

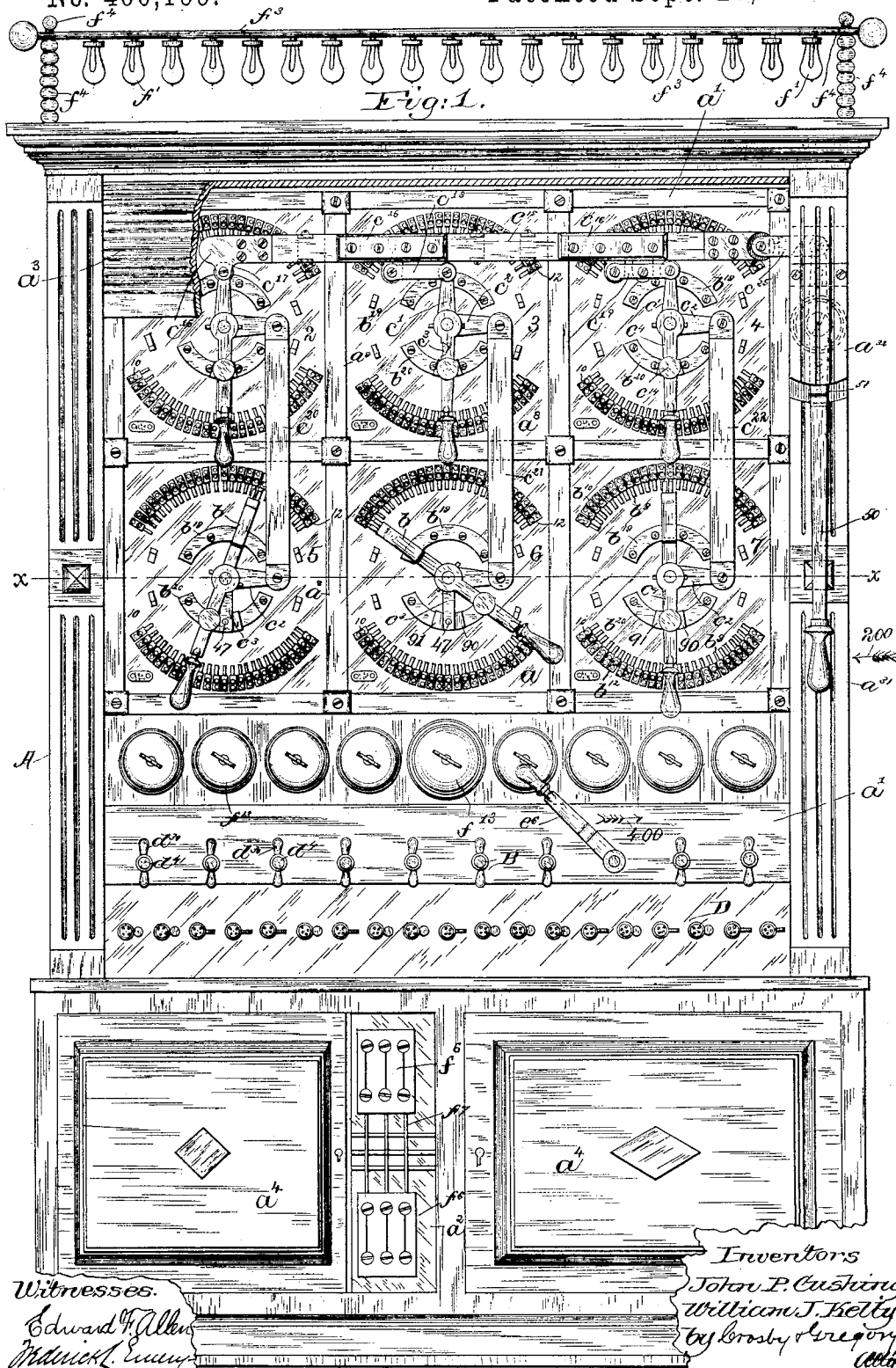
(No Model.)

4 Sheets—Sheet 1.

J. P. CUSHING & W. J. KELLY.
CIRCUIT CONTROLLING APPARATUS.

No. 460,199.

