

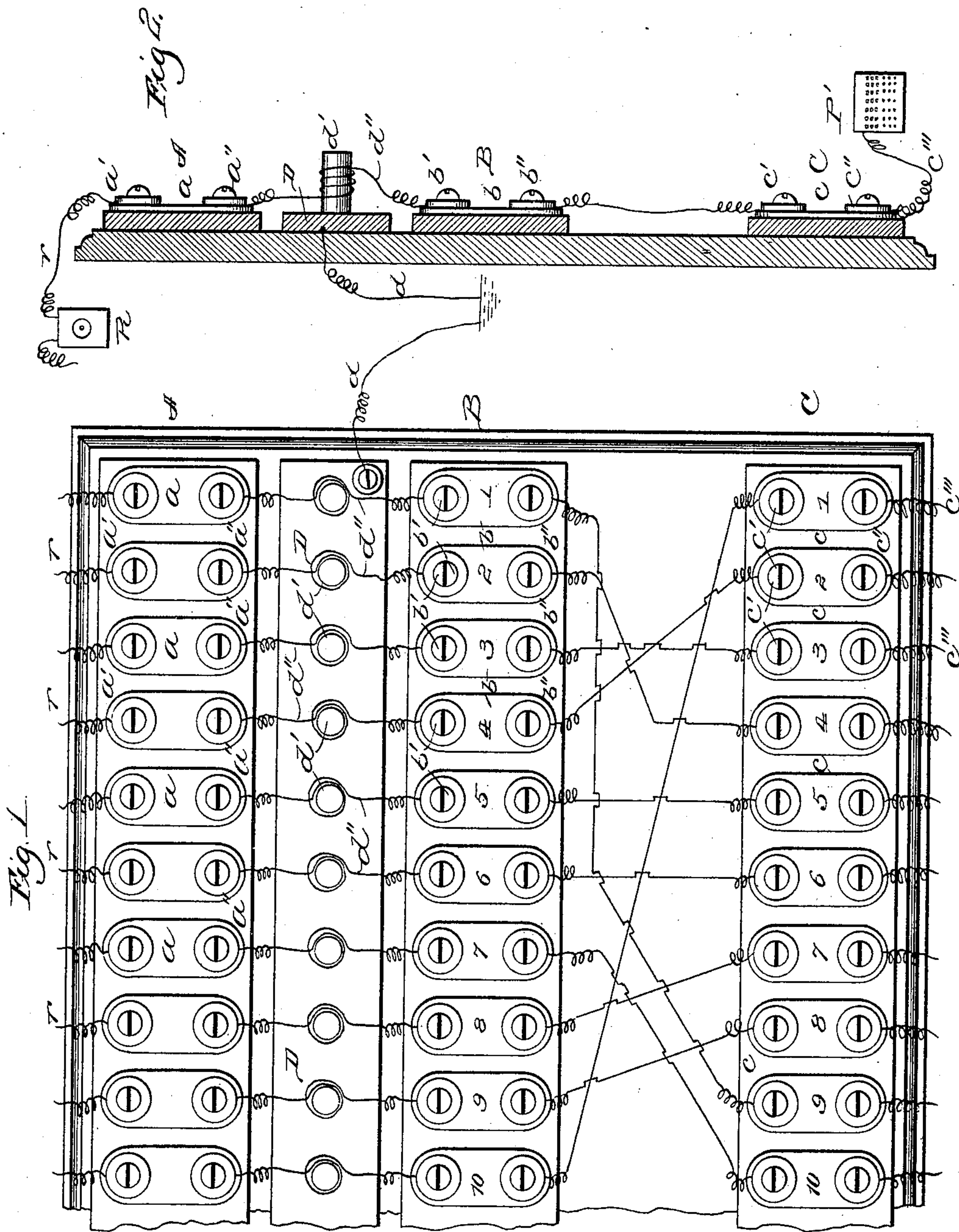
(No Model.)

