or other visible signal) will be brought into action in order to indicate to the operator at the calling office that the trunk-line S' thus plugged into is engaged, this lighting of the busy-signal lamp T being effected in the following manner, viz: From the battery 70 current will pass to the relay 71 and thence by wire 72 to the contact-plates s^2 of the jack S, by ring r of the plug R to the contact-plate s^3 of the jack; thence by wire 73 to the relay 74 and by wire

75 to ground. The coil of the relay 71 is of low resistance, (say fifty ohms,) while the coil of the relay 74 is of greater resistance, (say one thousand ohms,) and consequently current from the battery 70 will not affect the relay 71, but will energize the relay 74, thereby causing it to attract the armature 76 against the force of the spring 77. When this armature touches the contact-terminal 78 and thus closes the normally-open circuit in which is interposed the signal-lamp T, current will pass from the battery 79 to wire 80 through armature 76 and contact-terminal 78, to wire 81, back to battery 79, and the signal-lamp T will thus show that the trunk-line S' is busy.

The receiving operator having been notified by the calling operator to make the desired connection, will insert the trunk-line plug S² in the spring-jack of the desired subscriber and then retract the key U to the position shown in Fig. 2, this key being normally in the position shown in Fig. 1, but remaining in the retracting position shown in Fig. 2 so long as the trunk-line S' is busy. The retraction of the key U to the position shown in Fig. 2 will serve, in manner to be next described, to establish the local circuit, (at the calling office,) in which is interposed the signal-lamp w , whereby the operator at the calling office will be notified that the operator at the receiving office has made the required connection, this signal-lamp being termed, for convenience, the "O. K." signal. Upon one side of the key U are arranged the contact-plates 80, 81 and 82, and upon the opposite side of this key are arranged the contact-plates 83, 84, and 85, these several plates being insulated from each other, as well understood. The plates 80, 82, 83, and 85 have their outer ends bent as shown, to be engaged by the enlarged portions of the key U, and the outer end of the plate 84 is engaged by the non-conducting tip 86 that is fastened to the plate 85, and whereby the free ends of the plates 83 and 85 are caused to move in unison. When the receiving operator has retracted the key U to the position shown in Fig. 2 and with the several plates of the key in the position shown in such figure, it will be seen that the following circuit will be established between the subscribers' telephones, (it being assumed that the operator at the calling office still has the listening-key F in the subscribers' circuit), viz: From the subscriber's telephone B' current will pass by wire 2 through the multiple board A to the contact-plates c of spring-jack C; thence to tip e' of plug E, by wire 20 to contact-plate 22, by contact-point 23 and extension 24 to wire 25, to the extension of the contact h^3 , to plate 52, and by the extension 52^a of this plate to the wire 88, to tip r' of the plug R; thence by the spring s^{20} of the spring-jack S to the trunk-line wire s' ; thence to the contact-plate 81 of the key U, to contact-plate 82, to wire 89, to the tip s^4 of the trunk-line plug S²; thence by means of the subscribers'

spring-jack and the subscribers' wires to and from the distant subscriber's telephone. The return-current from the distant subscriber's telephone will pass from the ring of the spring-jack to the sleeve s^5 of the trunk-line plug S^2 ; thence by trunk-line wire 90 to the ring 91 of the trunk-line spring-jack S ; thence by the sleeve r^3 of the plug R to the wire 92; thence by the extension 50^a and the plate 50 to the contact 93; thence by the wire 94 to the plate 37 and contact 38; thence by plate 39 and extension 40 to the wire 41; thence to the sleeve e^2 of the plug E , and thence by wire 3^a to the rings 5 of the multiple switch-board A , and finally by wire 3 to the subscriber's telephone B' . It will be seen that at the same time that the key U is retracted by the receiving operator to the position shown in Fig. 2 a circuit will be established through the relay 71 in order to close the local circuit of the "O. K." signal-lamp W , and through the relay 95 in order to close the local circuit of the signal-lamp X .