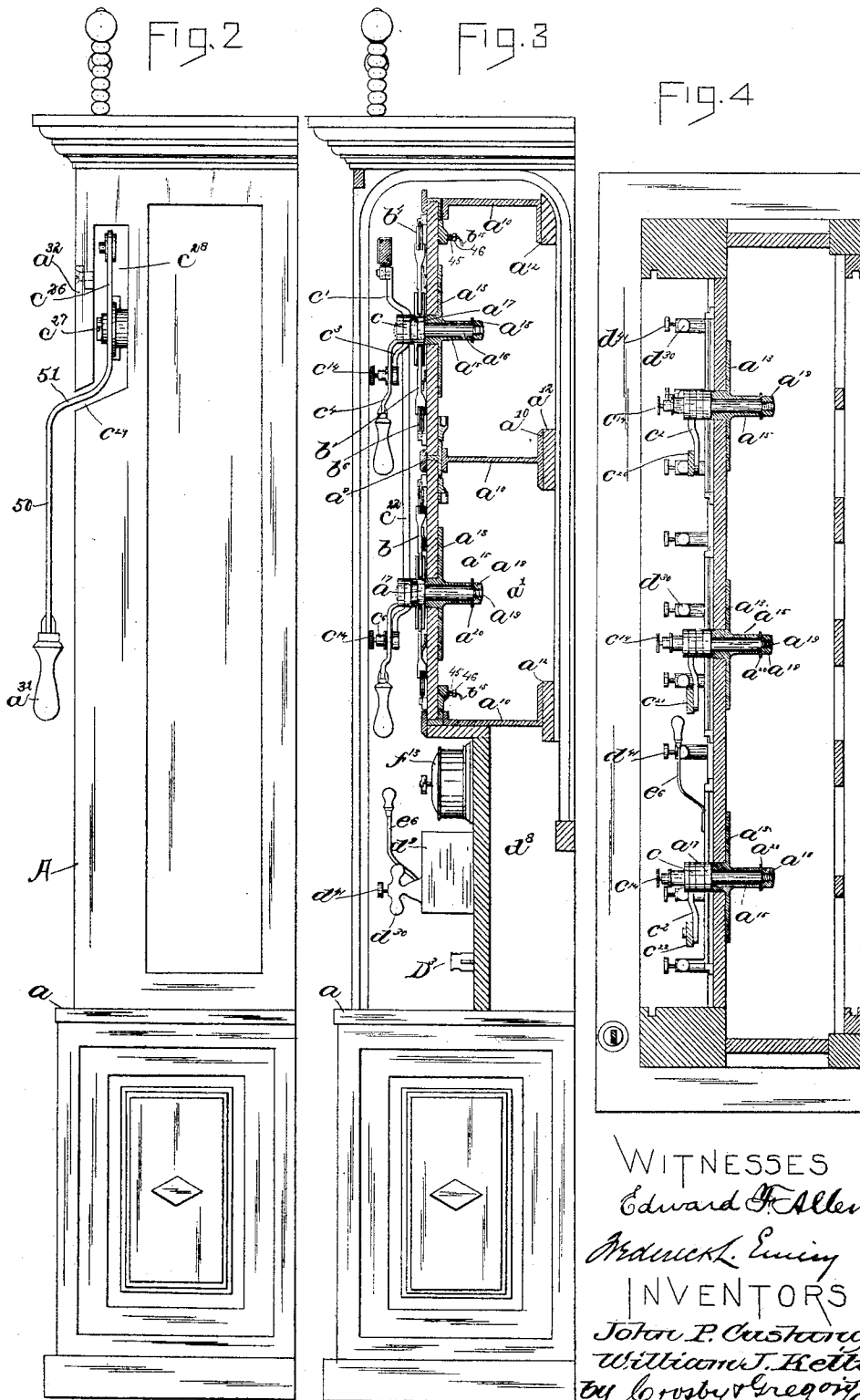
Patented Sept. 29, 1891.



