

J. J. O'CONNELL.
APPARATUS FOR TELEPHONE SWITCHBOARDS.

(Application filed May 12, 1899.)

(No Model.)

2 Sheets—Sheet 2.

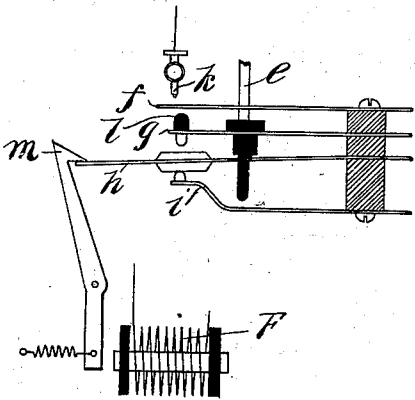


Fig. 2.

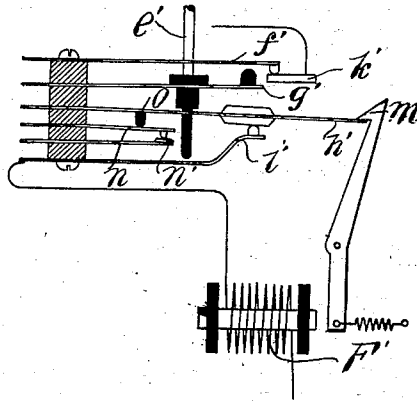


Fig. 3.

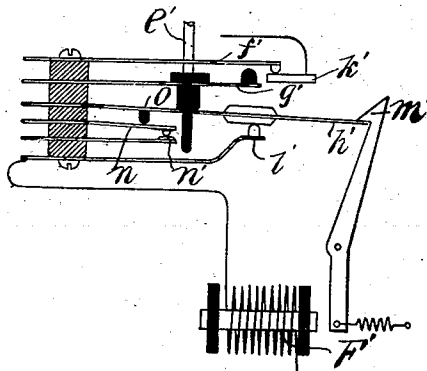
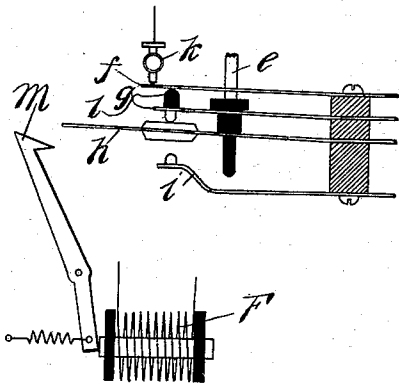


Fig. 4.

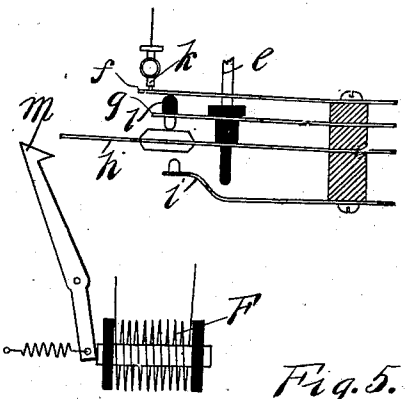


Fig. 5.

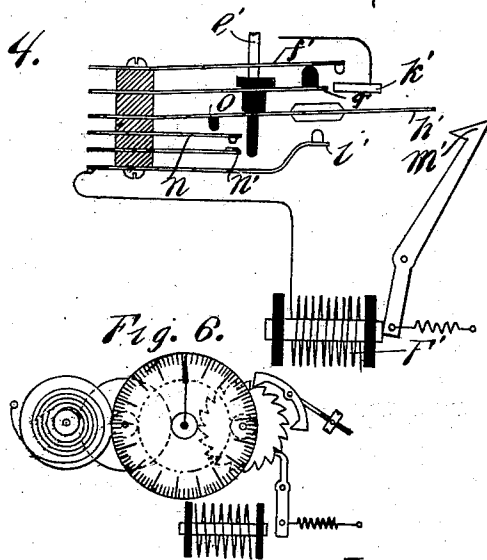
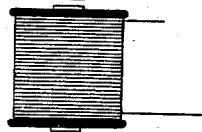


Fig. 6.