2 Sheets—Sheet 1.

W. S. & E. M. HARRISON.
CENTRAL OFFICE SWITCHBOARD SYSTEM.

No. 587,502.

Patented Aug. 3, 1897.



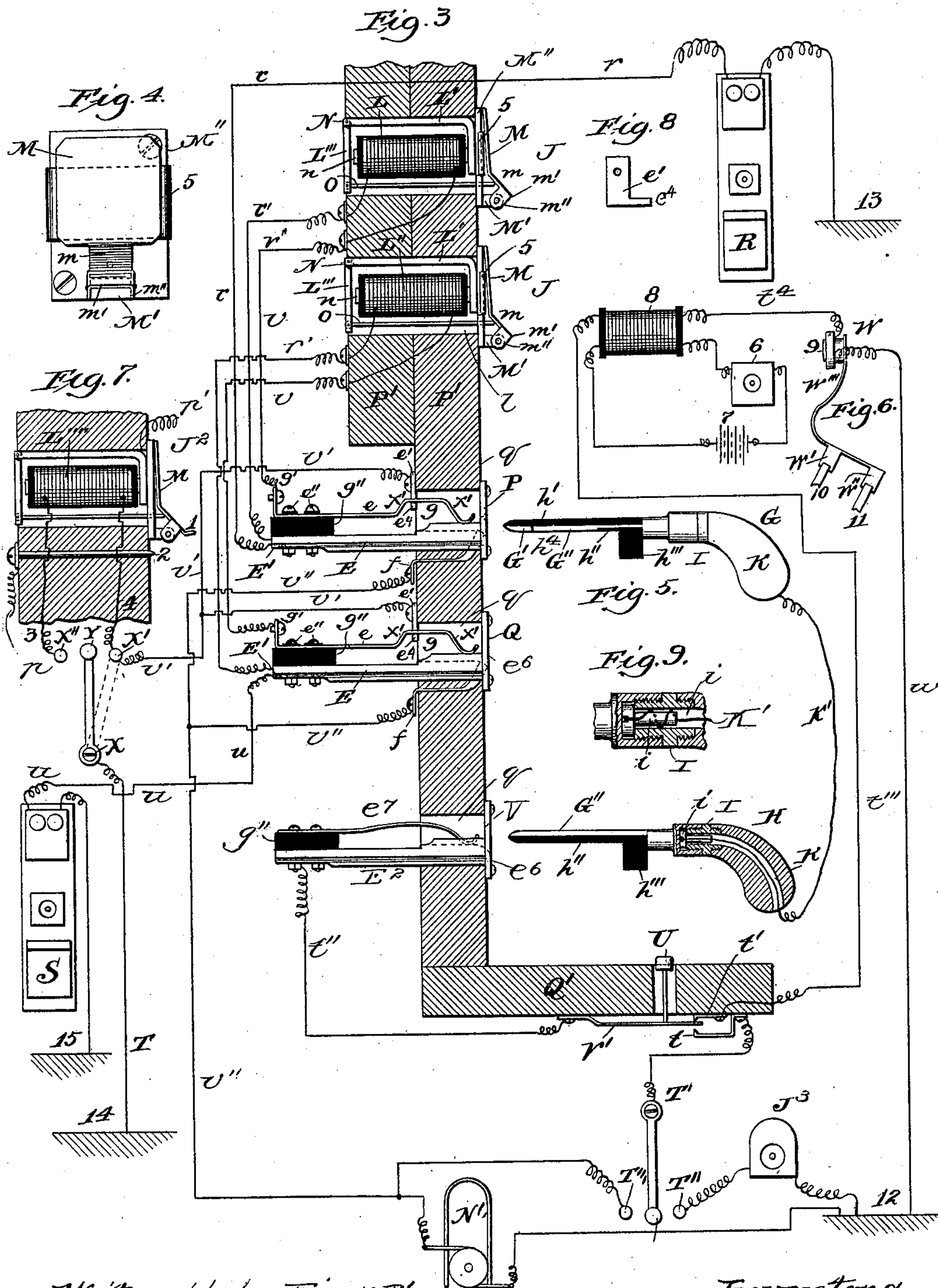
