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PATENTED JAN. 24, 1905.

F. R. McBERTY.

APPARATUS FOR TELEPHONE SWITCHBOARDS.

APPLICATION FILED JAN. 26, 1901.

2 SHEETS—SHEET 1.

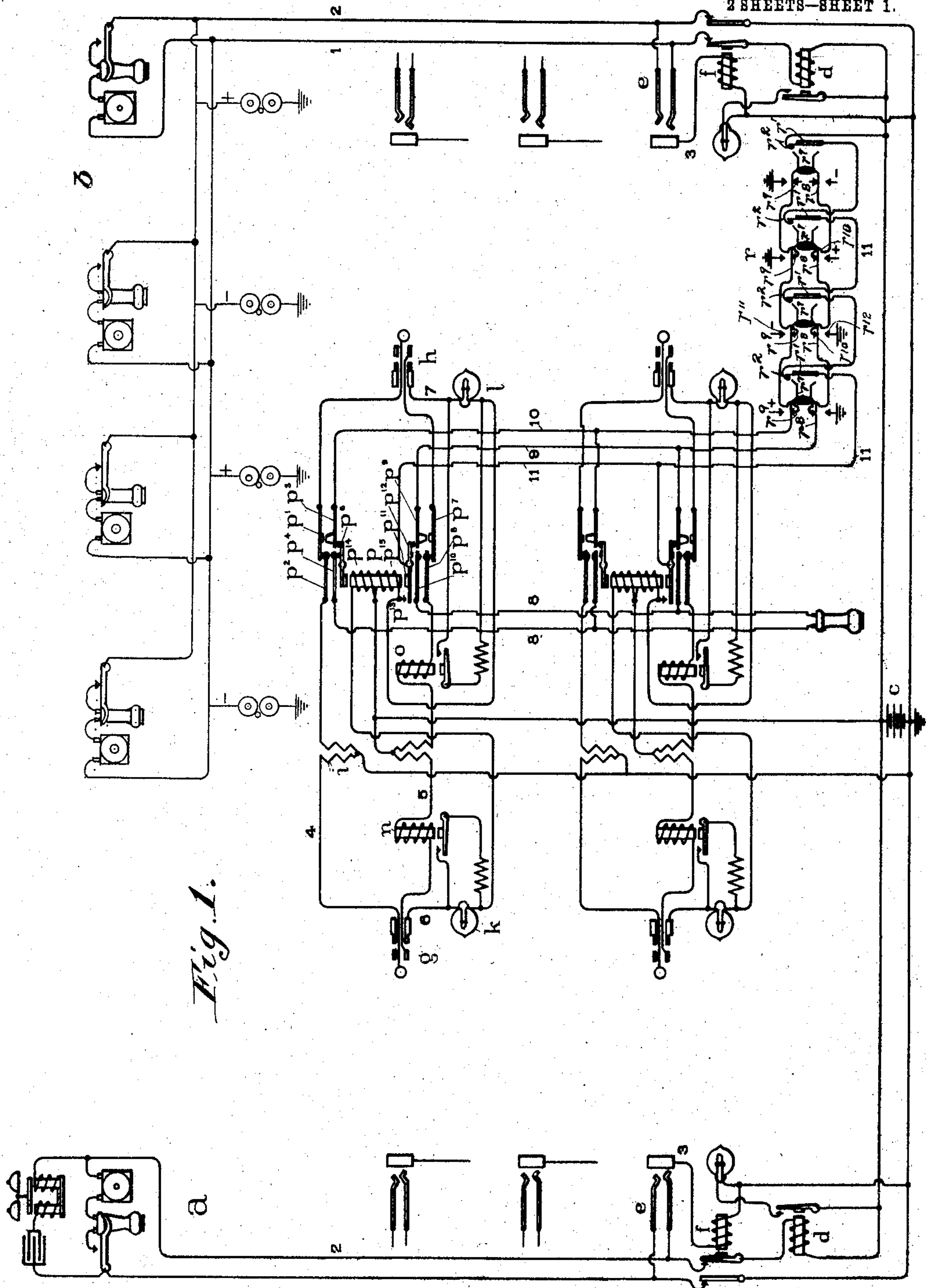


Fig. 1.

