Oct. 21, 1941. F. G. LOGAN 2,260,146

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed June 28, 1939 4 Sheets-Sheet 1

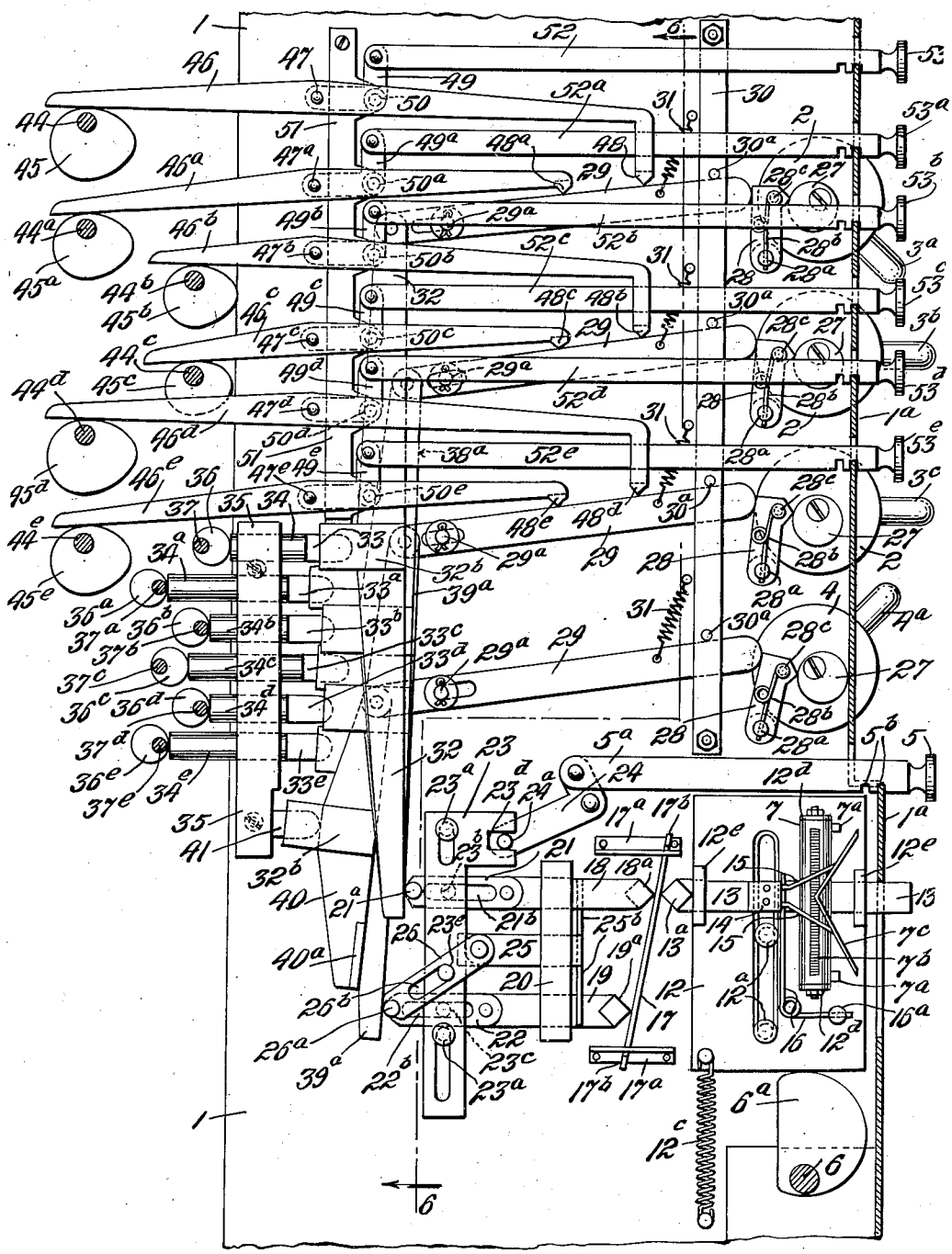


Fig. 1.