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UNITED STATES PATENT OFFICE.

JOSEPH J. O'CONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 654,758, dated July 31, 1900.

Application filed May 12, 1899. Serial No. 718,528. (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, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Apparatus for Telephone-Switchboards, (Case No. 2,) of which the following is a full, clear, concise, and exact description.

10 My invention relates to apparatus for telephone-switchboards; and its object is to provide improved mechanism associated with a connecting-plug for accomplishing a number of useful functions in the course of connecting and disconnecting telephone-lines.

15 My invention contemplates, first, switching mechanism associated with the seat wherein the connecting-plug normally rests for automatically including a source of signaling-current in circuit with one of the contacts of the plug when the latter is lifted from its seat preparatory to making a connection and for removing said source of signaling-current from circuit when the called subscriber answers the signal by removing his telephone from its hook.

Another feature of my invention consists in means for controlling the operator's telephone-circuit.

30 My invention is especially applicable to telephone-exchange systems wherein trunk-lines are employed between the different boards, one end of the trunk-line terminating before an answering or supervising operator who answers the calls of a number of subscribers whose lines terminate at her board and the other end of the trunk-line terminating at the board of a receiving operator, or, as she is sometimes called, a "trunk" operator, who merely makes connections between the trunk-lines and other telephone-lines at the order of the supervising operator. To prevent confusion, it is intended that the answering operator only and not the receiving operator shall converse with subscribers whose lines are connected by the trunk-line, and I have provided in connection with the trunk-line plug at the board of the receiving operator, an arrangement of mechanism controlled by the cooperation of the plug with the seat wherein it rests when not in active use,

whereby the telephone of the receiving operator, which is the instrument with which the "busy" test ordinarily is made, is automatically connected with the cord-circuit when the plug is lifted from its seat preparatory to making a connection, so that the busy test may quickly be made. I have further provided means for automatically cutting out or removing the operator's telephone from circuit by the act of inserting the plug in a spring-jack. Again, my invention contemplates the provision of means for indicating the length of time which is required to get a response from a subscriber after the connecting-plug has been inserted in his spring-jack—that is, for indicating how long a time the ringing-current has been maintained upon his line. In connection with the above a further feature of my invention consists in the provision of means for automatically counting the number of connections which are made at any given board or with any given group of plugs, an electrically-operated counting device being included in a circuit which is controlled by the insertion of the plug in a spring-jack.

My invention consists, further, in certain combinations of electrical and mechanical mechanism for accomplishing the functions set forth above, together with other functions incidental to the operation of the telephone-exchange system, all of which will be more fully set forth by reference to the accompanying drawings, and particularly pointed out in the appended claims.

In the drawings, Figure 1 is a diagrammatic view indicating by means of conventional symbols the telephone-exchange apparatus of my invention. Figs. 2, 3, and 4 are detail views illustrating certain portions of the apparatus in the positions or relations which they occupy at different stages of the operation of making a connection. Fig. 5 is a detail view of an electrically-operated counting device intended to be used in connection with the other apparatus of my invention, and Fig. 6 is a detail view of an electrically-controlled time-indicator.

Similar letters of reference are used to designate the same parts wherever they are shown.