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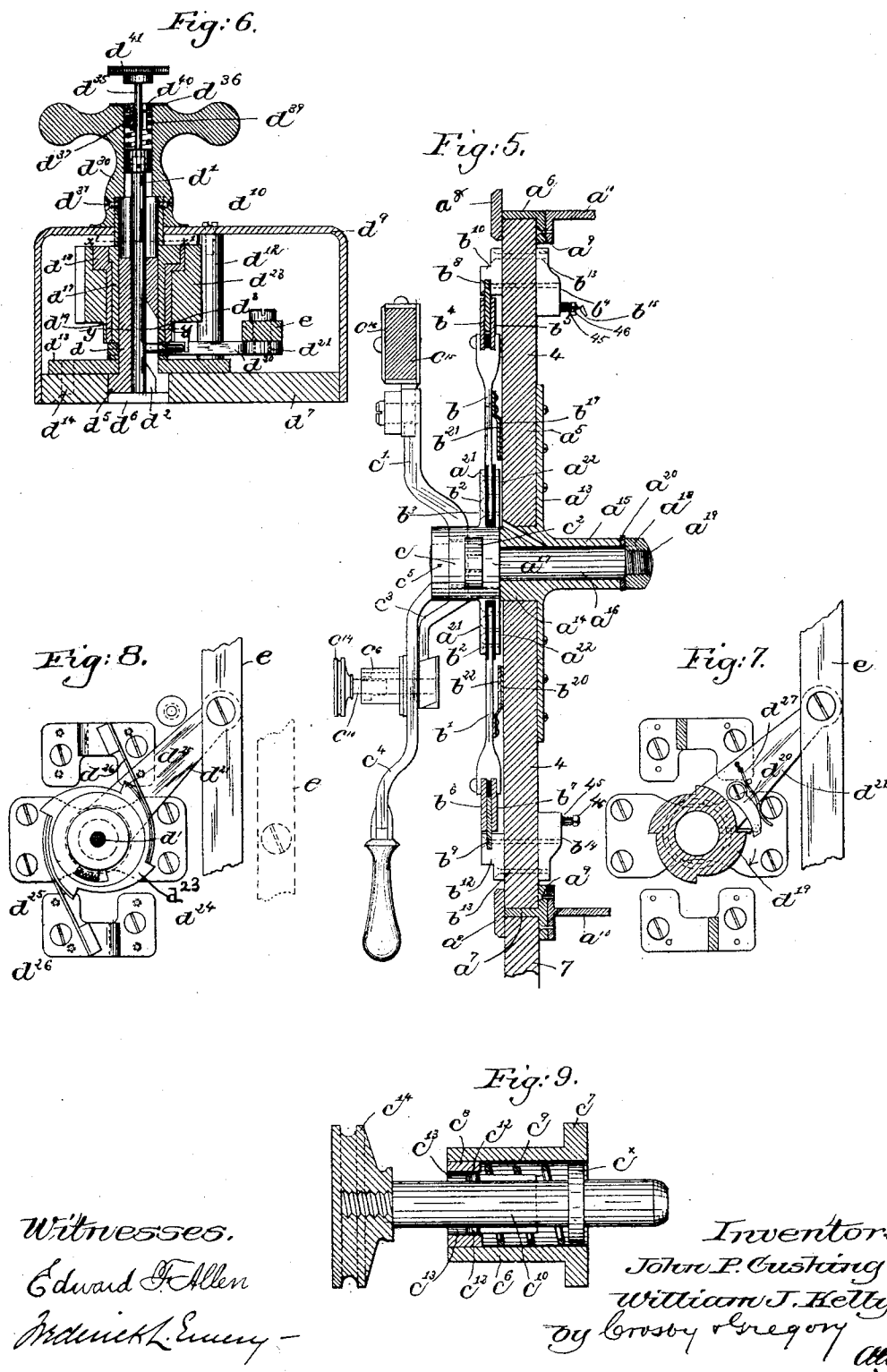
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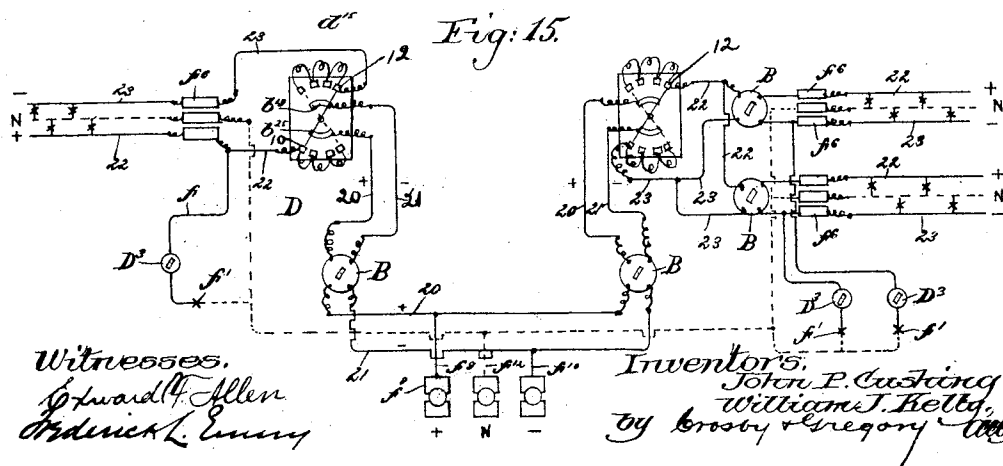
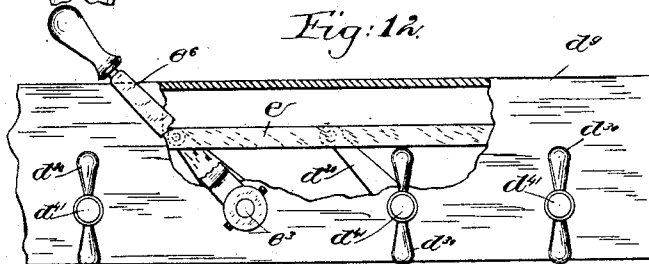
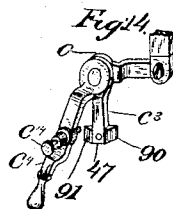
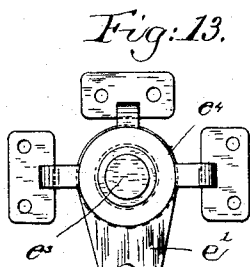
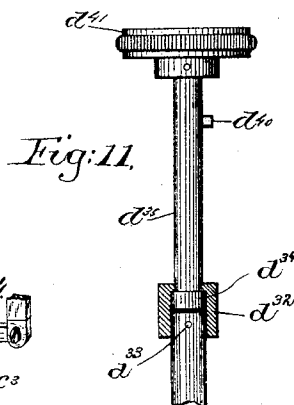
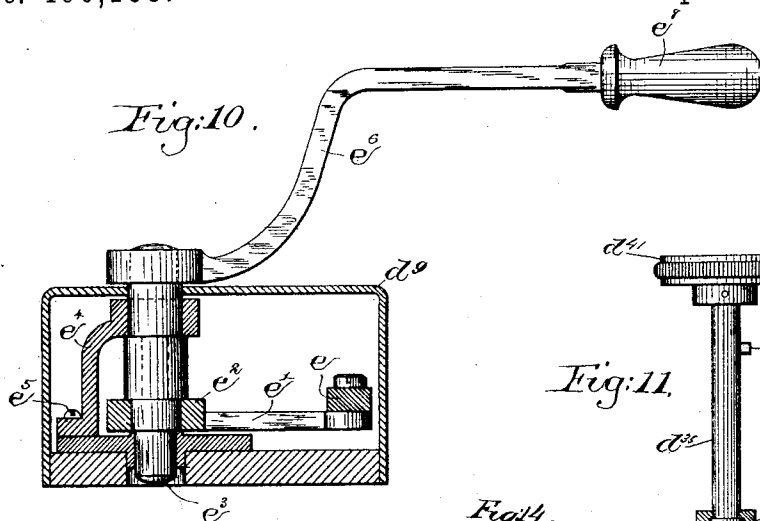


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Witnesses.
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UNITED STATES PATENT OFFICE.

JOHN P. CUSHING AND WILLIAM J. KELLY, OF BOSTON, MASSACHUSETTS.

CIRCUIT-CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 460,199, dated September 29, 1891.

Application filed November 6, 1890. Serial No. 370,437. (No model.)

To all whom it may concern:

Be it known that we, JOHN P. CUSHING and WILLIAM J. KELLY, of Boston, Massachusetts, have invented an Improvement in Circuit-Controlling Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to a novel circuit-controlling apparatus or switch-board especially designed and adapted to be used in theaters, halls, and like places lighted by electricity. Theaters employing incandescent electric lamps as a source of light are wired in sections—that is, a number of independent branch circuits are arranged about the theater, the said independent circuits being connected to a main or common supply circuit.

It is the object of this invention to provide a simple and efficient apparatus to which the independent circuits referred to may be connected, whereby suitable resistances may be interposed in the independent branch circuits simultaneously or individually to obtain the desired light effect in the said circuits, and thereby in the particular portion of the theater or hall in which the lamps in the branch circuit are located. The switch board or apparatus is also provided with switches, one for each independent branch circuit, which switches are constructed, as will be described, so as to be operated simultaneously or individually, whereby all of the independent branch circuits may be opened and closed simultaneously, or any one of the said circuits may be opened and closed independent of the others. The switch-board is also provided with an independent switch for each branch circuit and with fuse-blocks, which are connected in circuit with both sides of the branch circuit. The switch-board is further provided with pilot-switches controlling shunt-circuits for the branch circuits, in each of which shunt-circuits is located a pilot-lamp supported by the apparatus, and by means of which the condition of any branch circuit may be readily seen at the switch-board or circuit-controlling apparatus. The mechanisms referred to are inclosed in a preferably portable cabinet, which is pro-

vided with a suitable door or doors, by which the operating parts may be securely locked up when not in use, thereby providing against injury from handling by careless or incompetent persons, and also protecting the various contacts from dust, thus keeping the apparatus in the best condition possible. The cabinet is preferably made portable, so that the operating parts may be secured in position before the apparatus is placed in the theater or hall.