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Fig. 6.

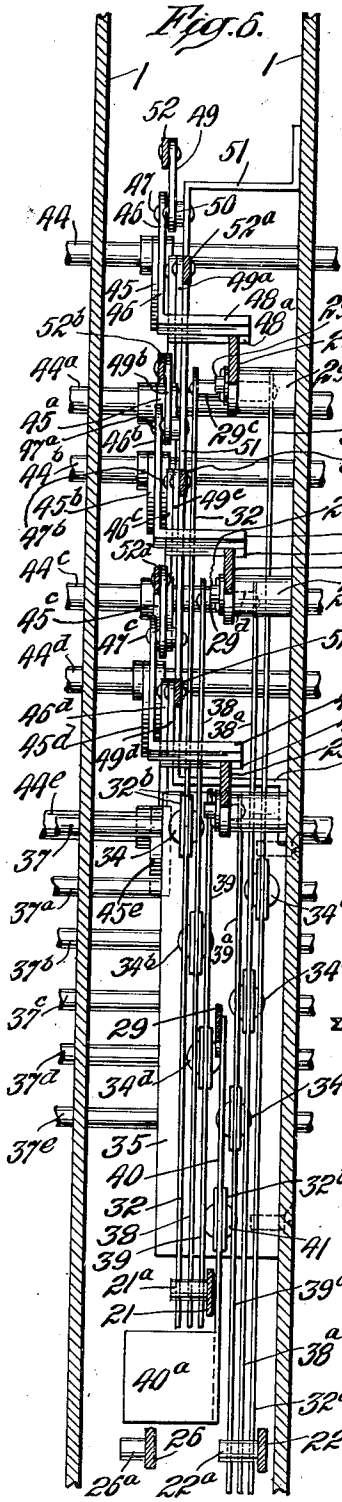


Fig. 2.

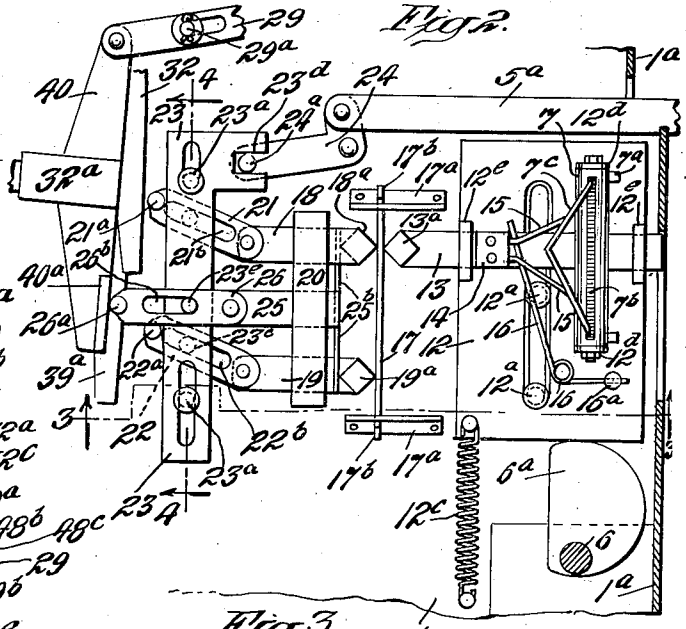


Fig. 3.

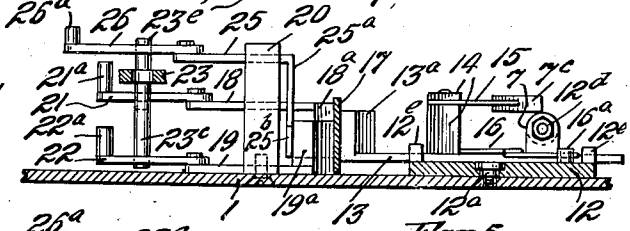


Fig. 4.

