No. 741,713. PATENTED OCT. 20, 1903.

S. B. PRENTISS.

# CIRCUITS AND APPARATUS FOR TELEPHONE SWITCHBOARDS.

APPLICATION FILED MAY 18, 1901.

NO MODEL.

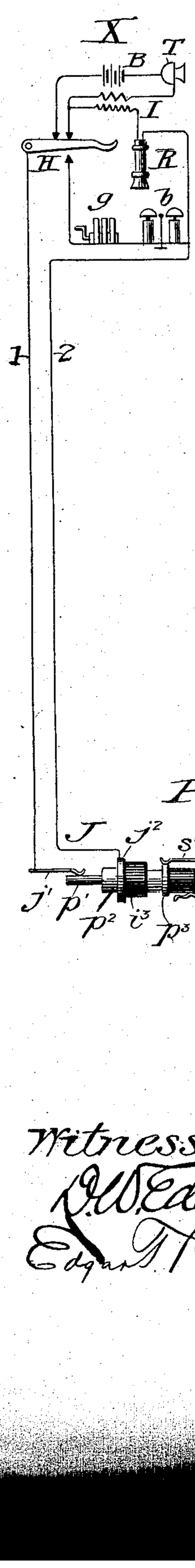



Fig. 1.

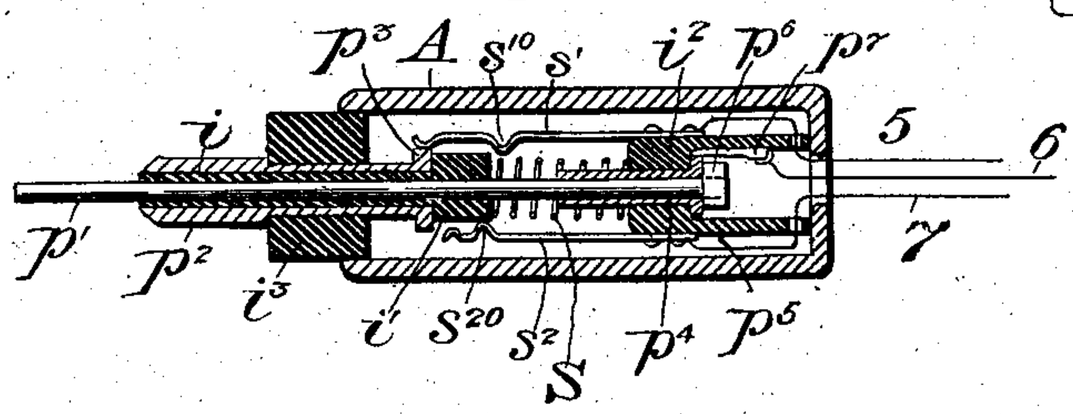



Fig. 2.