Referring to Fig. 1, two subscribers' stations A and B are indicated, together with portions of the apparatus at the answering-switchboard C at which the line of subscriber A terminates, and a trunk-line circuit extending from such receiving-switchboard to another switchboard D at which the telephone-line of subscriber B terminates. The trunk-line *a*, as is usual, terminates at the answering-switchboard in a spring-jack *b*, the two conductors *a*¹ *a*² of the trunk-line being connected to the line-springs *b*¹ *b*², respectively, of said spring-jack. At switchboard D the conductors *a*¹ *a*² are connected with the contact portions *c*¹ *c*², respectively, of the trunk-line plug *c*. When the plug is not in service for connecting lines, it rests in a vertically-movable seat *d*, which may be mounted upon the pivoted arm *d*'. Two plungers *e* *e*' are connected with the arm *d*', whereby the downward movement of said arm by the weight of the plug or the upward movement thereof by the spring *a*² will cause said plungers to move downward or upward in an obvious manner. The plunger *e* engages and operates a set of switch-contacts E. Similarly the plunger *e*' engages and operates a set of switch-contacts E'. The set E consists of contact-springs *f* *g* *h* *i*, mounted substantially parallel to one another, and a contact stud or point *k*. The contact-spring *h* tends naturally to engage the spring *g*; but when the plug rests in its socket the plunger *e* forces it downward and breaks this engagement, also forcing the spring *i* downward, which otherwise would engage the spring *h* and which does so at certain times when not prevented by the plunger. The spring *g* carries an insulating-lug *l*, which projects toward the spring *f*. Normally the spring *f* does not engage the contact-point *k*; but when the spring *h* engages the spring *g* the insulating-lug *l* upon the latter presses against the spring *f* and forces it against its contact-point *k*. An electromagnet F is associated with the mechanism E, the armature of which magnet is provided with a detent *m*, which is adapted normally to engage the projecting end of contact-spring *h* and maintain the same in a depressed condition independently of the plunger *e*, as shown in Figs. 1 and 2.

The mechanism E' is similar to mechanism E, being provided with springs *f*', *g*', *h*', and *i*', corresponding to the springs *f*, *g*, *h*, and *i*, and the contact-point *k*' and insulating-stud *l*', corresponding to the parts *k* and *l*, respectively, except that the spring *f*' is normally in engagement with its contact-point *k*', while in the apparatus E the situation is reversed—that is, the spring is normally disengaged from its contact-point. A magnet F' is associated with the mechanism E', the armature of which magnet is likewise provided with a detent *m*' for engaging the projecting end of contact-spring *h*'.

The mechanism E' differs from the mechanism E in that an additional spring *n* and

contact-point *n*' are provided, which normally are disengaged from one another, but which are in contact when the spring *h*' is depressed, an insulating-stud *o* being mounted upon said spring *h*' for engaging the spring *n* and forcing it downward upon its contact-point, as shown in Figs. 1, 2, and 3.

The contact mechanism E E' is included in the trunk-line circuit, the continuity of conductor *a*¹ being controlled by contact-springs *g* and *h*, while the continuity of conductor *a*² is similarly controlled by contact-springs *g*' *h*'. This will be obvious upon a glance at Fig. 1.

While I have spoken of the trunk-line as a "continuous line" and have given the letters *a*¹ *a*² to the conductors which constitute the same, it is shown as divided into two parts at the switchboard D by a repeating-coil G, one side of which repeating-coil—that is, the portions *p* *p*'—being included in that part of the trunk-line which extends to the spring-jack at the answering-board, and the other portions *p*² *p*³ of the repeating-coil being included in that part of the trunk-line which extends to the plug *c*. The parts of the trunk-line, while thus mechanically separated, and, indeed, electrically separated so far as direct currents are concerned, really constitute, in effect, a continuous line when alternating, pulsating, or varying currents, such as telephonic "voice-currents," are transmitted over it. Such an arrangement is not unusual, and the relations of the two parts of the trunk-line to one another are well understood by those skilled in the art. A battery *r* is shown included between the portions *p*² *p*³ to supply current for the subscriber's transmitter in accordance with the well-known operation of the "centralized-battery system." The conductor between the portions *p*² and *p*³ is grounded at *s*. A relay *t* is included in the circuit of battery *r*, this relay serving to control the clearing-out signal lamp *t*', which derives its current from battery *u*. An "order-wire" telephone-circuit H extends from switchboard C to switchboard D, whereby the operators may communicate with one another.

The above description of certain parts of the apparatus shown will be sufficient foundation for a description of the operation of the system whereby an idea of my invention may be more readily obtained than by a mere description of the electrical connections. I will therefore proceed to describe the different steps which are taken in establishing a connection between subscribers A and B.