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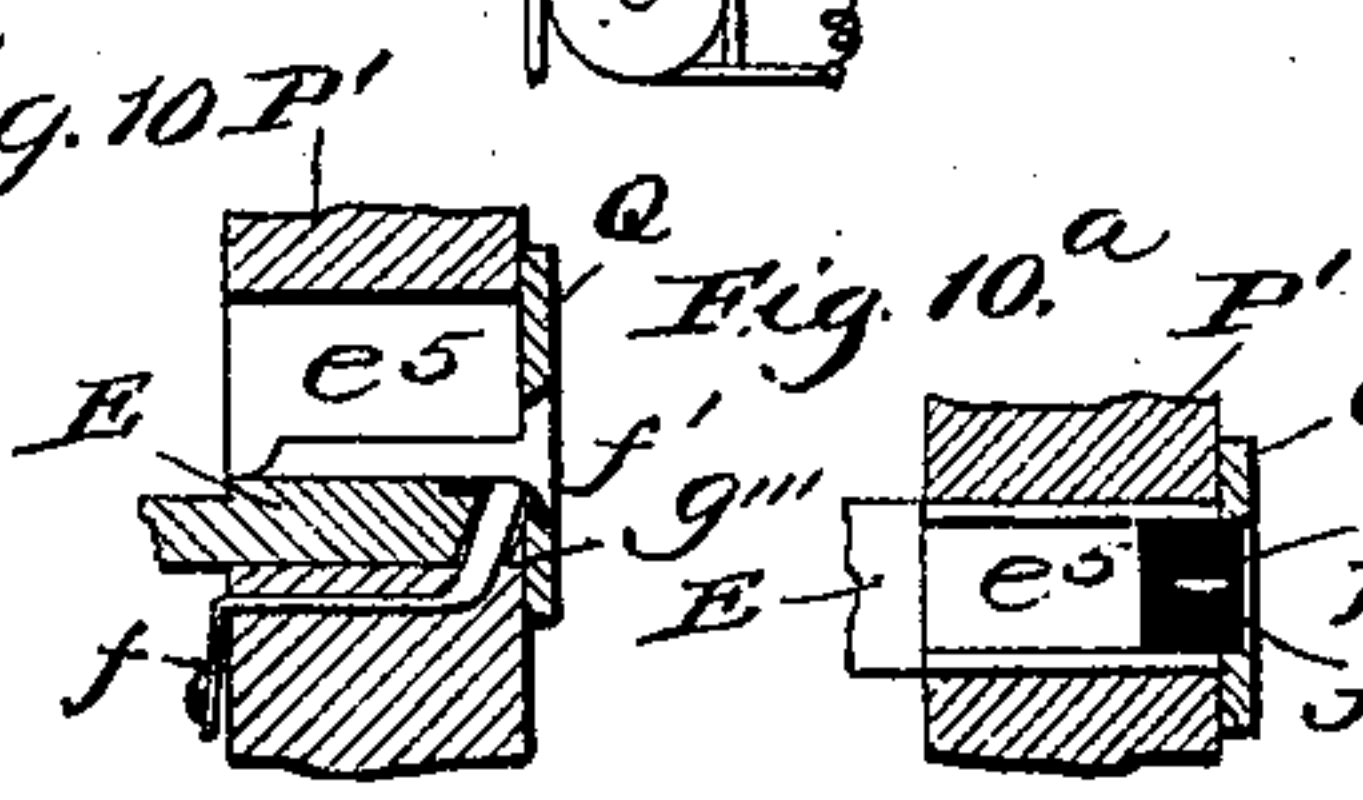
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UNITED STATES PATENT OFFICE.