WITNESSES

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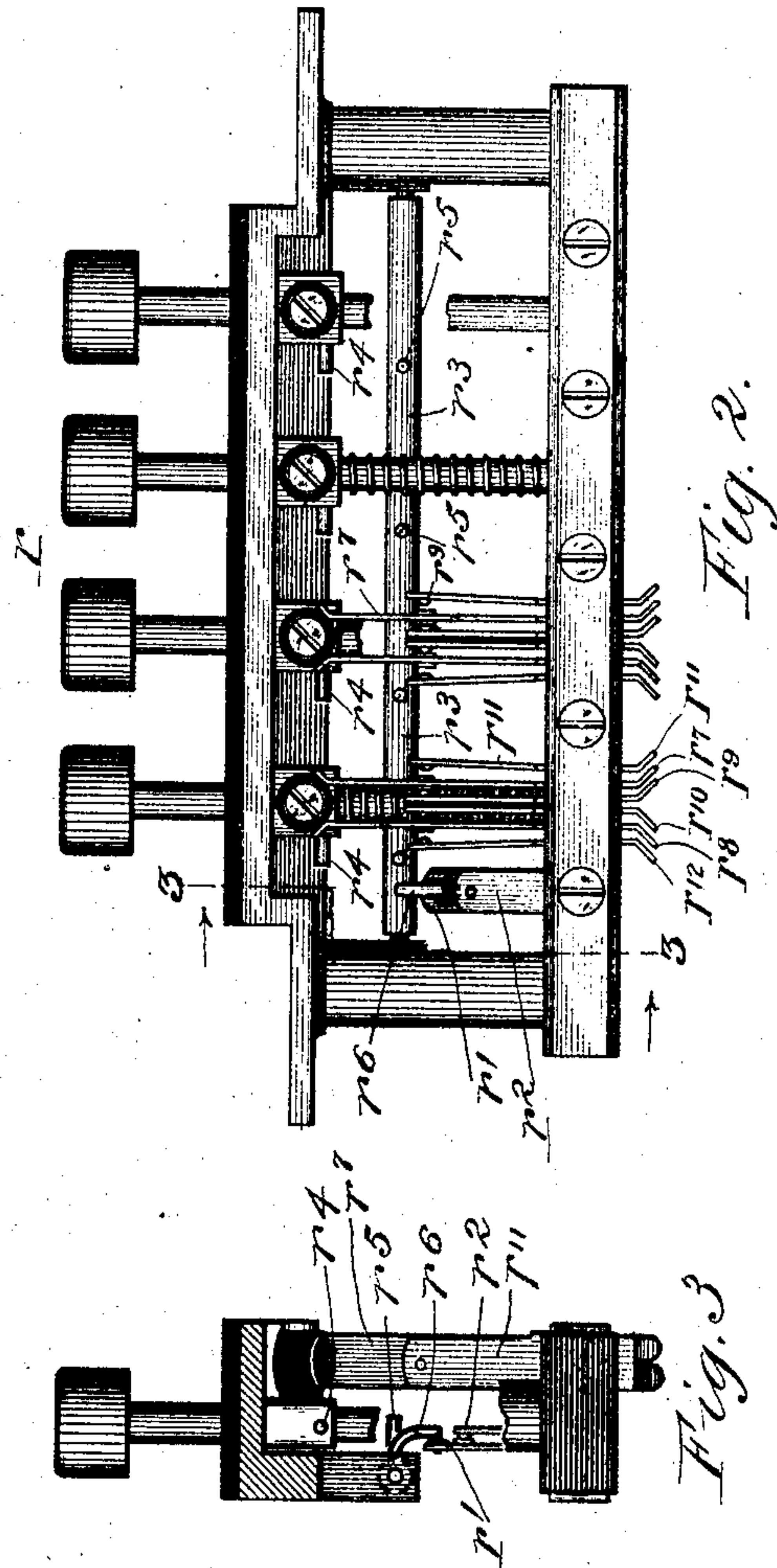
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 780,679, dated January 24, 1905.

Application filed January 26, 1901. Serial No. 44,920.

To all whom it may concern:

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

My invention concerns the control of the switching apparatus associated with the link conductors or plug-circuits for uniting telephone-lines in a switchboard, its object being to reduce the number of appliances requiring manual operation in the switchboard and to eliminate special manipulation of keys as far as is consistent with efficient control of connected lines.