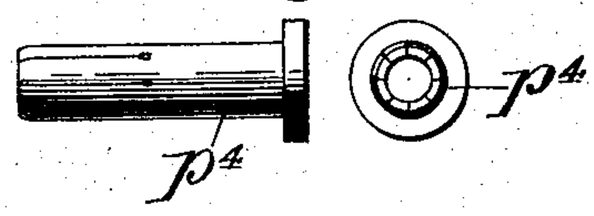
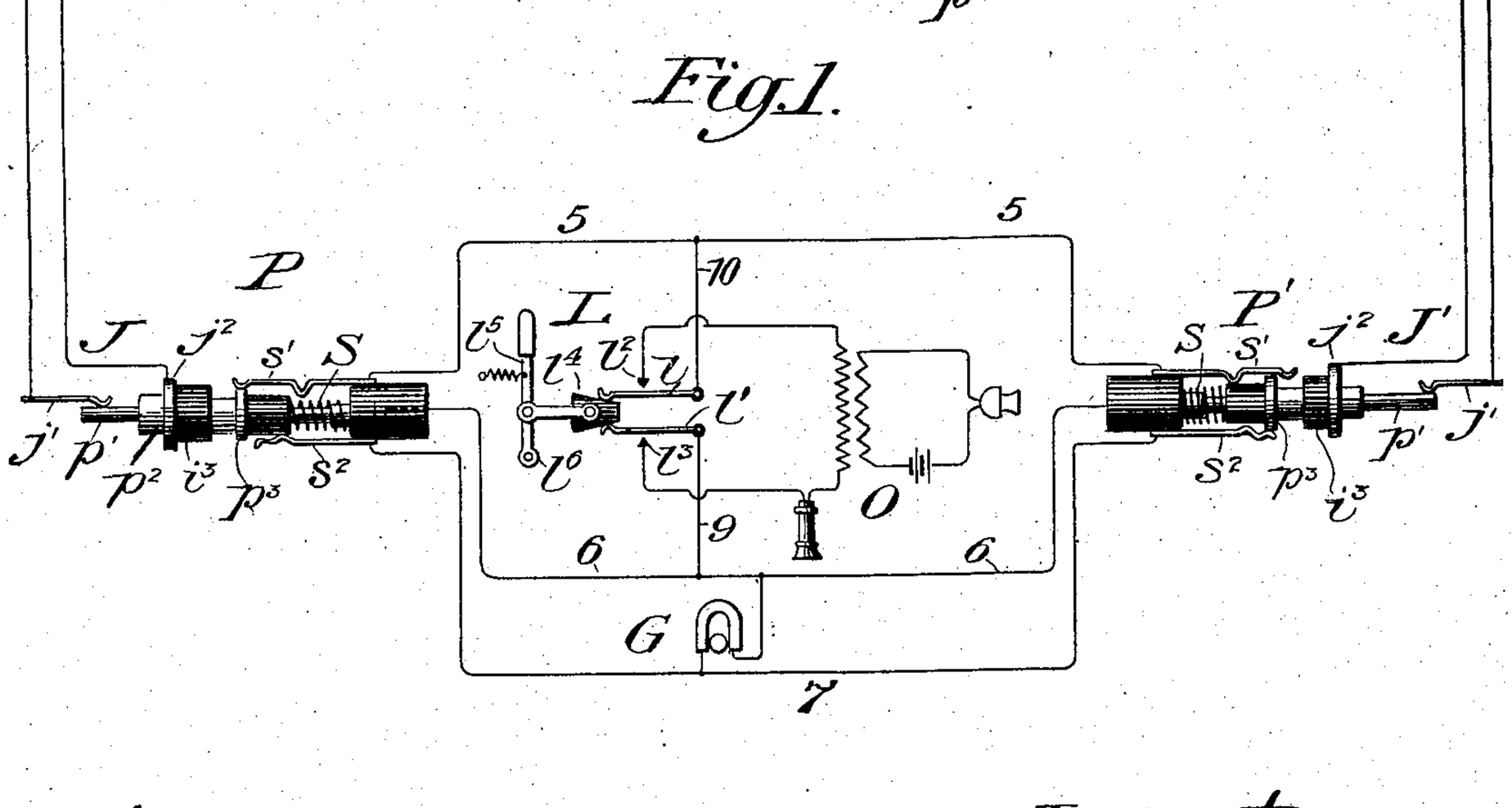



Fig. 3.

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No. 741,713. Patented October 20, 1903.

# UNITED STATES PATENT OFFICE.

SPENCER B. PRENTISS, OF WASHINGTON, DISTRICT OF COLUMBIA.

## CIRCUITS AND APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 741,713, dated October 20, 1903.

Application filed May 18, 1901. Serial No. 60,899. (No model.)

*To all whom it may concern:*

Be it known that I, SPENCER B. PRENTISS, a citizen of the United States, residing at Washington, in the District of Columbia, have invented a new and useful Improvement in Circuits and Apparatus for Telephone-Switchboards, of which the following is a specification.

My invention relates to improvements in circuits and apparatus for telephone-switchboards, and more particularly to that portion thereof by means of which electrical connection may be effected between the various line-terminals upon the board.