The particular features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 is a front elevation, partially broken out, of a circuit-controlling apparatus or switch-board embodying this invention; Fig. 2, a side elevation of the apparatus shown in Fig. 1; Fig. 3, a side elevation of the apparatus shown in Fig. 1, partially broken out to show the interior construction of the apparatus; Fig. 4, a transverse section on the line *x x* of the apparatus shown in Fig. 1; Fig. 5, a sectional detail on an enlarged scale to more clearly show the construction of the resistance-heads; Fig. 6, a vertical sectional detail of the form of snap-switch preferred by me for controlling the branch circuits; Fig. 7, a transverse section, looking down, of the switch shown in Fig. 6 on the line *y y*; Fig. 8, a top or plan view of the switch shown in Fig. 6, the inclosing case or hood being omitted; Fig. 9, a longitudinal sectional detail of a locking device to be referred to; Fig. 10, a sectional detail on an enlarged scale to more clearly show the mechanism for operating the snap-switches simultaneously; Fig. 11, a detail on an enlarged scale to more clearly show the construction of the snap-switch; Fig. 12, a detail partially broken out of the box or case containing a number of the snap-switches; Figs. 13 and 14, details to be referred to, and Fig. 15 a diagram of circuits to illustrate the invention.

Referring to Figs. 1 to 4, inclusive, A represents a cabinet or inclosing case constituting the supporting-frame for the circuit-controllers, as will be described. The cabinet A is preferably divided by a horizontal partition *a* into an upper compartment *a'* and lower compartment *a''*, the upper compartment being provided, as herein shown, with a rolling

front a^3 , constituting the door for the said compartment, and adapted to be slid back within the said compartment when the latter is opened, the compartment a^2 being provided, as herein shown, with hinged doors a^4 , one of which is shown partially open in Fig. 1. The upper compartment a' of the cabinet is provided with a plurality of preferably independent resistance-heads a^5 , of insulating material, there being six such heads herein shown, (see Fig. 1,) marked 2 3 4 5 6 7, arranged in two rows of three each. The resistance-heads a^5 are secured within the compartment a' , preferably, by means of angle irons or bars a^6 a^7 (see Fig. 5) and cross bars or strips a^8 , located on the front side of the resistance-heads and secured to the angle-irons by screws or in other suitable manner, the said bars or strips being extended horizontally and vertically, as herein shown, to practically form substantially square pockets, in which the said resistance-heads are located. The angle-irons a^6 a^7 are secured, as by countersunk screws a^9 , (see Fig. 5,) to preferably iron girders a^{10} , extended across the compartment a' and secured to cross bars or braces a^{12} , (see Fig. 3,) fastened to or forming part of the back of the cabinet. Each resistance-head a^5 has secured to it on its rear side a casting or spider a^{13} , (see Fig. 5,) provided with tubular bosses a^{14} a^{15} on its opposite sides, through which is extended a shaft or arbor a^{16} , having its rear end, as herein shown, screw-threaded, as at a^{19} , to receive a nut a^{18} , a washer a^{20} being interposed between the said nut and the end of the boss a^{15} . The arbor a^{16} on the front side of the resistance-head has mounted on it a collar or hub a^{17} , which is made fast on the said arbor, as by a set-screw (not shown) or in any other usual or well-known manner. The collar or hub a^{17} is provided on substantially diametrically-opposite sides, as herein shown, with two sets of ears a^{21} a^{22} , between which are secured contact-arms b b' , the said contact-arms being insulated from the ears a^{21} a^{22} by suitable strips b^2 of insulation interposed between the said contact-arms and ears, the said arms being fastened to the ears, as herein shown, by screws b^3 . The contact-arms b b' are preferably provided at their outer ends with two sets of contact-brushes b^4 b^5 b^6 b^7 , which engage and make contact with the opposite sides of contact-segments b^8 b^9 , secured to or forming part of supporting-terminals b^{10} b^{12} , respectively. The terminals b^{10} b^{12} on the front side of the resistance-heads are secured in suitable manner, as by screws or bolts b^{13} , (see dotted lines, Fig. 5,) to metal castings, blocks, or plates b^{14} on the rear side of the said resistance-head, to which castings resistance-coils b^{15} (shown in Fig. 15) are connected by a clamping device (shown as a threaded conical or tapering nipple 45) split longitudinally and screw-threaded to be engaged by a threaded nut 46, (see Fig. 5,) the resistance-coil b^{15} being firmly clamped in the nipple 45 by screwing the nut 46 upon the same. The

resistance-heads may have secured to them any number of terminals b^{10} b^{12} desired or required to correspond to the desired or required number of resistance-coils, whereby the desired or required effect with the lamps b^{15} interposed in the circuits connected to the said resistance-heads may be obtained.