Suppose that subscriber A has called for connection with subscriber B. Operator C, knowing that B's line terminates at board D, informs the operator there by means of the order-wire H what connection is desired and is informed in return what trunk-line she may use to extend subscriber A's line. If trunk-line *a* is to be used, operator C makes the connection at spring-jack *b*, using an ordinary pair of plugs and their cord-circuit, such

as every answering operator is provided with, and which includes the usual telephone and signaling apparatus incidentally employed in connecting and disconnecting lines. This is well known and does not enter directly into the system of my invention. Hence for clearness all of it, excepting the pair of plugs, has been omitted from the drawings and need not be further described. The mechanism $E E'$ is normally in the position shown in Fig. 1; but as soon as the plug c is lifted from its seat the plungers $e e'$ are raised, permitting contact-springs $i i'$ to engage with contact-springs $h h'$. Contact-spring i is connected to ground at s' through the operator's telephone i^2 , and a retardation-coil and spring h being connected with the tip of the plug c through conductor a' , when the operator makes the "busy" test and touches the tip c' of the plug to the test-ring of the called-subscriber's line if the line is busy—that is, if the test-ring is connected with a grounded battery in accordance with the usual "busy-test" system—current will flow through conductor a' , contact-spring h , contact-spring i , telephone i^2 to ground, giving the "busy" signal. If the called-subscriber's line be not busy, the plug is inserted, and the act of insertion causes several changes in the condition of the apparatus, as follows:

First. Current flows from the grounded battery u through a conductor u' and the coils of magnet F to the contact portion c^3 of the plug and from thence to the test-ring of the called-subscriber's spring-jack and through the usual cut-off relay to ground, thus establishing the "busy" signal at all of the multiple spring-jacks of the called-subscriber's line in the well-known way.

Second. The circuit including magnet F being controlled by registering contacts of the plug and spring-jack is thus completed, and magnet F is energized and attracts its armature, withdrawing detent m and permitting spring h to fly back, so that said spring disengages itself from contact-spring i and strikes contact-spring g above it, and, further, through the medium of the insulating-lug l , pushes contact-spring f into engagement with its stud k , as shown in Fig. 3. Contact being broken between springs h and i , the operator's telephone i^2 , which is connected with and controlled by the spring i , is thus automatically cut off from the circuit. As before stated, her telephone is intended only to be used in making the "busy" test and in conversing with the operator at switchboard C , this latter operator being the only one who is required to converse with the subscribers. Current from battery u now finds path through resistance w to contact-spring f' , contact-spring f , contact-point k , through a time-indicator x , (including a lamp x'), and counting device x^2 to ground at x^3 . The counting device x^2 , which is shown in detail in Fig. 5, consists merely in an arrangement

of indicating-disks like those of an ordinary cyclometer operated by the armature of an electromagnet, so that each energization of the magnet will register once upon the dial. The time-indicator shown in Fig. 6 is in the nature of a stop-watch and is connected with an armature of an electromagnet in such a manner that it can run only when the armature is in an attracted position—that is, when current is flowing through the magnet-coil. The electromagnets of both of these instruments are included in the circuit from battery u , controlled by the contacts $f' k'$ and $f k$. Upon this circuit being closed by the energization of magnet F and the consequent engagement with one another of contacts f and k the counting device x^2 will therefore register the connection and the time-indicator will begin to run and the lamp x' will burn until the circuit is broken. I will describe the breaking of this circuit hereinafter.