According to the practice now generally followed it is customary to provide connecting-plugs adapted to engage a spring or springs constituting a so-called "spring-jack," in which a subscriber's line or a trunk-line terminates. These plugs are usually arranged in pairs, which are connected by flexible conductors, and in the circuit thus formed are usually arranged two switches or keys, one to enable the operator to connect her telephone into the circuit and the other to enable her to connect in a generator for the purpose of signaling a subscriber into whose line-jack one of the plugs has been inserted. The pairs of plugs are arranged along the front of the switchboard, and there should be a sufficient number of them to serve the jacks upon the section of the board where they are located at the busiest time of the day. For this reason it is necessary to place the pairs very close together, and the switches or keys above referred to are usually placed just in front of the plugs with which they are designed to coöperate. These switches or keys, hereinafter termed, respectively, the "listening" and the "ringing" keys, necessitate a multiplicity of spring-contacts, by means of which the various circuit changes may be effected, and in their cramped position it is difficult to make the necessary wire connections with the springs, these connections when made forming a crowded mass of wires and soldered joints which are easily deranged and when out of order are difficult to repair. In the case of the ringing-key contacts must be provided whereby the generator-current may be sent in either direction, and at the same time the circuit in the opposite direction is opened, necessitating the multiplication of contact-springs, while in the case of the listening-key less or fewer contacts are necessary.

One of the objects of my invention is to greatly relieve this congestion of wiring and multiplicity of contacts by providing means which enable me to dispense with the usual ringing-keys and their appurtenances upon the front of the board.

A further object is to diminish the number of movements of the operator in making a connection, and thereby increase the efficiency of each operator.

A further object is to greatly simplify the wiring of the switchboard and to so arrange the ringing-keys that they will be easily accessible for purposes of repair without interfering with or injuring adjacent connections, thereby reducing the original cost of installation and the cost of maintenance.

A further object is to provide a simple, durable, and efficient connecting-plug for telephone-switchboards which shall, besides serving its usual purposes, perform the functions of a ringing-key.

With these objects in view the invention consists in providing a connecting-circuit for electrical signaling-lines comprising a pair of conductors and a third conductor and a source of signaling-current connected to the third conductor and to one conductor of the pair.

It consists, further, in providing a connecting-plug for electrical switchboards having a tip and a sleeve contact, spring-contacts movably mounted upon the plug and adapted to engage alternately one of said contacts, and a suitable inclosing shell for the parts.

It consists, further, in the novel arrangement of circuits of a telephone-switchboard and the construction and arrangement of parts of a telephone-switchboard connecting-plug hereinafter to be fully described and claimed.

My invention is illustrated in the accompanying drawings, in which like reference characters indicate corresponding parts, and in which—

Figure 1 is a diagrammatic representation of a portion of a telephone-switchboard to which my invention is applied, two subscribers' line-jacks and the stations to which they

are connected being shown and the various signals being entirely omitted from the board. Fig. 2 is an enlarged detail view, in central sectional elevation, of a preferred form of connecting-plug embodying the essential features of my invention. Fig. 3 is a detail.

Referring to the drawings, X and Y are two subscribers' stations connected by line-wires 1 2 and 3 4, respectively, with jacks J and J' upon the switchboard at central office, each jack consisting of the usual spring and ring contacts $j'$ $j^2$. The usual instruments and circuit connections at the subscribers' stations are shown in diagram, comprising at station X a transmitter T, battery B, induction-coil I, receiver R, hook-lever H, generator $g$, and ringer $b$. Similarly at station Y are shown transmitter T', battery B', induction-coil I', receiver R', hook-lever H', generator $g'$, and ringer $b'$. At subscriber's station X, hereinafter designated the "calling subscriber," the receiver R is shown removed from the hook and the lever H as in its raised position under the influence of its spring (not shown) to cut out the generator and ringer and close the local transmitter-circuit and also to connect the receiver and the secondary of the induction-coil to line. At station Y, hereinafter designated the "called subscriber," the receiver is shown upon the hook and the lever H' down to connect the ringer to line.