WILLIAM S. HARRISON AND EDWARD M. HARRISON, OF CHICAGO, ILLINOIS.

CENTRAL-OFFICE SWITCHBOARD SYSTEM.

SPECIFICATION forming part of Letters Patent No. 587,502, dated August 3, 1897.

Application filed March 30, 1895. Serial No. 543,869. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM S. HARRISON and EDWARD M. HARRISON, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Central-Office Switchboard Systems; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a central-office telephone-exchange system embracing various connecting devices, such as a transfer-board, as a part of a switchboard and containing ground lightning-arrester posts, spring-jack switches, having suitable switch-plugs, polarized annunciators, switchboard-receivers, and suitable details and electrical connections for constituting a complete telephone central office, as will be hereinafter particularly pointed out in connection with the accompanying drawings.

The objects of our invention are, first, to provide for concentrating the live wires on a transfer-board and for quickly and conveniently making transfer connections from the binding-post in any one section of such transfer-board to any binding-post in an adjacent section thereof without disturbing the connections of the wires from the transfer-board to the switchboard; second, to provide in the transfer-board a ground lightning-arrester post for each line-wire, said post being permanently secured to a common ground-plate and insulated wires of slight resistance coiled around said lightning-arrester posts and thence connecting with the binding-posts in adjacent sections of the transfer-board, said ground-plate being connected by wire with the earth; third, to provide a combination spring-jack switch having suitable connections for the purpose of cutting the line-wire in and out of circuit with the annunciator and at the same time ringing a distant bell; third, to provide pairs or couples of switch-plugs having electrical connections and insulating material suitably arranged for use with the spring-jack switches for bringing one line into connection with another and at the same time cutting the

annunciator of one line out of circuit and bringing the annunciator of the other line into circuit with the opposite telephone-line; fifth, to provide a polarized annunciator having a swinging armature connecting with a sliding push needle or rod so arranged that when a current is passed through the coil the said armature will be drawn to the core, thereby actuating said needle and kicking or pushing over the annunciator-shutter, said armature being held to the core until the shutter has been returned by hand to its normal position; sixth, to provide a row of spring-jack switches on one common receiving wire or circuit, so that when any right-hand switch-plug is connected with any line spring-jack switch it will connect said line with the operator's receiving-telephone.

We will now particularly describe our central-office switchboard system and the method of operating it by reference to the accompanying drawings, in which—

Figure 1 represents a front diagrammatic view illustrating our transfer-board and showing a series of line-wires, double binding posts or washers arranged in three sections, the ground lightning-arrester post, having the insulated wires of slight resistance coiled around them, said posts being riveted to a ground-plate which is connected with the earth and the interchangeable transfer-wires of two adjacent sections. Fig. 2 represents a vertical section of transfer-board, showing the electrical circuits connecting it with the line and the switchboard. Fig. 3 represents a vertical section of the switchboard, showing our spring-jack switches and the polarized annunciators in side elevation. Fig. 4 represents a front view of one of the annunciators with the elbow-shutter closed. Fig. 5 represents a side elevation, with parts in section, of the right and left hand switch-plugs. Fig. 6 represents a side elevation of the shoulder-rest receiver in connection with the induction-coil, switchboard, transmitter, and battery. Fig. 7 represents a side elevation of the night-bell annunciator and the connections with the switchboard and ground. Fig. 8 represents a front view of the ground-lug. Fig. 9 represents an enlarged sectional view of a part of the switch-plug, showing our clinch or

coupling device. Fig. 10 represents an enlarged vertical sectional view of the front end of the spring-jack, showing the insulation and ringing-spring. Fig. 10^a represents a horizontal section of the view shown in Fig. 10.

Our transfer-board, as represented in Figs. 1 and 2, consists of a board or other insulating material about twelve inches wide by twenty inches long and provided with three sections, as A, B, and C, of double end binding-washers *a*, *b*, and *c*, placed vertically, as shown; also, a ground-plate D, secured to the board between the sections A and B and provided with lightning-arrester posts *d'*, having coiled upon them the insulated wires *d''* of slight resistance. The ground-plate D consists of copper or other good conducting material about one-quarter of an inch in thickness and one inch or more wide, according to the necessities of the case, and has riveted or otherwise secured to it the perpendicular ground lightning-arrester posts *d'*, about one-half an inch long. Plate D is connected with the ground by wire *d*. Binding-posts *a' a''* are applied at the opposite ends of the elongated washers *a*, and similar binding-posts *b' b''* and *c' c''* are applied, respectively, at the opposite ends of the elongated washers *b* and *c*.