Third. Ringing-current will flow from a generator y through the coils of magnet F' to contact-spring i' , spring h' , conductor a'' to the sleeve-contact c^2 of the plug, whence it will flow out over the subscriber's line, through his bell, and back over the other side of the line to the tip of the plug, conductor a' , spring h , spring g , through the portion p^2 of repeating-coil G to ground at s . The current through magnet F' is not sufficient at this time to energize it and the subscriber's bell continues to ring until he answers by removing his telephone from its hook. When he does this, it reduces the resistance of the circuit and permits more current to flow, energizing magnet F' , which attracts its armature, and thereby withdraws the detent m' from contact-spring h' . This permits the spring to fly upward and assume its normal position, whereupon its contact with spring i is broken and the generator cut out of circuit. The spring h' now presses upward against the contact g' , completing the circuit of battery r to line, and the raising of the contact-spring g' causes the insulating-button n' , carried thereby, to engage the contact-spring f' and raise it from its contact k' , as shown in Fig. 4. The contact-spring n , relieved from the downward pressure of the insulating-button o , carried by the spring h' , springs upward, separating itself from its contact-anvil n' and breaking the contact between them. The breaking of the electrical contact between the spring f' and its anvil k' cuts off the branch circuit including the counting device, signal-lamp x' , and time-indicator, so that the time-indicator, being deprived of current, will cease to run. The time during which current has been flowing in this branch circuit is therefore the length of time which has been taken in getting response to the call, and this is shown by the indicator, which began to run when the circuit was established at contacts $f k$ at the time the calling plug was inserted and ceased to run when the flow

of current was stopped by the breaking of the circuit at contacts $f' h'$ at the time the called subscriber answered.

Current for operating the subscriber's transmitting instrument is sent from the centralized battery r through the portion p^3 of the repeating-coil G , contact-spring g , contact-spring h , conductor a' to the tip of the plug, out over the subscriber's line, through his transmitting instrument in the usual manner, back over the other side of the line to the sleeve-contact c^2 of the plug, conductor a^2 , spring h' , spring g' through the relay t , and the portion p^3 of the repeating-coil G , and back to the other side of the battery. The line of subscribers A and B are thus connected through the trunk-line at switchboards C and D.

While the plug c is inserted in the jack of the called line, current from battery u flows through the helix of magnet F and by way of the third contact c^3 of the plug and test-ring of the jack to ground through the cut-off relay in the usual manner; but the signal-lamp l' included in this circuit is shunted by the low resistance w until the called subscriber responds, the contacts $n n'$, which control this shunt, being pressed together by the insulating-button o , carried by the spring h' , as shown in Figs. 1, 2, and 3. When the called subscriber answers, the magnet F' is energized, as before described, to release the springs controlled thereby, so that they take the position as shown in Fig. 4 and the shunt of the lamp, which includes the resistance w and is controlled by contacts $n n'$, is broken, these contacts being separated, as hereinbefore described; but the signal-lamp l' is not yet illuminated, because, although the shunt controlled by contacts $n n'$ is broken, yet a second shunt, including a low resistance l^2 , is immediately closed by the relay t , this relay being excited by the current from battery r through its helix and out over the line, as previously traced. When, however, the subscriber B has finished using his telephone and hangs up his receiver upon its hook, this circuit through relay t is broken at the switch-contacts of the telephone-hook at the substation, so that the relay t becomes deenergized and allows its armature to fall back. The shunt of the lamp including resistance l^2 is thus broken and the lamp is illuminated.

I am aware that means for automatically ringing the called subscriber upon the insertion of the connecting-plug into the spring-jack of his line has been accomplished heretofore, and I do not wish to be understood as claiming this broadly. I believe, however, that I am the first to accomplish the automatic connection and disconnection of the generator and the operator's telephone with the cord-circuit by means of a plug-seat switch. Heretofore the circuit changes necessary for the automatic connection and disconnection of the generator have been effected by means of contact-springs, which were

electrically controlled. It will be noted that in the system I have above described the contact-springs are controlled mechanically as well as electrically and that the only changes in the relations of the contact-springs which are brought about electrically are the releasing of the contact-springs $h h'$ by electromagnets F F'. The other circuit changes are produced by the mechanical connection between the contact-springs and the movable plug c . It will be evident that the ideas I have above set forth may be embodied in telephone-exchanges differing widely as to their specific construction and that numerous modifications may be made from the form shown in the drawings without departing from the spirit of my invention.

I therefore claim—

1. An apparatus for telephone-switchboards, consisting of a connecting-plug and its cord-circuit, a seat wherein the plug is adapted to rest when not in use, switch-contacts and means for setting the same controlled by the cooperation of the plug with its seat, an electromagnet having an armature for releasing said switch-contacts, and means for energizing said magnet, substantially as set forth.