The acts performed by an operator in uniting telephone-lines into common circuits and bringing the users of the telephones into communication necessarily follow one another in a definite order and sequence, and the different link conductors or plug-circuits of the group provided for each operator are used successively in performing the sequence of acts. The central new idea of my present invention is the utilization of each step of the series performed with respect to one plug-circuit to establish a condition of mechanism adapted for the performance of the subsequent operation and to perform the required operation by means of a suitable appliance common to all the plug-circuits, the common appliance when operated being capable of affecting only the plug-circuits of which the mechanism has attained the necessary condition or stage in the sequence. This idea is most fully embodied in mechanism for disconnecting the operator's telephone from the plug-circuit and transmitting a call-signal to the substation of the line called for, which comprises means for connecting the telephone with the portion of the plug-circuit leading to the answered line and the leads of the source of calling-current with the calling-plug, an appliance common to the different plug-circuits for applying suitable calling-current to

said leads, and mechanism actuated in operating the common appliance to disconnect the leads from the plug-circuit, the mechanism when thus rearranged being self-maintaining in the new condition, subject to the act of disconnection. This mechanism may be either mechanical or electrical in its nature; but in the preferred form it consists mainly of electromagnets and circuits.

The invention is peculiarly suited for switching systems of multiple station or party lines fitted for selective calling. A single group of selective calling-keys is provided, each adapted to apply to the generator-leads the specialized current for operating a corresponding selective call-signal, and all the keys of the group are arranged for controlling the mechanism above referred to.

The embodiment in electrical mechanism for controlling the connection and disconnection of the operator's telephone and of the generator of calling-current with the plug-circuit is illustrated in the accompanying drawings, wherein—

Figure 1 represents two telephone-lines to substations entering a switchboard in a central station with two link conductors or plug-circuits in the switchboard for uniting the lines for communication, the plug-circuits being controlled by the devices peculiar to the invention. Fig. 2 is a view in elevation of the party-line ringing-key which is shown in diagram in Fig. 1. Fig. 3 is a sectional view on line 3 3 of Fig. 2.

The same parts are indicated by the same reference characters in all the figures.

The telephone-exchange herein represented is organized as a central-battery system—that is to say, each line is adapted to receive its supply of current for operating signals and for exciting the substation-transmitters from a central source of current located in the central station.

The telephone-line α is a single-party telephone-line which is normally open at the substation with respect to currents from the central battery, although the circuit is induced

tively closed through a call-bell and a condenser at the substation. The telephone-line b is a four-party line, and a circuit through said line for the central battery is normally completed by way of limb 1 to earth through the branches including the signal-bells at two of the substations, which bells are of such high resistance as to practically prevent the flow of current in the circuit. At each of the substations the closing of the telephone-switch when the telephone is taken for use completes a low-resistance conducting-circuit for the central battery through the telephonic apparatus at such station. The line conductors 1 and 2 of each of the lines ab are led in the central station to the poles of the central battery c , and the call-signal indicator d is interposed in one of the conductors to give a signal when the telephone is taken for use at the substation. One pole of the battery c is preferably grounded in accordance with the usual practice for the purpose of preventing inductive disturbances in the lines. Switching-terminals of the line appear in the switchboard in a spring-jack e . The extensions of the line to the central battery are controlled by switch-contacts of a cut-off relay f , of which the magnet is in a local circuit 3 of the battery designed to be closed in switching the line for communication. The circuits and apparatus of the lines in the switchboard are alike. It will be understood that a large number of similar lines enter the switchboard and are attended by several operators. Each operator is furnished with a number of pairs of plugs g and h , fitting the spring-jacks, the plugs of a pair forming the terminals of a plug-circuit 4 5, which may thus unite into a composite circuit two lines into whose spring-jacks the plugs are inserted. The plug-circuit is a complete circuit between lines only in the sense that it serves for the translation of telephonic currents originating in one line into the other line. The conductive continuity of the plug-circuit is broken by an interposed repeating-coil i , whose windings form a means of connecting the two conductors 4 and 5 with the battery c . The parts of the plugs which are placed to register with the ring-contacts or "thimbles" of the spring-jacks form the terminals of conductors 6 and 7, which lead to the battery c and which are formed in part by lamps k and l , respectively, and in part by windings of an electromagnet to be described presently. These signal-lamps are controlled by shunts closed by two supervisory relays n and o , one for each lamp, having their magnets in the conductor 5, one in the portion leading to the plug g and the other in the portion terminating in plug h .