By means of the elongated washers *a* and *b*, with their double rows of binding-posts in sections A and B, any of the insulated wires *d''* may be removed or adjusted without disturbing the trunk-line wires *r*. By means also of the elongated washers *b* and *c*, with their double rows of binding-posts in sections B and C, any of the transfer-wires connecting the binding-posts *b''* of section B with the binding-posts *c'* of section C can be removed or rearranged without disturbing the switch-board-wires *c'''* or any other parts of the transfer-board. This arrangement is quite advantageous in practice.

In Fig. 2 the line-wire *r* is shown connecting the binding-post *a'* with the distant telephone R and the switchboard-wire *c'''* connecting the binding-post *c'* with the switchboard P', which is shown on a greatly-reduced scale.

Our transfer-board possesses the advantage of being very compact in construction and arrangement and of being provided with ground lightning-arrester posts, each having coiled upon it an insulated wire connecting with the trunk-lines and the posts being normally connected with the earth, making it certain that if an extra heavy atmospheric or other high-tension current flows in over the trunk-line it will burn the insulation off from the resistance-wire, thereby conducting the current down through the post and thence to the earth instead of to the switchboard.

The annunciators J J' and the spring-jack switches P, Q, and V are mounted horizontally in the switchboard P', as shown in Fig. 3.

The spring-jack switches P and Q consist each of a frame or line-wire shoe E, having in its upper face at the front end a groove

e⁵, Fig. 10, end face-plate *e⁶*, and a downwardly-extending opening *g'''*, containing insulating material *f'*, having an opening for the upwardly-bent end of the ringing-spring *f*, as shown in Figs. 10 and 10^a. The shoe E is set into an opening *q* in the switchboard P' and is secured in place by screws passing through the front end plate *e⁶*. The ringing-spring *f* is placed in an opening in the switchboard and is secured by a screw at the back thereof, as shown in Figs. 3 and 10, and is connected by wire in a circuit to be hereinafter described. To the rear end E' of the shoe E is secured the flat annunciator-spring *e* through the medium of the plug *g''* of insulating material and by means of insulated binding-screws *e''*. The rear end of spring *e* is turned upward and provided with a binding-post *g'*, and the front end is bent at *x' x'* to form a bow *g* for the purpose of engaging with an arm *e⁴* of the ground-lug *e'*, and also for permitting the passage of switch-plugs below said ground-lug, as will be hereinafter described. The ground-lug *e'* is secured to the back of the switchboard P', and its arm *e⁴* passes transversely below the bow *g* of the annunciator-spring *e*. By arranging the arm *e⁴* of the ground-lug within the bow *g* the switch-plug may be passed into the switch-jack in contact with spring *e* without making connection with the said lug.

Right and left hand switch-plugs G and H are used for making electrical connection, and they are preferably provided with bent handles K, of insulating material, and are connected by the conductor K', covered with insulating material. The plug G is constructed with flat strips of metal G' and G'', secured to the under side of strip *h'* of insulating material. The metal strip G'' connects with the metallic part of the handle, which is in circuit with the conductor K'. Metallic strips G' G'' are separated at their adjacent ends by a narrow strip of insulating material *h⁴*. A downwardly-extending lug *h'''* is secured adjacent to the handle for indicating to the operator the lower side of the plug, so that he may never make the mistake of inserting it in the switch-jack upside down.