The purpose of the signal-lamp X , which for convenience is termed the "sentinel" signal, is to notify the receiving operator that the calling operator has received the "O. K." signal and has thus been informed that the desired connection has been made. The relays 71 and 95 will now be energized by passage of current in the following manner, viz: From relay-battery 70 current passes through the relay 71, thereby energizing this relay and attracting its armature 71^a against the contact-point w of the "O. K." signal-circuit wire w' , which leads to battery 79, this battery being connected, as shown, with the armature 71^a. Consequently, when the armature 71^a is caused to contact with the point w , the local signal-circuit of the lamp W will be completed and this lamp will be caused to burn, thereby indicating to the operator at the calling office that the required connection of the trunk-line plug with the distant subscriber's spring-jack has been made. It will also be seen that current from battery 70, after passing through relay 71, will pass by wire 72 to contact-plate s^2 of the jack S , by ring r of the plug R to the contact-plate s^3 , by signal-wire 100 to the contact-plate 84 of the key U ; thence by terminal-contact 101 to the wire 102; thence to relay 95, and by wire 103 to ground. As current thus passes through the relay 95, it will energize such relay, thereby attracting its armature 95^a against the force of the spring 95^b, causing the armature to bear against the contact 104 of the sentinel-signal wire x , thus completing the local circuit (which is normally open) through this signal-wire x , its battery x' , and sentinel-signal lamp X , thereby causing the lamp X to burn and so indicate to the operator at the receiving office that the operator at the calling office has received notice that the desired connection has been made. The coil of the relay 95 is of low resistance, (say fifty ohms,) so that the current from the relay-battery 70

as it passes to the signal-wire S' will not escape through the wire 73 to the relay 74 to ground, because, as has been stated, this relay 74 is of such high resistance (say one thousand ohms) as to check the flow of the current and permit it to pass through the signal-wire S' to the relay 95 in manner above defined. After the calling operator has been notified by the "O. K." signal that the desired connection at the receiving office has been made, she will next force outward the listening-key F and thus throw the head telephone 19 out of circuit and also move outward the ringing-key H to ring up the distant subscriber called for. When the operator forces outward the ringing-key H , current will pass as follows, viz: from the generator M by wire 55, contact-plates 52 and 53, arm 52^a of the plate 52, wire 88, tip r' of the plug R , spring-plate s^{20} of spring-jack S , trunk-line wire s' , contact-plates 81 and 82, respectively, of the key U , wire 89 to the tip s^4 of the trunk-line plug S^2 , and from tip s^4 to the distant subscriber's telephone, as well understood. The return current will pass from the distant subscriber's telephone to the sleeve s^5 of the trunk-line plug S^2 , as well understood. Continuing, the return current will pass from the sleeve s^5 of the trunk-line plug S^2 by wire 90, trunk-line wire s , ring 91 of the trunk-line jack S , sleeve r^3 of the answering-jack R , wire 92, arm 50^a, and plate 50 of the key H , plate 51 and its extension, wire 58, back to generator M . The line is now complete between the two subscribers, the operator's telephone is out of the subscriber's circuit, and the busy-signal lamps T at the calling office and the sentinel-lamps X at the receiving office are burning, thus indicating to the operator at the calling office that the trunk-line O is busy and to the operator at the receiving office that the operator at the calling office has been duly notified that the desired connection has been made.

When either of the subscribers rings off, the clearing-out drop Y will be caused to drop, thus showing to the operator at the calling office that a disconnection of the subscribers is to be made.

In tracing the circuits established between the subscribers' telephones it has been seen that current passes from the trunk-line S' to the plate 50 and contact-point 93 of the ringing-key H , and thence by wire 94 and its connections to the subscriber's spring-jack C and telephone B' . It will be seen also that at such time a portion of the current received at contact 93 is free to pass by the wire 110 through the releasing-coil y of the clearing-out drop Y . This clearing-out drop is of the style known as a "self-restoring drop," being similar in construction to the calling-drop D before described. From the releasing-coil y current will pass by wire 111 to the contact h^3 of the key H , and thence to contact-plate 52 and by wire 88 to the tip of the plug R , whence it will pass, in manner hereinbefore described,