Each resistance-head a^5 has secured to its front face, on opposite sides of the pivot or arbor a^{16} , terminal plates or surfaces b^{19} b^{20} , preferably arc-shaped, as herein shown, to which the line-wires 20 21 are connected, and with which co-operate spring contact brushes or strips b^{21} b^{22} , fastened to or forming part of the contact-arms b b' , respectively. The supporting-terminals b^{10} b^{12} are preferably arranged concentrically on the resistance-heads, as shown in Fig. 1, and the positive wire 22 of a branch circuit is connected to the endmost terminal b^{12} , (herein shown in Fig. 15 as the terminal marked 10 on the extreme left,) while the negative branch wire 23 is connected to the diametrically-opposite terminal b^{10} , (marked 12 on the extreme right in Figs. 1 and 15.) The contact-arms b b' , co-operating with the terminals on preferably all of the resistance-heads, are detachably connected together, as will be described, so that all the contact-arms may be moved simultaneously or individually. The pivot or arbor a^{16} of each resistance-head, as herein shown, has loosely mounted on it a collar or hub c , provided with a plurality of arms, the hubs or collar c of the uppermost row of resistance-heads being provided, as shown, with three arms c^1 c^2 c^3 , preferably substantially at right angles to each other, and the hubs or collars of the lower row of resistance-heads being provided with but two arms c^2 c^3 . The collar or hub c and its attached arms loose on its arbor a^{16} are made fast thereon, so as to be moved when the said arbor is rotated, by means of a locking device, as will be described, which engages and locks one of the arms of the hub or collar to a handle c^4 , fast on the arbor a^{16} , the said handle being made fast on the said arbor by a pin, or it may be a set-screw c^5 , (see Fig. 5,) or in other usual manner. The locking device referred to is preferably made as shown in Fig. 9, it consisting of a shell c^6 , provided at its bottom with a flange c^7 , by which the shell may be screwed or otherwise secured to the handle c^4 . The shell c^6 has secured within it a sleeve c^8 , having its lower end of less diameter than the shell to leave a cylindrical space, in which is located a spiral spring c^9 , the lower end of which bears against a collar or flange c^x on a rod or stem c^{10} , extended through the sleeve c^8 and shell c^6 , the upper end of the spring abutting against the said sleeve, as clearly shown in Fig. 9. The stem c^{10} is provided with projections c^{12} on substantially diametrically-opposite sides, preferably formed by inserting a pin through a hole in the said stem, the said projections being adapted to enter channels or grooves c^{13} in the sleeve c^8 . The stem c^{10}

is provided, as herein shown, with a knob or handle c^{14} , preferably of insulating material, and the stem beyond the collar c^x is made of sufficient length to extend through a hole in the handle c^4 and into and preferably through a hole 47 in the arm c^3 of the loose collar or hub c . The spring c^9 acts to force the stem c^{10} through the sleeve c^8 and shell c^6 , and the said stem may be withdrawn from the said sleeve and shell sufficient to remove the projection c^{12} from the groove c^{13} and withdraw the lower or inner end of the stem from the hole in the arm c^3 , and thereby disconnect the handle c^4 from the arm c^3 , permitting the handle c^4 , the spindle a^{16} , and the contact-arms $b\ b'$ to be moved without moving the hub c , and the stem c^{10} may be held in its inoperative position by rotating the said stem to bring the projections c^{12} out of line with the channels or grooves c^{13} , they at such time resting against the outer end of the sleeve c^8 .

In order that the contact-arms $b\ b'$ of two or more and preferably of all the resistance-heads may be operated simultaneously, I have connected the loose hubs c of the said resistance-heads with a main actuating device, shown as a bar or rod c^{15} , (see Fig. 1,) preferably made of wood or other insulating material re-enforced or strengthened by suitable metal plates or band c^{16} , having lugs or ears c^{17} , to which, as herein shown, the arms c' of the loose hubs or collars c are connected, the arms c' of the hub c of the resistance-head marked 2 being directly connected to the lug or ear c^{17} , and the arms c' of the hubs c of the resistance-heads marked 3 4 being respectively joined by links or rods $c^{18}\ c^{19}$ to the said lugs or ears, the connecting-rod c^{19} being also firmly secured substantially near its longitudinal center to a second lug c^{17} . The arms c^2 on the hubs c of the resistance-heads marked 2 3 4 are respectively joined by connecting-rods $c^{20}\ c^{21}\ c^{22}$ to the arms c^2 on the hubs c of the resistance-heads marked 5 6 7.

The main actuating bar or rod c^{15} is herein shown as located at the top of the apparatus, and is connected, preferably, by a link c^{25} to one end of a lever c^{26} , pivoted, as at c^{27} , to the side of the frame or cabinet, the latter being cut out, as at c^{28} , to form a pocket in which the upper end of the lever c^{26} is located, the said frame on its front side being provided with a slot c^{29} , communicating with the pocket c^{28} , and through which the long arm 50 of the lever is extended to project in front of the cabinet, so that the resistances may be operated from the front of the cabinet, the long arm 50 of the lever being bent, as at 51, (see Fig. 2,) to project through the slot c^{29} , and the said arm is preferably provided with a handle c^{31} , of insulating material.

Instead of locating the actuating device or bar at the top of the cabinet, it may be placed at the bottom or side, if desired, and the required connections readily made.

The side of the cabinet is provided with a removable piece a^{32} , normally closing the

pocket c^{28} , but which may be readily removed to permit of access to the lever c^{26} within the said pocket.

When the handle c^4 of each resistance-head is fastened to the arm c^3 of the hub c , the contact-arms $b\ b'$ and their attached brushes may be moved simultaneously to throw into or remove from their individual branch circuits any desired or required amount of resistance to thus produce the desired or required light effect in the various branch circuits—that is, in the various parts of the theater, hall, or like place.

As represented in the circuit marked D at the left in Fig. 15, the lamps or lights in the branch circuit shown are burning with their full or normal brilliancy when all the resistance-coils b^{15} are cut out of the circuit—that is, when the contact-arms are moved so as to bring their brushes in engagement with the terminal on the extreme right of the upper row of terminals b^{10} and the extreme left of the lower terminals b^{12} , which may be accomplished by moving the lever c^{26} in the direction of arrow 200, Fig. 1; and if it is desired to dim the lights or lamps in the branch circuits the lever c^{26} will be moved in the direction opposite to that indicated by arrow 200 to bring the contact-brushes into their dotted-line position shown in Fig. 15; but it is evident that the line-wires 22 23 of the branch circuits may be disconnected from the terminals to which they are herein shown as connected and be joined or connected to the terminals on the opposite extremities of the rows of terminals.