Each of the plugs is constructed with a detachable metallic section I, having screw-threaded ends, and a longitudinal passage *i*, as shown in Fig. 9, and the adjacent portions of the handle are formed with screw-threaded sockets for receiving said section I. Into the inner end of the longitudinal passage *i* is inserted the headed binding-pin *i'*, the head of which is provided with a transverse slot for receiving the conducting-wire K', which is coiled around the stem of the plug, as shown. This metallic section I and detachable pin *i'* form a convenient and reliable electrical connection or coupling.

The right-hand switch-plug H is similar in appearance to the left-hand plug G, but has a continuous metal strip G'' at the upper side and a strip of insulating material *h''* at the

under side. It also has the downwardly-extending lug h''' , of insulating material, as above described.

In the receiving spring-jack V no ground-lug e' is used, and the electrical connections are different from those in the spring-jacks P and Q, as will be hereinafter set forth in the description of the operation.

The annunciators J J' are set horizontally in openings l in the switchboard P' and consist of the electromagnetic coils L and L', the polarized field-magnets L', the swinging armature L'', the latter being pivoted at N to the magnet L' and having pivotally connected to its lower end the push-needle o , which extends forward through the front plate M'', so as to bear at its front end upon the shutter M. The pivotal pin N is of some diamagnetic material, and thin washers of diamagnetic material should be placed between the joints to prevent any sticking or retardation of the action of the swinging armature. Instead of using washers the end of the field-magnet L may be copper-plated. The electromagnetic core n of the magnet is secured at its front end to the front plate M'', which is screwed or otherwise secured to the switchboard P'. Plate M'' is provided at its lower end with an outwardly-projecting hinge-post M' and is beveled at its lateral inner edges, so as to receive the number-plate 5. The shutter M is provided with an elbow m , having downwardly-turned ears m' , which are pivotally connected by a pin m'' to the post M'.

When the current is sufficiently strong to reinforce the magnetic attraction of the polarized electromagnet L or L', the swinging armature L'' will be drawn up against the core n , thereby driving the push-needle o forward against the elbow m of shutter M and pushing the latter out past its center of gravity, causing it to fall down against the projecting hinge-post M', which acts as a stop. There is no chance for shutter M to stick or fail to fall, because when push-needle o has been forced forward by armature L'' the shutter has been so moved out of place that it must drop and the armature L'' will stick to the core n and remain in this position until some force is used to lift the shutter and force the push-needle o backward, thereby forcing the armature L'' out of contact with core n .

In the night-bell annunciator, Fig. 7, the shutter M is provided at its lower end with a projecting spring 1, which when the shutter falls makes contact with the pin 2. To the front plate M'' and the pin 2 are connected the wires p' and p , which connect, respectively, to a battery and bell. (Not here shown.) The annunciator-coil L''' connects by wires 3 and 4 with the conductors x' and x'' , and a switch Y, pivoted at x , may be shifted to either of the contacts x' and x'' . The electrical circuit connecting with the switch will be hereinafter described.

The receiving spring-jack V connects by wire t'' to the spring V', secured to the under

side of the board Q', which spring is normally in contact with the contact-piece t' , which connects by wire t''' with the induction-coil 8, which in turn connects by wire t^4 with the receiver 9, which connects by wire w with the earth 12. The operator's transmitter 6 connects by wire through battery 7 with the induction-coil 8 and also directly with said coil. The receiver 9 is constructed with a compound curved magnet w''' and with shoulder-braces w' and w'' , having strips 10 and 11 to hold it firmly on the shoulder, so that when the operator pushes the receiver with its earpiece against his ear the said receiver will be securely held. By pushing the plug G a short distance into the spring-jack P below the annunciator-spring the metallic end strip G' makes connection between the insulated ringing-spring f and the shoe E, causing the current to pass from the alternating magneto-generator to the ringing-spring f through the medium of said strip G' to the line-wire shoe E, thence out on the line r to a distant signal-bell, thereby avoiding the use of separate push-buttons or other devices for signaling distant instruments. The switch-plug H since it has an insulating-strip h'' at its under side will not make electrical connection with ringing-spring f unless it should be inserted upside down. The switch-plug G when forced into the spring-jack switch cuts out the annunciator by lifting the annunciator-spring e off from the arm e^4 of the ground-lug e' .