to and over trunk-line S' to the distant subscriber's telephone, returning from which the current will pass to the sleeve r^3 of the plug R, to wire 92, to plate 50 of key H, to contact 5 93, and by wire 110 to the releasing-coil y of the clearing-out drop. When generator-current developed by the ringing of the generator at the subscriber's telephone is passed through the clearing-out drop by the circuits 10 last defined, the releasing-coil y of this drop will be energized, thus attracting the armature y' , so as to raise the hook y^2 and release the pivoted indicator-shutter y^3 of the drop, in order to show to the operator at the calling 15 office that a disconnection of the subscriber's telephone is to be made. The operator at the calling office will next remove the plug R from the trunk-line jack S, thereby disconnecting the subscribers, and this removal of 20 the plug R will cause the "O. K." signal-lamps W and the busy-signal lamps T at the calling office and the sentinel-lamps X at the receiving office to be extinguished, and will also cause the disconnect-signal lamps 25 Z to burn at the receiving office, in order to indicate to the operator at such office that a disconnection of the subscribers has been made. When the plug R is thus withdrawn from the trunk-line jack S, the passage of 30 current from battery 70, through relay 71, wire 72, and plate s^2 of the jack S is broken, and consequently the armature 71^a is retracted by its spring from the contact w , and the local circuit through the "O. K." signal 35 lamps W is broken. It will also be seen that as current cannot pass from battery 70 beyond the plate s^2 of the jack S, the relay 74 will be de-energized and its armature 76 will be retracted by its spring away from the contact 78, thereby breaking the local circuit 40 through the busy-signal lamp T. So, also, the breaking of current from battery 70, as last described, will prevent passage of current from such battery through the relay 95 in manner hereinbefore described, and the 45 relay 95 will be de-energized, thereby allowing its armature 95^a to be withdrawn from the contact 104 in order to break the local circuit through the sentinel-signal lamp X. The 50 local circuits of the several lamps T, W, and X being thus broken, these lamps will be extinguished. When the armature 95^a of the relay 95 is retracted by its spring 95^b , it will be brought to bear against the contact-point 112 of the wire 113, thereby closing at such 55 point the circuit for the passage of current from battery x' through the disconnect-signal lamp Z; and inasmuch as the key U will be in the retracted position shown in Fig. 2 60 at the time the disconnect-signal is to be given, the terminal 114 of the wire 113 will be in contact with the plate 83 of the key U. Consequently current may pass at such time from battery x' through the disconnect-signal 65 lamp Z by wire z^2 to contact-plate 83, to terminal 114, to wire 113, to armature 95^a , and by wire x^3 to battery x' . The disconnect-

signal lamp will thus be caused to burn and indicate to the operator at the receiving office that a disconnection of the subscribers has 70 been made, and this signal-lamp will continue to burn until the operator at the receiving office forces inward the key U, thereby forcing outward the plate 83 from contact with the terminal 114, and so breaking at such 75 point the local circuit of the disconnect-signal lamp Z. Immediately before the operator at the calling office removes the plug R from the trunk-line jack S, she will withdraw the plunger 15 of the listening-key F 80 in order to throw her head telephone into the trunk-line circuit, and by this inward movement of the plunger 15 of the listening-key F a passage is established for current from battery 125 through the restoring-coils y^4 of 85 the clearing-out drop Y, thence by wire 126 to the extension of contact-plate 45, thence by contact-point 46 and wire 127 to ground. The passage of current through the restoring-coils y^4 will cause the shutter y^2 to be returned 90 into engagement with the hook of the clearing-out drop.

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

1. In a telephone exchange system, the combination with a trunk line connecting two offices, of a spring jack wherein said trunk line terminates at one of said offices, a supplemental signal wire extending between the offices 100 and connected to said spring jack but normally broken at such point, a battery from which current may be caused to pass over said signal wire, said battery being normally disconnected therefrom, an operator's key at the 105 other office to which said signal wire leads, said signal wire being broken adjacent said key and being adapted to be closed at such point by said key for passage of current, whereby the passage of current between the 110 offices over said signal wire is not effected until the trunk line terminal at one office is inserted in said spring jack, and the operator's key at the other office is shifted.

2. In a telephone exchange system, the combination of a trunk line connecting two offices, 115 a spring jack wherein said trunk line terminates, a separate signal wire extending between the offices and connected to said spring-jack, and a signal operating battery also connected to said spring-jack, a relay interposed 120 between said signal operating battery and said spring-jack, and a local signal circuit controlled by said relay, whereby when the trunk line is closed at said spring-jack current will pass from said battery through said 125 relay to close said local signal circuit.

3. In a telephone exchange system, the combination with a trunk line connecting two offices and with a separate signal wire connecting 130 said offices, of a spring jack wherein said trunk line terminates and to which said signal wire connects, said spring jack comprising a sleeve to which one of the trunk line

wires is united, a contact plate to which the other of said trunk line wires is united and comprising also separate contact plates or terminals to which the signal wire is connected and by which said wire is normally broken at said spring jack, substantially as described.