In Fig. 1 a pair of connecting-plugs P P' are shown with their outer casings removed and inserted into line-jacks J J', respectively, these plugs being connected by the usual cord-circuit conductors 5 6, these conductors making connection between the sleeves and the tips of the plugs in a manner to be hereinafter more fully described. The central-office operator's telephone set is shown in diagram at O, the induction-coil, switch-hook, and contacts being omitted and the transmitter being shown on a closed circuit for the sake of clearness. This set is arranged to be bridged across the cord-circuit by means of the listening-key L, consisting of springs $l$ $l'$, contacts $l^2$ $l^3$, plunger $l^4$, and operating-lever $l^5$, pivoted at $l^6$, all of well-known construction. This portion of the circuits and apparatus being old and forming no part of the present invention may be varied in construction at pleasure without departing from the invention.

The calling or generator circuit and the means for connecting the same with the lines which constitute the present invention will now be explained in brief. One form of plug suitable for making the connections will then be described in detail and the operation of the circuits and apparatus as a whole will then be described.

An additional conductor 7 is added to the cord connecting the plugs P and P', and at any suitable point a generator G is bridged across this conductor and one of the voice-current conductors, as 6. The plugs are of special construction, being provided with movable contacts by means of which the voice-current circuit may be broken and the generator-circuit connected to line. The contacts for making these circuit changes are shifted by subjecting the plugs to added pressure after they have been inserted into the line-jacks, as will be more fully explained presently. Normally the parts of the plug are in the position shown at P, Fig. 1, and in Fig. 2 as a whole, in which the conductor 5 is connected to spring $s'$, the latter being in contact with sleeve $p^2$ of the plug. Conductor 6 is in permanent connection with the tip $p'$ of the plug. The third or generator conductor 7 is connected to spring $s^2$, the free end of which is normally out of contact with the sleeve $p^2$. Both the springs $s'$ and $s^2$ are so mounted that, the plug being inserted into the jack, when extra pressure is applied the parts take the position shown at P', Fig. 1—that is, spring $s'$ is forced out of engagement with sleeve $p^2$, thus interrupting the talking-circuit, and spring $s^2$ engages said sleeve, completing the generator-circuit.

Referring now more particularly to Fig. 2, A represents the shell or casing of the plug inclosing the working parts. $p'$ is the tip-rod, of brass, bronze, or other suitable metal, forming the base of the structure, upon which is secured in any suitable manner the sleeve $p^2$, also of metal, the two being separated by a tube of insulation $i$. The sleeve $p^2$ is provided with a flange $p^3$ at its inner end, against which abuts the block of insulating material $i'$. Slidingly mounted upon the tip-rod is a metallic sleeve $p^4$, having at its rear end a flange $p^5$. This sleeve may be split a portion of its length from the end opposite the flange, as shown in Fig. 3, in order to make a better contact with the rod, the spring portions taking up the wear. The sleeve $p^4$ carries a second sleeve or boss $i^2$, of insulting material, to which it is firmly secured, and upon this second sleeve are mounted the contact-springs $s'$ $s^2$, to which are secured the circuit-wires 5 and 7. The rearwardly-projecting portion of the sleeve $i^2$ is provided with a chamber or recess to admit the nut $p^6$, the latter being adapted to engage external threads upon the rod $p'$ and limit the rearward movement of the sleeve $p^4$ and sleeve $i^2$. Between the insulating-block $i'$ and the sleeve $i^2$ is fitted a coiled spring S, which may be secured at one end to the tip-rod $p'$ and at the other to the sleeve $p^4$, thus to make more perfect electrical connection between these parts and maintain the sleeves $p^4$ and $i^2$ in their extreme rearward position. The contact-springs $s'$ $s^2$, mounted in any suitable manner upon the insulating-sleeve $i^2$, project toward the forward end of the plug, the former being normally in contact and making electrical connection with the flange $p^3$ of the plug-sleeve $p^2$. This spring $s'$ is provided with a bend or projection $s^{10}$, extending inwardly in such a manner as to be normally free of, but adapted to ride upon, the block $i'$