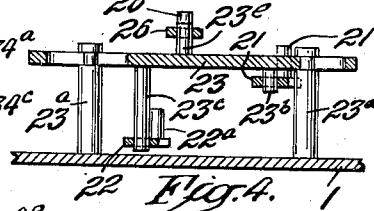


Fig. 5.

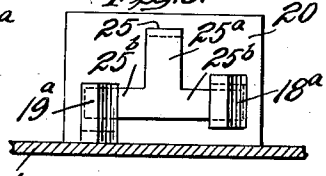


Fig. 8.

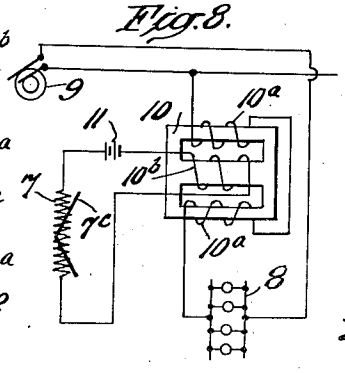
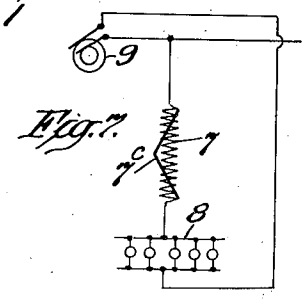