If it is desired to affect the lights or lamps in some branch circuits and not in others, the stem c^{10} of the locking device, which secures the handle c^4 of its resistance-head to the co-operating arm c^3 on the loose hub c of the said resistance-head, it is withdrawn to disengage the said stem from the arms c^3 , so that when the lever c^{26} is moved the contact-arms of the resistance-head having its locking device disengaged or rendered inoperative—as, for instance, on the heads 5 6—will not be moved. At the same time the handles c^4 of the heads 5 6 may be moved individually to operate the contact-arms connected to their arbors a^{16} , and consequently the desired light effect in the branch circuits controlled by the resistance-heads 5 6 may be effected. For instance, it may be desired to dim the lights in all the branch circuits except in the circuits in which are located the resistance-heads 5 6 and to have the lights only partially lowered or dimmed in the circuit of the head 5 and fully dimmed in the circuit of the head 6, which may be effected by turning the disconnected handles into the positions shown in Fig. 1, so as to interpose in the said particular circuits the amount of resistance required to obtain the desired light effect.

In order that a handle c^4 , which has been disconnected from the arm c^3 , may be auto-

matically connected again to its arm c^3 by the movement of the lever c^{26} , the arm c^3 of each loose hub c has secured to or forming part of it cams or projections 90 91 (see Figs. 1 and 14) on opposite sides of the said arm, and the cans 90 91 are beveled or inclined, as shown, and they engage the projecting end of the stem c^{10} of the locking device when the latter is in its unlocked position and force the said stem back against the spring c^9 until the arm c^3 has been moved far enough to bring the hole 47 in line with the stem c^{10} , at which time the spring c^9 forces the stem c^{10} into the hole 47, and thus secures the handle to the arm c^3 .

The switch-board or apparatus is provided with a plurality of switches B, preferably one for each branch circuit, which switches, hereinafter designated by means "snap" or "gang" switches, are constructed, as will be described, so that they may be operated simultaneously or individually, as desired. Each snap-switch B is preferably constructed as shown in Figs. 6, 7, and 8, it consisting of a hollow stem d , through which is extended a spindle or rod d' , provided at its lower end with a cam or projection d^2 , movable in a longitudinal slot d^3 in the hollow stem d , into which slot projects a pin or rod d^4 . The hollow stem d is provided at its lower end, as clearly shown in Fig. 6, with a flange d^5 , fitted into an opening d^6 in a base d^7 , secured, as shown in Fig. 3, to a vertical wall d^8 . The base d^7 is preferably extended across the apparatus and provided with a cover or hood d^9 , fastened, as by screws d^{10} , (see Fig. 6,) to a post d^{12} on the base d^7 . A plate d^{13} , having an opening through which the hollow stem d is extended, is secured, as by screws d^{14} , to the base d^7 . The hollow stem d has mounted upon it a metallic sleeve d^{17} , on which is loosely fitted a metallic bushing d^{18} , provided near its lower end with ratchet-teeth d^{19} , normally in engagement with a pawl d^{20} , pivoted to an arm d^{21} , fitted in and secured to the hollow stem d . The bushing d^{18} has fastened to it a hub d^{23} , of insulating material, provided with notches or teeth d^{24} , (see Fig. 8,) the alternate teeth or notches having secured to them contact-pieces d^{25} , with which co-operate brushes or terminals d^{26} , to which the line-wires 20 21 are connected, the branch circuit being completed when the said brushes or terminals are in engagement with the said contact-pieces, and the said branch circuit is broken when the brushes or terminals are in contact with the insulated teeth of the hub d^{23} . The toothed hub d^{23} is rotated by means of the pawl d^{20} on the arm d^{21} , the said pawl being normally held in engagement with the ratchet-teeth d^{19} by a spring d^{27} . (See Fig. 7.) The snap-switch is provided with a hollow handle d^{30} , (see Fig. 6,) fastened, as by screws d^{31} , to the sleeve d^{17} , the said hollow handle having extended into it the upper end of the rod or spindle d' , upon which is fitted a cap d^{32} , secured to the spindle or rod, as shown, by a pin d^{33} , the said cap being also fitted

over a head or flange d^{34} on a spindle d^{35} , extended above the handle and through an opening in a cover d^{36} , the spindle d^{35} being encircled, as shown, by a spiral spring d^{37} , which acts against the cap d^{32} and normally forces the rod d' within the handle, so that the cam or projection d^2 is out of engagement with the pin d^4 , and the latter is at such time forced into the hollow stem by the spring-actuated pawl d^{20} , the latter being brought into engagement with the ratchet by the spring d^{27} . The spindle d^{35} has a pin or projection d^{40} traveling in a longitudinal slot in a cylindrical boss on the inner side of the cover d^{36} , by means of which pin the spindle d^{35} and rod d' are held locked when the said spindle and rod are drawn out from the hollow handle to place the cam d^2 in engagement with the pin d^4 and force it out against the pawl d^{20} , thereby disengaging the said pawl from its ratchet and permitting the arm d^{21} to be moved without moving the toothed hub d^{23} . The spindle d^{35} is provided, as shown, with a head d^{41} , of insulating material, serving as a handle for the said spindle. The head d^{34} on the spindle d^{35} is loose in the cap d^{32} and permits the said spindle to be readily turned to place the pin or projection d^{40} out of line with its slot d^{39} without moving the rod d' .

In order that the snap-switches B in all the branch circuits may be operated simultaneously, the arms d^{21} of the several switches are pivotally connected to an actuating device, shown as a bar or rod e , (see Figs. 6 and 12,) which is connected, as shown in Fig. 10, to an arm e' , similar to the arms d^{21} , but which is secured to or forms part of a collar e^2 on a shaft or arbor e^3 , having its upper end journaled, as shown, in an upright e^4 , fastened to the plate d^{13} , as by screw e^5 , the said shaft or arbor being shown as extended through the cover d^9 and having fast on it a crank or lever e^6 , provided with a handle e^7 , of insulating material.