4. In a signaling apparatus for telephone systems, the combination of two signals arranged in local circuits, two electromagnets of differing resistances for controlling said signal circuits, a source of current arranged to energize both of said magnets and two outlets for current leading from the circuits in which said magnets are placed, whereby when current is caused to flow through one of said outlets, one of said magnets will be energized and when current is passed through the other of said outlets, the other of said magnets will be energized.

5. In a signaling apparatus for telephone systems, the combination with a trunk line connecting two exchanges and with a terminal of said trunk line of two signals arranged in circuits, two electro-magnets of differing resistances for controlling said signals, said magnets being connected to said trunk line terminal, a source of current arranged to energize both of said magnets and two outlets for current leading from the circuits in which said magnets are placed, whereby when current is caused to flow through one of said outlets one of said magnets will be energized and when current is passed through the other of said outlets, the other of said magnets will be energized.

6. In a signaling apparatus for telephone systems, the combination of two signals, two electro-magnets of differing resistances for controlling said signals, a source of current arranged to energize both of said magnets, two outlets for current, a third signal and a magnet for controlling said third signal, said magnet being placed in one of the outlets leading from the source of current by which the magnets are energized.

7. In a telephone exchange system, the combination with two offices provided with suitable switchboards and a trunk line connecting said offices and having a suitable switch terminal at each of said offices whereby telephonic communication may be established, of a signal controlling circuit extending between the offices, two signals, one located at each of said offices, a source of current for said signal controlling circuit, said signal controlling circuit being broken at both of said offices, a trunk line terminal at one of said offices to which terminal said signal controlling circuit leads and at which it is normally broken, said terminal being provided with means whereby when the desired connection is made thereat with the trunk line said signal controlling circuit will be thereby closed at such point, and circuit closing mechanism at the other office adapted to there complete said signal controlling circuit; whereby said signal controlling circuit will remain open until the operator at

one office has closed the trunk line circuit and the signal controlling circuit at said office and until the operator at the other office has also completed said signal controlling circuit, the completion of the signal controlling circuit at the last named office serving to bring both signals into operation.

8. In a telephone exchange system, the combination with two offices and a line connecting said offices, said line being provided with suitable terminals whereby telephonic connections may be made, of a signal at one of said offices whereby the operator at said office can be notified that the operator at the other office has made a required connection, a signal at said other office whereby the operator at said office can be notified that the signal at the office first mentioned has been caused to operate; and a signal controlling circuit extending between said offices and provided at each office with a relay interposed in said circuit for controlling the signal at the corresponding office, said signal controlling circuit being normally broken at one of said offices and means at the other of said offices whereby the operator can close said signal controlling circuit and thereby permit passage of current over said circuit to energize the relays and cause both signals to indicate.

9. In a telephone exchange system, the combination with a calling office and a receiving office, of a conversation line extending between said offices, said line being provided with a spring jack at one office and a switch plug at the other office, whereby telephonic communication can be established, of a signal at said calling office to indicate to the operator there that the operator at the receiving office has made a required connection; a signal at the receiving office to indicate to the receiving operator that the signal at the calling office has been caused to indicate, a signal controlling circuit provided at each office with means for controlling the signal at such point, said signal controlling circuit being connected with the conversation line terminal at the calling office and normally open at such point, and being normally open at the receiving office, and means at said receiving office for closing said signal controlling circuit at such point whereby when the calling operator has closed the signal controlling circuit at the calling office by the insertion of a plug, the operator at the receiving office having made the required connection can close the signal controlling circuit at such point and thereby cause passage of current over said signal controlling circuit in order to bring said signals into operation.

10. In a telephone exchange system, the combination with two offices and a trunk line connecting the same and having a suitable switch-terminal at each of said offices, of two signals, one signal being located at each of said offices, a relay at each of said offices for controlling the signal at said office, suitable circuit connections between said relays and

the switch-terminal at one office, said terminal being so connected with the circuit in which the relays are interposed that when a trunk line connection is made at such office both of said signals will be brought into action, and a source of current for causing the operation of the relays.

11. In a telephone exchange system, the combination with two offices and a trunk line connecting the same and having a suitable switch-terminal at each of said offices, of two signals, one signal being arranged in a local circuit at each of said offices, a relay at each of said offices for controlling the local signal

circuit at said office, suitable circuit connections between said relays and the switch-terminal at one office, said terminal being so connected with the circuit in which the relays are interposed, that when a trunk line connection is made at such office, both of said signals will be brought into action, and a source of current for causing the operation of the relays.

JOSEPH J. O'CONNELL.

Witnesses:

JAMES H. PEIRCE,
FRED GERLACH.