Fig. 7.



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Fig. 9.

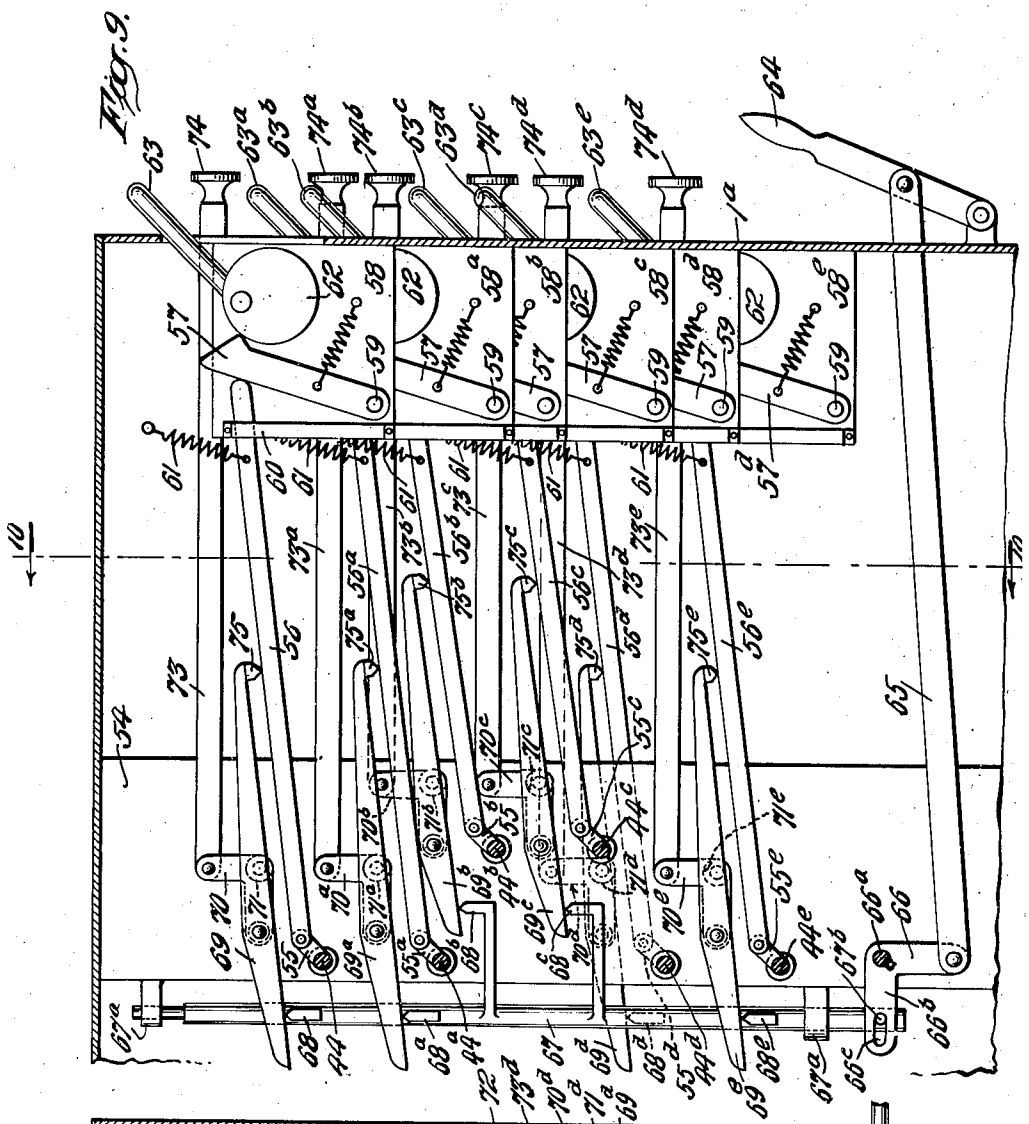
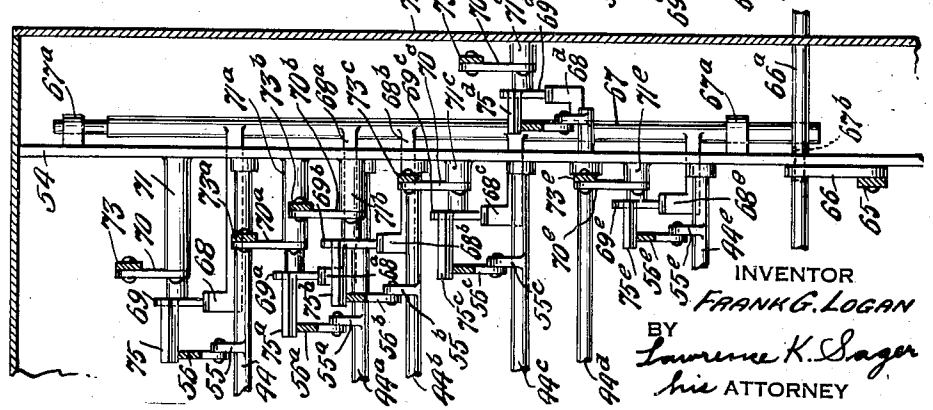