when the sleeve $i^2$ is forced forward against the action of the spring S, thereby to take the thrust of the spring $s'$ and lift its contact end out of engagement with the flange $p^3$. The spring $s^2$ is similarly mounted, preferably, on the opposite side of the sleeve $i^2$, this spring being shorter than spring $s'$ and normally supported by a bend or projection $s^{20}$, which rests upon block $i'$, its free end being adapted to make contact with flange $p^3$ when sufficient pressure is applied to the plug. A block or flange $i^3$, preferably of insulating material, is rigidly secured to the plug by any suitable means, such as a pin, (not shown,) with which block the plug-casing makes a sliding contact and closure. The rear end of the casing is provided with a central aperture to admit the circuit-wires 5, 6, and 7, which pass therethrough and are secured, respectively, to springs $s'$, terminal piece $p^7$, which is in contact with sleeve $p^4$, and spring $s^2$, the rear end of the casing resting against and being secured to the sleeve $i^2$.

The operation of the device and circuits thus described is as follows: Supposing that the subscriber at station X wishes to communicate with another subscriber, as Y, he signals central in any suitable or well-known manner. Thereupon the operator at central inserts an answering-plug P into the jack J, forming the terminal of that line. The spring S of the plug is of such strength that it will not yield to the ordinary pressure necessary to force the plug into the jack-seat, so that the contact-springs $s'$ $s^2$ of the plug P remain in the normal position—that shown—whereby the calling-subscriber's line is connected with conductors 5 5. The operator then manipulates the listening-key L in the usual manner and having ascertained the number wanted releases said key and inserts the calling-plug P′ in the jack J′, (or into the jack of a trunk-line leading to the section of the board upon which the jack of the wanted subscriber is located,) bringing sufficient additional pressure to bear upon the plug to overcome the resilience of spring S′ and move contact-spring $s'$ out of engagement with flange $p^3$ and spring $s^2$ into contact therewith, thereby breaking the electrical connection of conductor 5 with said flange and connecting conductor 7 therewith. Current from the generator G (said generator being operated by power or by the free hand of the operator) now flows out to the called station over the following circuit: from generator G by wire 7 to spring $s^2$ of plug P′, flange $p^3$ and sleeve $p^2$ to ring $j^2$ of jack J′, line-wire 3 to ringer $b'$ and lever H′ at station Y, wire 4, jack-spring $j'$, plug-tip $p'$, and return to generator by wire 6. Having thus given the call, the operator releases the plug-handle, when the parts immediately resume their normal position under action of spring S′, as shown in plug P and in Fig. 2. If the called subscriber fails to answer, the operator repeats the call. When the called subscriber answers, should the calling subscriber have left his phone all that is necessary to recall him is for the operator to press his plug to its extreme inward position to connect the generator, thereby "ringing back." It will thus be seen that by constructing both plugs of each pair similarly I am enabled to dispense with the two ringing-keys now usually employed, mounted upon the front of the switchboard, together with their attendant complications of circuit connections and contacts. When connection between the subscribers has been established and both plugs are in the position shown at P, the through talking-circuit is established over wires 5 6 in the usual manner.

These plugs, while they must necessarily be slightly larger than those of ordinary construction, are well suited for their purpose and when well made should seldom get out of order. When repairs are needed, however, all that is necessary is to remove the one which is out of order, replace it with another from a supply kept on hand for the purpose, and send it to the factory for repairs. The annoyance so well known to manufacturers of having to send an expert out to a switchboard which they have installed to overhaul the circuits is thus avoided in all cases where the trouble is in the ringing device.