The switch-plug H is the annunciator cut-in plug. When it is forced between the annunciator-spring e and the shoe E, it leaves the metal strip G'' at the upper side of the plug in contact with the spring e and forces the current from the outer end E' of the shoe, where the line-wire is attached, up through wire r' to the annunciator L and back through wire r'' to the annunciator-spring e at binding-post g' , and thence out to the metallic contact-strip G'' of switch-plug H, thence through the insulating conducting-wire K' to the plug G, through its metallic strip G''.

Supposing that a message or signal is sent from a distant telephone R to the central office, the current may be traced as follows: It will flow over line-wire r to the end E' of line-shoe E of spring-jack P, thence over wire r' to annunciator-coil L, where it will reinforce the electromagnet L' and cause its swinging armature L'', carrying the push-needle o , to kick or push over the shutter M, and the current then flows from the coil, through wire r'' , to the annunciator-spring e at binding-post g' , thence to the ground-lug e' and by wire v' and wire T to the ground 14. The current may pass either directly by the switch-contacts Y and x' or through the electromagnet L''' of the night-bell annunciator J² and thence through the switch-contacts x'' and y , depending upon whether switch Y is upon the contact x' or x'' . If the current passes through the night-bell annunciator J², the operator is notified that the telephone R

desires a communication. The operator then inserts plug G into spring-jack P, thereby cutting out the annunciator-coil L.

The operator ascertains that telephone R wishes to communicate with telephone S. He then removes plug G from spring-jack P and inserts it into spring-jack Q, and in doing so first holds the metallic ringing-tip G' for a moment between the annunciator-spring *e* and the ringing-spring *f*, and making electrical connection between said ringing-spring and shoe E, thereby signaling telephone S. The operator then forces plug G clear into the spring-jack Q, causing spring *e* to rest in contact with the insulating material *h'* of the plug and raising said spring up from contact with the arm *e'* of the ground-lug *e'*, thus breaking connection with the ground and cutting the annunciator L' out of circuit. He now removes the plug H from receiving spring-jack V and inserts it into the calling spring-jack P, thereby cutting the annunciator-call L into circuit between the telephone-stations R and S. The complete circuit between telephones R and S may now be traced by commencing at station R as follows: The current passes by line-wire *r* to the heel E' of shoe E of spring-jack P, thence over wire *r'* to annunciator-coil L, thence through said coil back over wire *r''* to annunciator cut-out spring *e*, connecting with the metal strip G'' of switch-plug H, and the current thence flows out through plug H and the conductor K' to the metal strip G'' of switch-plug G, which is now in contact with shoe E of spring-jack Q, so that the current flows out on line-wire *u* to the telephone-station S. The plug H made no electrical connection with the shoe E, since the insulating material *h''* on the under side of said plug was in contact with said shoe.

The flexible insulated wire K' between the two plugs is held in position by a weight. The ringing-spring *f* is connected by wire *v''* to the power magneto-generator N'. By means of the switch T', contacts T'' and T''', and the push-button *u* connection may be made from the spring-jack V to the power-generator N', and calling-signals can then be sent through the receiving spring-jack V and the switch-plugs to the line. This means and method of signaling are preferable to the use of a hand magneto-generator. In case the power magneto-generator N' breaks down the switch T' may be moved to contact T'', and signals may then be sent to the line by means of the hand-generator J³.

Having described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination with the switchboard, of a spring-jack switch, constructed with an elongated frame composed of a line-wire shoe having a front socket face-plate and of an annunciator-spring bowed upward or outward near its front end, and secured at its rear end

to the rear end of said shoe, the parts being separated by insulating material, a ground lug, as *e'*, secured to the switchboard above said shoe and having an arm *e'*, passing under the bowed portion of said spring and serving to support it, and a switch-plug, whereby the plug may be inserted in the switch-jack in contact with the spring without making contact with said ground-lug.