Fig. 10.



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APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

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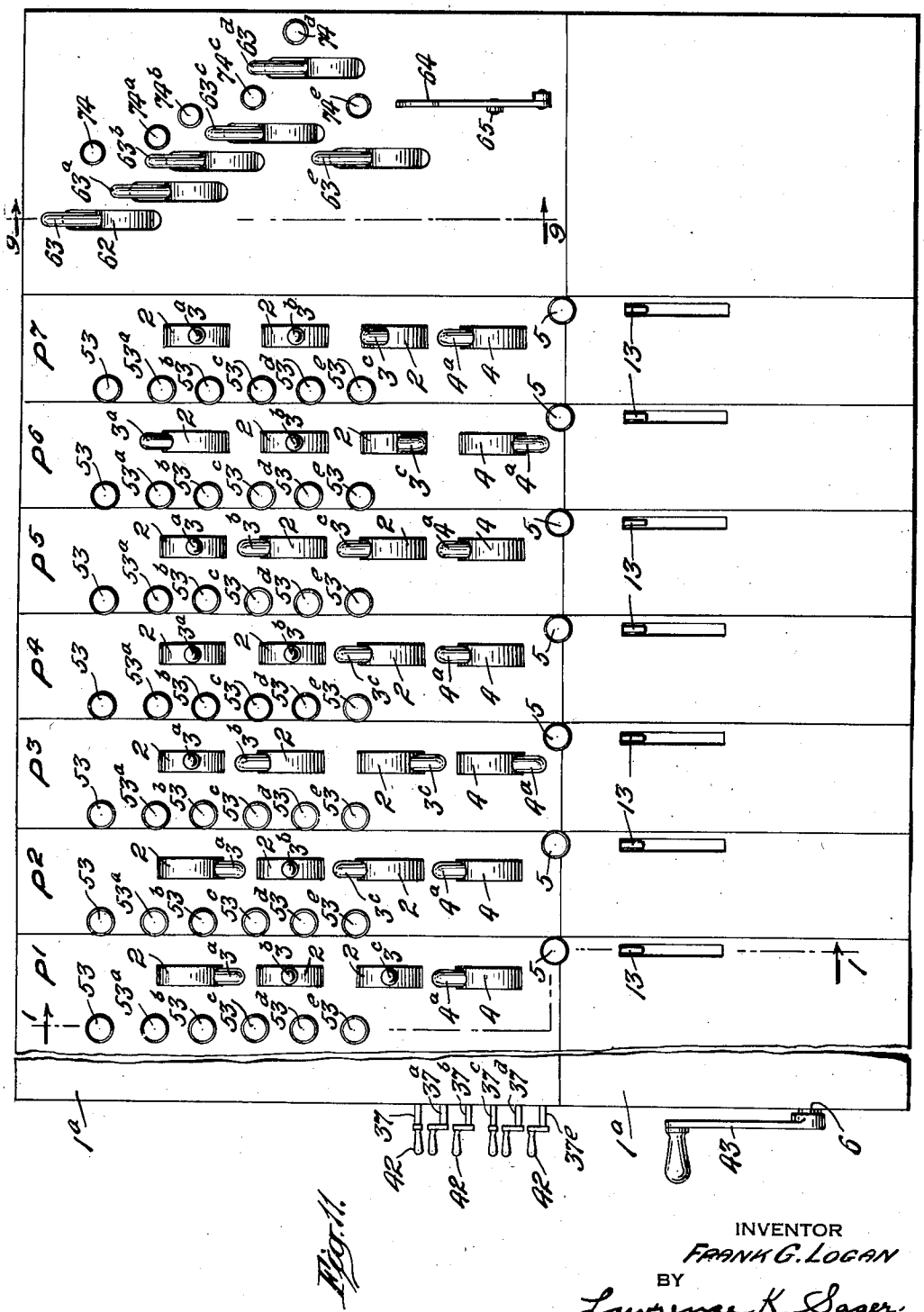


Fig. 11.

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Patented Oct. 21, 1941 2,260,146

UNITED STATES PATENT OFFICE

2,260,146

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Frank G. Logan, Mount Vernon, N. Y., assignor to Ward Leonard Electric Company, a corporation of New York

Application June 28, 1939, Serial No. 281,533

36 Claims. (Cl. 74—1)

This invention relates particularly to the control of lighting circuits especially adapted for use in theatres and the like and for spectacular productions and illuminations wherein the scenes and lighting effects are changed in a sequential manner, or otherwise varied to suit particular requirements. The invention is applicable also to other purposes where it is desired to affect a plurality of electric circuits in various ways and in various combinations, selectable at will.

In prior apparatus and methods of control, the various circuits have been capable of individual electrical adjustment and the circuits have been jointly and variously controlled by superimposing regulation on the circuits by auxiliary electric means of various forms, including regulatory rheostats, combining the circuits in various ways and in various relations to each other, and by the use of switches, relays, contactors and various forms of electrically responsive devices. This has required the use, not only of many electrical devices of different kinds and of different capacities to fulfill the requirements where a large number of circuits are to be variably controlled, but also a multitude of circuits and great complexity of connections. It has resulted that when such a system is installed at the place of use, the making of the connections between the control board and the lighting circuits requires a large amount of time involving large expense and the work must be carefully done in order to insure proper operation in the manner intended.