The appliances so far described are those which characterize the ordinary central-battery system. In combining my invention with

this mechanism I provide a relay p , having two magnet-windings and a number of switch-contacts. This electromagnetic switch is represented diagrammatically in the drawings; but a suitable mechanical construction will at once suggest itself to those familiar with telephonic appliances. Two spring switch-levers p^1 and p^2 rest normally together. These are opposed to two spring-contacts p^3 and p^4 , which are in engagement with a lever carrying the armature p^5 . When the armature is attracted, it thrusts the contacts p^3 and p^4 against the levers p^1 and p^2 , respectively, separating the latter at the same time. The parts are duplicated in spring-levers p^7 p^8 , contacts p^9 p^{10} , and armature p^{11} at the other pole of the magnet, and a pair of contacts p^{12} p^{13} is added, which are closed together by the armature when attracted. The switch-levers p^1 p^2 are interposed in conductor 4 of the plug-circuit, and the corresponding levers p^7 p^8 are included in conductor 5. Contacts p^4 p^{10} constitute terminals of a conductor 8, containing the operator's telephone. Contacts p^3 p^9 terminate conductors 10 and 9, leading to a group of calling-keys. The windings p^{14} and p^{15} are included in conductors 6 and 7, respectively. These windings are differentially connected and are of equal ampere-turns, so that they neutralize each other when both are active. The contacts p^{12} p^{13} control a short circuit 11 about the winding p^{15} . A portion of this short-circuiting conductor is common to all the plug-circuits assigned to one operator. The group of keys r to which the leads 9 and 10 extend are selective calling-keys of familiar use and construction. Each key when depressed applies to one or the other of the leads a pole of a source of calling-current adapted for the operation of the particular selective call-bell at the required substation. I add to this group of keys, which is common to all the plug-circuits, a device for opening the short-circuiting conductor 11 after the transmission of a call-signal by means of any key. As shown in the drawings, the device is a contact-lever r^1 for each key in position to be pressed away from its anvil r^2 when the key is fully depressed. The stroke of the key is made sufficiently long to allow a calling-current of adequate duration to flow before the contacts r^1 r^2 are separated.

I will now trace the operation of the invention.

The device above referred to, which is diagrammatically indicated in Fig. 1, is shown more clearly in Figs. 2 and 3. Each of the plungers of the key r carries a stud r^4 , which is adapted as the plunger reaches its lowest position to engage a stud r^5 , carried on the rocking shaft r^3 , whereby said shaft is rocked in its bearings. The shaft r^3 carries a stud r^6 , which is arranged to engage the contact-spring r^7 and press the same away from its

contact-anvil r^2 . The contacts r' r^2 control the short circuit 11, as heretofore described, and said short circuit is broken at the contacts r' r^2 at the end of the transmission of a call-signal by any key. The contact-springs r^7 r^8 of each key normally rest against inner anvils r^9 r^{10} , respectively connected with the springs r^7 r^8 of the next key r , and upon the depression of the plunger of the key said springs are moved away from the anvils r^9 r^{10} and into engagement with contact-springs r^{11} r^{12} , leading to a source of current.

A subscriber's call is answered by inserting the plug g into the spring-jack e of the calling-line. This act forms a temporary extension of the line into the plug-circuit 4 5 and completes the local circuit 3 6, containing the magnet of the cut-off relay f , the lamp k , and the winding p^{14} of relay p . The cut-off relay severs the normal extensions of the line to the central battery c . The lamp receives current for its illumination; but it is immediately shunted by the supervisory relay. The relay p is excited by current in the winding. The conductors 4 and 5 are severed, the portions leading to the answering-plug g are connected with the terminals of the operator's telephone, and the ends of the wires leading to the calling-plug h are connected with the generator-leads 9 10; also, the short circuit of the winding p^{15} is closed, rendering this winding ineffective to demagnetize the core when it shall be brought into a closed battery-circuit. Having obtained from the calling subscriber the order for the desired line, the operator places the mate plug h of the pair in the spring-jack of the correspondent line. Thereby a circuit 7 3 is closed, containing the cut-off relay of the line called for, the supervisory lamp l , temporarily associated with that line, and the winding p^{15} , (still short-circuited.) Then the operator presses the key of group r to send the requisite signaling-current. In its final travel the plunger of the pressed key opens the shunt 11. The current previously passing through the shunt is thereby diverted through the winding p^{15} , wherein it neutralizes the magnetism evoked by winding p^{14} . The relay p is thus caused to release its armatures, the telephone is disconnected from the answering-plug, the generator leads are cut off from the calling-plug, and the breaks in the plug-circuit are closed. Further, the short circuit 11 of winding p^{15} is permanently broken. The cycle of operations which effected and preserved its closure is complete. Other pairs of plugs may be employed in linking other lines together, the common keys r being used for calling; but during the transmission of the call-signal the current is applied only to the plug-circuit last connected with a line upon which no ringing-current has yet been impressed. The operator supervises the connected lines by means of

signals k and l . When both signals are displayed, she removes plugs g and h from the spring-jacks and returns them to their resting-places in the switchboard.