Although I have described specifically one form of plug embodying my invention as having the contact-springs engage the sleeve-contact of the plug, this is by no means essential, as these springs may be arranged differently, and many other changes in details of construction and arrangement of parts may be made without departing from the spirit of the invention, and these I wish it to be unstood fall strictly within the scope and purview of the same.

Having described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. Connecting means for terminals of electrical signaling-lines comprising a pair of conductors and a third conductor, a source of signaling-current permanently connected to the third conductor and to one conductor of the pair, and switching mechanism at the ends of said conductors coöperating with terminal contacts carried by said switching mechanism, substantially as described.

2. In an electrical switchboard, line-terminals suitably placed thereon, connecting means comprising a pair of conductors and a third conductor, a source of signaling-current permanently connected to the third conductor and to one conductor of the pair, and switching mechanism at the ends of said conductors coöperating with terminal contacts for connection with said line-terminals, substantially as described.

3. In an electrical switchboard, line-terminals suitably placed thereon, connecting means comprising a pair of conductors and a third conductor, a source of signaling-current

connected to the third conductor and to one conductor of the pair, and switching mechanism at the ends of said conductors coöperating with terminal contacts carried by said switching mechanism for connection with said line-terminals, substantially as described.

4. In an electrical switchboard, line-terminals suitably placed thereon, means for connecting said line-terminals comprising a pair of conductors and a third conductor, a source of signaling-current permanently connected to the third conductor and to one conductor of the pair, terminal contacts for connection with said line-terminals, and switching mechanism at the ends of said conductors coöperating with said terminal contacts for connecting alternately (*a*) said pair of conductors, and (*b*) one conductor of the pair and said third conductor, to a line-terminal, substantially as described.

5. In a telephone-switchboard, spring-jacks forming line-terminals suitably mounted thereon, a connecting-circuit comprising a pair of conductors and a third conductor, a source of signaling-current connected to the third conductor and to one conductor of the pair, plugs carrying terminals for engagement with said spring-jacks, said plugs being provided with contacts movable relatively to said plug-terminals and so arranged as to be adapted to connect to line alternately (*a*) said pair of conductors, and (*b*) one of said pair and the third conductor, substantially as described.

6. A connecting-plug for telephone-switchboards comprising a tip and a sleeve contact, spring-contacts movably mounted upon the plug and adapted to engage alternately one of said contacts, and a suitable inclosing shell for the parts, substantially as described.

7. A connecting-plug for telephone-switchboards comprising a tip and a sleeve contact, movable springs slidingly mounted thereon and adapted to engage one of said contacts, means for making continuous electrical connection with the other of said contacts, and means for maintaining the parts normally in one position, substantially as described.

8. A connecting-plug for telephone-switchboards comprising a central rod forming the tip-contact, a sleeve-contact insulated therefrom, a conducting-sleeve slidingly mounted upon said rod and carrying a block of insulation, contact-springs secured to said block of insulation and extending into proximity to the sleeve-contact, a spring adapted to maintain normally the block of insulation in such a position that one of said contact-springs will be in engagement with the sleeve-contact, the parts being so arranged that when pressure is applied to the casing the last-named contact-spring will be moved out of engagement with the sleeve-contact and the remaining spring-contact will be moved into engagement therewith, substantially as described.

9. A connecting-plug for telephone-switchboards comprising a tip and a sleeve contact, springs slidingly mounted thereon and adapted to engage one of said contacts, one of said springs having a bend or shoulder to engage a portion of the plug structure and having a contact portion to engage one of said plug-contacts, means for maintaining the parts normally in one position, and suitable electrical connections, substantially as described.

10. A connecting-plug for telephone-switchboards comprising a tip and a sleeve contact, springs slidingly mounted thereon and adapted to engage one of said contacts, a sleeve or block adjacent said contact to be engaged and through which current cannot pass to said contact, a bend or shoulder upon one of said springs to engage said sleeve or block, means for making continuous electrical connection with one of said contacts, and means for maintaining the parts normally in one position, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

SPENCER B. PRENTISS.

Witnesses:
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