An important general object of the present invention is to greatly reduce and simplify the electrical equipment required and to greatly reduce and simplify the wiring and number of required circuit connections. This is accomplished by avoiding all joint electrical regulation or control of the lighting circuits and by avoiding their interconnections, or the superimposing of one regulation upon another and by omitting the necessary apparatus required for such joint regulation and interrelationship of the circuits. By the present invention each circuit is individually and separately controlled and isolated insofar as any other circuit is concerned and there is no joint regulation or interrelationship of one circuit upon another. This greatly simplifies the amount of labor required where the control board and apparatus are installed, greatly reduces and simplifies the number of wires and circuit connections required and thus greatly reduces the cost of installation. By the present invention it is necessary only to connect a pair of wires controlling each lighting circuit to a pair of contacts on the control board. This simplicity of connections has the further advantage of reducing errors in connections and ease of segregating and locating faults whenever they occur.

The foregoing is accomplished by providing mechanical means for individually moving the control means of each individual circuit; and this mechanical means is arranged to actuate the control means of each circuit and to permit the desired character of control in various combinations and relationships by the interrelationship of mechanical parts. In this way the control of each circuit is entirely independent of the control of any other circuit and acts separately, as distinguished from any common, or joint, regulation.

Another object is to provide simple mechanical means for predetermining selected mechanical positions of the individual circuit controllers which will be available at will and in any sequence, without the introduction of modifying electrical influences upon the circuit controllers. And a further object is to permit adjustment of the mechanical means so that any desired intensity of the lighting effect in any circuit for any scene may be obtained in any sequence, ranging from full intensity to complete blackout.

Another object is to provide mechanical means for actuating the control of the individual circuits so that a gradual change of lighting effect may be obtained from any existing condition to a desired condition; and that in passing from one scene to the next, the lighting effect of one scene may be changed gradually to the lighting effect of the next scene according to the set-up of the handles which determine the final positions of the individual controls. A further object is to obtain this gradual change in decrease or increase of lighting effect by a translation from the existing scene to the next scene in a manner such that the change commences at the same time in all circuits of the scene from their existing condition, whether full-bright, 75%, 40% or 25% bright or other intensities, and continues the change until they are all gradually brought to the changed intensity at the same time. This gradual translation, or so-called fading, is accomplished by this present invention in a simple manner by the mechanical shifting of the individual control of each circuit affected, the set-up of the mechanical means for each circuit having determined the desired change of control of each circuit and whether or not any particular circuits shall be affected.

Another object is to provide means for permitting independent control of any one or more of the lighting circuits and without disturbing the existing set-ups for the various circuits. This is sometimes desirable for rehearsals, the planning of the lighting effects for future productions, or for other purposes. By the present invention this is readily accomplished by simple mechanical means.

Another object is to provide means for the simultaneous change of any desired number of the circuits, separately from the shifting fader control, from their existing condition of intensities to black-out, or to a partial dimming, and return, if desired, to their initial condition; and to accomplish this mechanically by affecting all selected circuits simultaneously from their existing conditions by a gradual change in each circuit to another condition. This may be termed master control and is readily accomplished by this invention by mechanical actuation of the individual control of each selected circuit, as distinguished from any common regulation of the circuits. The selection of the circuits affected by the master is obtained by mechanical enabling and disabling means individual to each circuit and without relation to any other circuit. Another object is to provide mechanical means whereby the masters may be operated selectively by a grand master simultaneously and gradually from their existing condition to another condition.

Another object is to provide mechanical means related to the control of each circuit which shall occupy small space laterally and be in the form of a comparatively thin panel with the set-up handles and certain other cooperating parts at the front edge of the panel. This is for the purpose of enabling any desired number of such panels to be stacked side by side and occupy small space, the number of such panels being dependent upon the number of circuits that are to be included in the complete assembly. A further object is to so relate the parts that the addition of such panels provides for permitting mastering and fading by merely extending the operating means therefor according to the desired number of circuits. Other general objects are to provide a simple and rugged form of construction, dependable in long continued use and adapted for convenient inspection and repair. Other objects are to provide means whereby special controlling effects may be obtained by manipulation of the parts, such as cross control, so-called "pile-on" and other methods of control for particular purposes. Other objects and advantages will be understood from the following description and accompanying drawings.