If it is desired to operate all the snap-switches B at once—that is, by one movement of the lever e^6 —the spindle d^{35} of each switch is turned so as to place its pin d^{40} in its slot d^{39} , and upon releasing the said spindle the spring d^{37} will force inward the spindle and the rod d' and remove the cam d^2 from engagement with the pin d^4 , whereupon the spring d^{27} forces the pawl d^{20} into engagement with the ratchet d^{19} , so that when the lever e^6 is moved in the direction of arrow 400, Fig. 1, the actuating arbor or rod e and the arms d^{21} , pivotally attached to it, are moved in the direction indicated by arrow 400, and the hubs d^{23} of the switches are rotated so as to remove one notch or tooth from engagement with the brushes or terminals d^{26} and bring a second notch or tooth of the hub in engagement with the contact brushes or terminals.

If the tooth or notch removed from engage-

ment with the brushes or terminals is provided with a contact-strip d^{25} , the circuit will be opened, and vice versa.

If it is desired to open some of the branch circuits and leave others closed, and vice versa, when the handle e^6 is moved, the spindle d^{35} of the switches controlling the circuits to remain closed will be withdrawn from the hollow handle and locked by turning them so as to bring the pin d^{40} out of line with the slot or opening d^{39} in the cover d^{36} , the withdrawal of the spindle bringing the cam d^2 in engagement with the pin d^4 and forcing the pawl d^{30} out of engagement with the ratchet d^{19} , so that when the lever e^6 and the actuating-bar are again moved in the direction of arrow 400 only the toothed hubs d^{23} , having their ratchets engaged by the pawls d^{20} , will be rotated.

We have herein shown one form of switch by which to open and close the branch circuits, and, while we prefer to construct the switch as shown and described, we do not desire to limit ourselves to the particular construction shown, as it is evident that it may be variously modified.

Each branch circuit has connected to it a loop-circuit f , (see Fig. 15,) in which is located a lamp f' , similar to the lamps in the branch circuit and hereinafter designated by me as a "pilot-lamp;" and in order that the operator at the switch-board or apparatus may know the condition of the branch circuits the said pilot-lamp is secured to the switch-board or apparatus, it being herein shown in Fig. 1 as connected to a hollow rod or pipe f^3 , extended across the frame or cabinet above the same and resting upon suitable supports f^4 , (shown as hollow posts,) there being as many pilot-lamps f' as there are branch circuits. The switch-board also is provided, as herein shown, with pilot-switches D^3 , which may be of any usual or well-known construction, there being one for each loop-circuit f . The switch-board or apparatus is also preferably provided with fuse-blocks f^6 , joined by fuses f^7 , to which the line-wires are connected, as shown in Fig. 15, there being one such fuse for each line-wire. The fuse-blocks f^6 are secured to the apparatus, as herein shown, within the compartment a , and the said compartment also contains within it suitable plug-switches f^8 , to which the positive and negative line-wires leading from the dynamo are connected, there being three such plug-switches shown in Fig. 15, to which the three main line-wires f^9 f^{10} f^{12} are joined after the manner of the well-known Edison three-wire system. The switch-board or apparatus is also provided, as herein shown, with switches f^{13} , to which the other branch circuits not provided with resistances may be connected, and by which each of said branch circuits may be positively opened and closed as desired.

As represented at the right in Fig. 15, two branch circuits are shown as connected to

one resistance-head, so that the lamps therein may be lowered at the same time, and the lamps in one circuit may be of one color—as, for instance, red—and the lamps in the other circuit may be of a different color—as, for instance, blue—such as may form part of the foot-lights.

We have herein shown each resistance-head as provided with two rows of terminals, to which the resistances are connected, and two contact-arms co-operating with the said terminals, and while we prefer this construction, as the same amount of resistance is interposed on both sides of the line, we do not desire to limit our invention in this respect, as only one row or set of terminals and one contact-arm may be used.

We have herein shown six resistance-heads arranged in two rows of three each; but we do not desire to limit our invention in this respect, as any other desired number or arrangement may be employed.

It will be noticed that the contact-terminals and brushes co-operating with them are located on the front side or face of the resistance-head, where they may be readily cleaned, adjusted, and repaired.

We claim—

1. In a circuit-controlling apparatus or switch-board, a supporting-frame and a plurality of resistance-heads secured thereto and provided with a plurality of contact members or terminals to which the resistances are connected, combined with a plurality of independently-movable contact-arms co-operating with the said contact terminals or members, an actuating device for said contact-arms, handles connected to said contact-arms to move therewith, and means to detachably connect the said contact-arms with the actuating device, substantially as described.

2. In a circuit-controlling apparatus or switch-board, a supporting-frame and a plurality of resistance-heads secured thereto and arranged in rows, and a plurality of contact members or terminals on said heads to which the resistances are connected, combined with a plurality of contact-arms co-operating with the said contact-terminals, an actuating device connected to the contact-arms of one row of resistance-heads, and an independent connection joining the contact-arms of the resistance-heads in different rows, whereby the contact-arms of all the resistance-heads may be operated by a single actuating device, substantially as described.

3. In a circuit-controlling apparatus or switch-board, a supporting-frame and a plurality of resistance-heads secured thereto and arranged in rows and a plurality of contact members or terminals on said heads to which the resistances are connected, combined with a plurality of contact-arms pivoted to said resistance-heads, hubs loosely mounted on the pivot of the said contact-arms and provided with arms, handles fast on the said pivots, locking devices to secure the arms of the loose

hubs to the said handles, an actuating device or bar connected to an arm of the loose hub of one row, and an independent connection or bar joining arms of the loose hubs, and means to move said actuating device or bar, substantially as described.

4. In a circuit-controlling apparatus or switch-board, a supporting-frame and a plurality of resistance-heads secured thereto and provided with a plurality of contact members or terminals to which the resistances are connected, combined with a plurality of contact-arms pivoted to the said resistance-heads, an actuating device for said contact-arms, arms loose on the said pivots, handles fast on the pivots, and locking devices to secure the said loose arms to the handles, substantially as described.