To correlate the preliminary description of the invention with the apparatus shown in the drawings, it is to be noted that the winding p^{14} , with its magnet, constitutes a means individual to the plug-circuit for connecting the common group of keys r with the plug-circuit. The magnet is excited automatically in one step of the sequence of acts involved in making a connection, and in its excitement it prepares the circuits 9 10, 4 5 for the application of calling-current, and incidentally brings the magnet under the control of a device r' r^2 , associated with the calling-keys r . The transmission of a call-signal by incidentally rendering the magnet p neutral disconnects the calling-leads 9 10 from the plug-circuit and by breaking the shunt 11 changes the condition of the mechanism to maintain the shifted position of the switch in the plug-circuit and to destroy the control of the shunt 11 and contacts r' r^2 over it.

My invention is defined in the following claims:

1. The combination with telephone-lines and a group of plug-circuits for uniting them in pairs, of an appliance, such as a generator of calling-current, and connections thereof with the plug-circuits of said group, a switch for each plug-circuit controlling the connections, means associated with each plug-circuit for actuating said switch made operative in using the corresponding plug-circuit, mechanism made operative by the switch adapted to maintain the arrangement of said connections when shifted by the switch, and a device common to the group of plug-circuits controlling said mechanism as described.

2. The combination with telephone-lines and a group of plug-circuits for uniting them, of circuit connections with the plug-circuits and an electromagnetic switch for each plug-circuit controlling them, a circuit for the actuating-magnet of each of said switches, controlled by the switch for maintaining the position of the switch when shifted by the magnet, and a device common to the plug-circuits controlling said circuits of all the magnets; whereby any switch which has been individually shifted to close the circuit of its actuating-magnet may be governed by the common device, as described.

3. The combination with telephone-lines and plug-circuits for uniting them and appliances for connection with the different plug-circuits, of a switch for each plug-circuit and an actuating-magnet for each switch, a circuit for each actuating-magnet and an individual switch controlling the circuit, a second circuit for each magnet controlled by the switch thereof adapted to maintain the shifted posi-

tion of the switch, and a common key controlling all said last-mentioned circuits for the magnets, as described.

4. The combination with telephone-lines and
 5 a group of plug-circuits, of a calling-generator, a switch of each plug-circuit for connecting the leads of the generator with the plug-circuit, and an actuating-magnet for each switch, a circuit for the actuating-magnet and
 10 an automatic switch, actuated in connecting the plug-circuit with a line, a locking-circuit for the magnet controlled by the switch thereof when shifted adapted to maintain the shifted position of the switch, a calling-key for
 15 completing the generator-leads, and contacts of the key controlling all said circuits for the magnets for maintaining the positions of the switches; whereby the generator-leads are automatically applied to a plug-circuit in using
 20 the plug-circuit, and are disconnected therefrom in the transmission of a call, as described.

5. The combination with a plug-circuit and an operator's telephone, of a switch for connecting the telephone with the plug-circuit,
 25 an electromagnet for actuating the switch, a circuit containing a winding of the magnet closed through contacts of the plug and spring-jack in making connection with the calling-line by means of the answering-plug, and a
 30 circuit containing another winding of the magnet closed through contacts of the plug and

spring-jack in making connection with the line called for by means of the calling-plug; said windings being differential and equal, substantially as described. 35

6. The combination with telephone-lines, of selective call-bells at the substations of the lines, a group of plug-circuits for uniting the lines, a group of calling-keys common to the plug-circuits and each adapted to apply a distinctive current for operating a particular selective signal; a switch for each plug-circuit adapted to connect therewith common leads to said group of keys, an actuating-electromagnet for each switch and a circuit for the magnet controlled automatically in making connection with a line by means of the plug-circuit, contacts of the switch closing a circuit for the magnet when the switch is shifted thereby adapted to maintain the shifted condition of the switch, and contacts of each key of said group, operated in applying calling-current to the leads controlling said last-mentioned circuit for the magnet to return the switch to its initial position, as described. 40 45 50 55

In witness whereof I hereunto subscribe my name this 27th day of December, A. D. 1900.

FRANK R. McBERTY.

Witnesses:

ELLA EDLER,
 FRANK J. HOLMES.