2. The combination with a telephone-line, extending from a subscriber's station and terminating in a spring-jack at the central office, of a plug and its cord-circuit, said plug being adapted for insertion in said spring-jack, a seat wherein said plug is adapted to rest when not in active use, a set of switch-contacts controlled by the cooperation of said plug with its seat, a source of signaling-current, means controlled by said switch-contacts for connecting the same to the cord-circuit, whereby said source of current is connected with the cord-circuit and through the latter with the telephone-line when the plug is lifted from its seat and inserted in the spring-jack, an electromagnet connected or adapted to be connected with the telephone-line, mechanism adapted to be influenced by said magnet to change the relations of said switch-contacts to remove the source of signaling-current from circuit, and means controlled at the subscriber's station for energizing said magnet, whereby said source of signaling-current is cut out when the subscriber answers, substantially as described.

3. The combination with a connecting-plug adapted for insertion in a telephone-line spring-jack, of a seat wherein said plug is adapted to rest when not in active use, a set of switch-contacts controlled by the cooperation of said plug with its seat, a source of signaling-current and a circuit controlled by said switch-contacts for connecting the same with the cord-circuit, whereby said source of signaling-current is connected with the plug when the latter is lifted from its seat preparatory to making a connection, an electromagnet, circuit-changing mechanism adapted to be influenced thereby to cut out said source

of signaling-current, and means for energizing said electromagnet, substantially as set forth.

4. The combination with a telephone-line extending from the subscriber's station and terminating in a spring-jack at the central office, of a plug and its cord-circuit, said plug being adapted for insertion in said spring-jack to connect the cord-circuit with the telephone-line, an electrically-operated time-indicating device, means controlled by registering-contacts on the plug and spring-jack for operating said indicating device, and means controlled by the subscriber's apparatus for preventing the operation of said time-indicating device, whereby said device is operated during the time between the insertion of the plug and the operation of said subscriber's apparatus, substantially as set forth.

5. The combination with a connecting-plug, of a seat wherein the same is adapted to rest, a switch-contact adapted to occupy alternative positions, controlled by the co-operation of the plug with its seat, a detent for retaining the spring in one of its alternative positions independent of the plug, an electromagnet having an armature adapted to release said contact, and means for energizing said magnet, substantially as described.

6. The combination with a connecting-plug and its cord-circuit, of a seat wherein said plug is adapted to rest when not in active use, a contact-spring, mechanical means for moving said contact-spring out of its normal position, said means being controlled by the co-operation of the plug with its seat whereby said spring is bent out of its normal position when the plug rests in its seat, contacts with which said spring is adapted to engage in alternative positions, a detent adapted to maintain said spring in an abnormal position in-

dependently of the means controlled by the plug and its seat, an electromagnet and means adapted to be influenced thereby to disengage said detent from said contact-spring, a circuit including said magnet, and a source of current and registering-contacts on the plug and spring-jack for controlling said circuit, whereby the spring is released from said detent by the insertion of the plug in the spring-jack, substantially as set forth.

7. The combination with a connecting-plug, of a seat wherein the plug is adapted to rest when not in use, two independent sets of switch-contacts, a telephone-circuit controlled by one set of contacts and a signaling-circuit controlled by the other set of contacts, means associated with the plug-seat for changing the relations of both sets of contacts and for setting the same, electromagnets associated one with each set of switch-contacts, armatures for said magnets adapted when moved to release the contacts previously set, and means for energizing said electromagnets, substantially as described.

8. The combination with a connecting-plug, of a movable seat wherein the same is adapted to rest when not in use, two independent sets of switch-springs, both adapted to be set by the movable plug-seat, independent electric circuits controlled by each of said sets of switch-springs, electromagnets associated one with each of said sets of switch-springs, mechanism operated by said magnets for releasing the switch-springs, and means for energizing said electromagnets, substantially as set forth.

In witness whereof I hereunto subscribe my name this 9th day of May, A. D. 1899.

JOSEPH J. O'CONNELL.

Witnesses:

DE WITT C. TANNER,
GEORGE P. BARTON.