5. In a circuit-controlling apparatus or switch-board, the combination, with a resistance-head provided with contact members or terminals to which the resistances are connected, of contact-arms pivoted to the said resistance-head, a hub loose on the pivot of the said contact-arms and provided with arms, a handle fast on said pivot, and a locking device to secure said loose hub to the handle, substantially as described.

6. In a circuit-controlling apparatus or switch-board, the combination, with a resistance-head provided with contact members or terminals to which the resistances are connected, of a contact-arm pivoted to said resistance-head, a hub loose on said pivot and having arms, one of which is provided with cams 90 91 and with a hole or opening 47, a handle fast on said pivot, and a locking device for said handle, consisting of a shell c^6 , secured to the handle, a stem c^{10} , and a spring in said shell to act on said stem and engage the stem with the hole 47, substantially as described.

7. The herein-described switch-board, it consisting of a cabinet provided with a door and having one side cut away to form a pocket c^{28} , a plurality of resistance-heads arranged in an upper and lower row and provided with contact members or terminals, contact-arms pivoted to said resistance-heads, hubs loose on the pivots of the contact-arms and provided with arms, handles fast on said pivots, locking devices to secure one arm on the loose hubs to the handles, an actuating-bar fastened to arms of the loose hubs of one row, a lever pivoted in the pocket c^{28} , to which the actuating-bar is connected, and independent connections joining the arms of the loose hubs of the upper and lower rows, substantially as described.

8. In a circuit-controlling apparatus or switch-board, a cabinet having a door and provided with a plurality of resistance-heads located therein and having contact members or terminals, contact-arms co-operating therewith, and a plurality of pilot-lamps supported by said cabinet, substantially as described.

9. In a circuit-controlling apparatus or

switch-board, a cabinet having a door and provided with a plurality of resistance-heads located therein and having contact members or terminals, contact-arms co-operating therewith, and a plurality of pilot-lamps supported by said cabinet, and independent switches located in said cabinet and governing the said pilot-lamps, substantially as described.

10. In a circuit-controlling apparatus or switch-board, the herein-described switch, consisting of a revoluble hub having notches or teeth, some of which are provided with contact-pieces with which co-operate circuit-terminals, a ratchet, a pawl to engage said ratchet, a hollow handle for said switch, a device extended through the hollow handle to disengage the pawl and ratchet when drawn out of the hollow handle, and a locking device to secure the disengaging device in operative position until positively released, substantially as described.

11. In a circuit-controlling apparatus or switch-board, a cabinet or supporting-frame provided with a plurality of switches, consisting of a revoluble hub having notches or teeth, some of which are provided with contact-pieces with which co-operate circuit-terminals, a ratchet, a pawl to engage said ratchet, a hollow handle for said switch, a device extended through the hollow handle to disengage the pawl and ratchet when drawn out of the hollow handle, and a locking device to secure the disengaging device in operative position until positively released, an arm to produce revolution of the said revoluble member, an actuating-bar to which the arms of the said switches are connected to move therewith, and means to produce movement of the said actuating-bar, substantially as described.

12. In a circuit-controlling apparatus or switch-board, a cabinet provided with a rolling front a^3 , a plurality of resistances supported within said cabinet and having pivoted contact-arms, contact-terminals arranged in arcs on opposite sides of the pivot and with which co-operate the said contact-arms, resistances connected to said terminals, hubs loose on the said pivots having arms, an actuating-bar to which said loose hubs are connected to be actuated thereby, as described, handles fast on the pivots, locking devices to secure the loose arms to the said handles, circuit-terminals on the resistance-heads, brushes on the contact-arms to engage the said circuit-terminals, a plurality of snap-switches B to control circuits in which the resistances are located, a plurality of pilot-lamps supported by said cabinet, a plurality of switches D, controlling the pilot-lamps, a plurality of switches f^{13} , and fuse-blocks f^6 , located within the cabinet, substantially as described.

13. In a circuit-controlling apparatus or switch-board, a cabinet, a plurality of resistance-heads located therein, angle-irons a^6 a^7 , and cross bars or strips a^8 , secured to the said angle-irons to form pockets within which the

resistance-heads are secured, castings or spiders a^{13} , secured to the back of the resistance-heads and provided with bosses a^{14} a^{15} , a pivot or arbor supported in said bosses, contact-arms fast on said arbor and provided with brushes, terminals on the resistance-heads with which the said brushes co-operate, terminal-plates b^{19} b^{20} on the resistance-heads, brushes on the contact-arms co-operating with the said plates, hubs loose on the said pivots and having arms, means to connect the arms of hubs on different resistance-heads, handles on the pivots, and locking devices to fasten said handles to one of the arms of the loose hubs, substantially as described.

14. The herein-described locking device, consisting of the shell c^6 , the sleeve c^8 , located therein and provided with a groove c^{13} , a stem c^{10} extended through said sleeve and shell and provided with a collar c^x , and a spring encircling the said stem between the collar c^x and sleeve, substantially as described.

15. In a circuit-controlling apparatus or switch-board, the combination, with a resistance-head provided with contact members or terminals arranged in two independent arcs or rows on the one and the same face of the resistance-head, of independent contact-arms pivoted to the said resistance-head on one side of the same, a handle to move said contact-arms simultaneously, and independent resistances connected to each row of terminals, substantially as described.

16. In a circuit-controlling apparatus or switch-board, the combination, with a resistance-head provided on its front face with circuit-terminals and on its rear face with terminals or castings electrically connected to the terminals on the front face of the resistance-head and provided with a clamping device consisting of a threaded split nipple and nut to engage said nipple to clamp the end of a wire thereto, of a contact-arm pivoted to the front face of the resistance-head and a handle to move said contact-arm, substantially as described.

17. In a circuit-controlling apparatus or switch-board, a cabinet having a door and provided with a plurality of resistance-heads located therein and having contact members or terminals, contact-arms co-operating therewith, a plurality of pilot-lamps, and independent switches located in said cabinet, and electrical connections joining said pilot-lamps with said switches, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN P. CUSHING.
WILLIAM J. KELLY.

Witnesses:

JAS. H. CHURCHILL,
EMMA J. BENNETT.