2. In the switchboard a spring-jack switch consisting of a line-wire shoe, having an insulated opening and a front socket-plate, and of an annunciator-spring secured at its rear end to the rear end of said shoe, the parts being separated by insulating material, in combination with a ground-lug, supporting said spring near its front end, a ringing-spring projecting up through said insulated opening in the shoe, and a switch-plug having a metallic tip for making contact with said spring, substantially as described.

3. In a switchboard, a spring-jack switch, constructed of an elongated frame or shoe, having an insulated opening, and of an insulated annunciator-spring, in combination with a ringing-spring projecting through said insulated opening in the shoe, and a switch-plug having insulating material on one side and a metallic contact-tip at its other side for making contact with said ringing-spring, substantially as described.

4. The combination with the switchboard, of an annunciator having a front plate, provided at its lower end with a projecting horizontal hinge-post as M', a drop-shutter, having an outwardly-inclined knee projection *m*, at its lower edge and provided with inwardly-projecting ears *m''*, pivotally connected to said post M'; also having a field-magnet, a polarized pendulous armature pivoted thereto, a push-needle pivotally connected to and operated by said armature and bearing at its opposite end against said drop-shutter for pushing it over, substantially as described.

5. The combination with the switchboard of the spring-jack switches, a polarized annunciator, companion switch-plugs, one plug being insulated on the upper surface and the other on the under surface and applied, one for the purpose of cutting out the annunciator and the other for the purpose of bringing the annunciator into circuit, substantially as described.

6. In a switchboard, the combination with a spring-jack switch having an annunciator in circuit of a pair of switch-plugs, one plug insulated on the under surface and the other plug insulated on its upper surface and having at the outer end a ringing-tip, insulated from the plug proper, substantially as shown and described.

7. In combination with a switchboard, polarized annunciators, spring-jack switches, and companion switch-plugs, one plug being insulated on the upper surface and the other on the under surface for cutting one annun-

ciator into circuit and the other annunciator out of circuit, substantially as described.

8. In combination with a switchboard a polarized needle-push annunciator, a spring-jack switch, having an insulated ringing spring or contact and a switch-plug having insulating material on one side and a metallic contact tip or lug at its other side and outer end for the purpose of bringing the ringing-spring into circuit with a distant bell, substantially as described.

9. A spring-jack switch having a line-shoe and an annunciator-spring secured to said shoe, in combination with a ground-lug secured to said switchboard, said spring resting at one end on said lug, a needle-push annunciator wires connecting said shoe with the annunciator, and switch-plugs connected by a conductor, one of which, when inserted into the spring-jack lifts the annunciator-spring from contact with said ground-lug, cutting off all connection with the ground-wires except through said plugs, substantially as described.

10. In a switchboard, the combination with the spring-jack switches having line-shoes, of the switch-plugs in pairs, having one side of metal and the other of insulating material, the metal part of one being on the top and the metal part of the other being on the bottom, and also having downwardly-projecting lugs of insulating material and said pairs of plugs

being connected by a flexible conductor, substantially as described.

11. The combination with spring-jack switches, of switch-plugs, connected in pairs by a flexible wire conductor, each of said plugs having a detachable hollow section containing a slotted binding-pin for attaching said conductor, substantially as described.

12. A switch-plug having in its handle a detachable section, I, having a longitudinal passage, *i*, in combination with a binding-pin, *i'*, having a slotted head and a stem inserted in said passage *i*, for connecting a conducting-wire, substantially as described.

13. In a switchboard a spring-jack switch, having an elongated frame or shoe, provided near its front end with an insulated opening, in combination with a ringing-spring, projecting through said opening, and a switch-plug having a metallic tip at its front end for making contact with said spring for sending signals over the line-wire, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

WILLIAM S. HARRISON.
E. M. HARRISON.

Witnesses:

ELIZABETH ENGSTROM,
J. E. HOLYOKE.