Fig. 1 is a side view, in section on line 1—1 of Fig. 11, of one of the control panels for the control of one individual circuit; Fig. 2 is a similar view of a portion of Fig. 1 with certain of the parts in a different position; Fig. 3 is a horizontal section on the line 3—3 of Fig. 2; Fig. 4 is a vertical section on the line 4—4 of Fig. 2; Fig. 5 is a section on the line 5—5 of Fig. 2; Fig. 6 is an enlarged vertical section on the line 6—6 of Fig. 1; Figs. 7 and 8 are illustrative diagrams of connections of the individually controlled circuits; Fig. 9 is a side of the master mechanism being a section on the line 9—9 of Fig. 11; Fig. 10 is a vertical section on the line 10—10 of Fig. 9; and Fig. 11 is a front view on a reduced scale of a control board.

Fig. 1 represents a form of control panel for affecting an individual circuit controlled thereby. This is adapted to stand vertically and the set-up handles at the right-hand side project through the front part of the control board which may be made up of a number of such panels positioned side by side. These individual panels are narrow in width so that a large number of them may be assembled side by side and occupy a comparatively small amount of space. Any desired number of such individual panels may be assembled and usually will correspond in number to the number of individual circuits to be controlled. In some cases there may be only a few such panels and circuits while in other cases there may be required fifty or more depending upon the requirements of the particular installation.

The parts for affecting the circuit individually are shown in Fig. 1 mounted on and supported by a thin sheet 1 of suitable material such as sheet-steel. The front portion of this sheet is bent at right angles to form the front 1*a* of the panel. These panels are suitably secured to a supporting frame. At the upper right-hand portion of the supporting plate are pivotally mounted three disks 2 in vertical relationship having handles 3*a*, 3*b* and 3*c* which extend outwardly, as well as portions of the disks, beyond the front portion of the panel. These handles may be swung upwardly and downwardly and adjusted to any desired position and form the set-ups for the control of the circuit affected by this panel. Any desired number of such set-ups may be used, even up to ten or more depending on the number of scenes desired; and ordinarily the greater the total number of circuits controlled the greater will be the number of set-ups desired for each circuit. In the present instance only three such set-ups per panel are shown as the principle and mode of operation are the same for any additional number.

Below the three set-ups are shown an additional disk 4, a knob 5 and a shaft 6. The disk 4 projects somewhat beyond the front edge of the plate and is provided with an operating handle 4*a* on the front edge. The shaft 6 having the cam 6*a* is for transferring when shifting from the set-up of one scene to the next. The knob 5 and its rod 5*a* are for disabling all of the set-ups and enabling the independent handle 4*a* to affect the controller. The disk above the knob and its handle 4*a* are the independent means for operating the controller without disturbing the set-ups of this panel and without disturbing any other panel or other set-up. In case any additional number of set-ups over the 3*b* were desired; they would be introduced between the disks controlled by handles 3*c* and 4*a*.

Each panel is provided with individually adjustable means for independently and solely controlling its respective circuit. In this instance, there is shown for this purpose a rheostat having an adjustable element, although any suitable form of variable device might be used, such as a variable inductor, variable capacitor, or any other form of device for adjusting or varying the circuit constants. The rheostat shown is in the form of a tubular resistor 7 comprising a number of insulated turns of resistive wire having terminals 7*a*. These terminals are connected to the circuit to be controlled by this panel. The resistive unit 7 has the outer portion of the insulation removed from the turns of the resistive conductor along a narrow path so as to provide an exposed contact surface 7*b* of the adjoining turns of the conductor. This surface is engaged

by the rear edge of a bow-shaped or a wide open V-shaped conductor 7c having the apex of the bow at the middle of the resistive unit. In the position shown in Fig. 1 this bow-shaped conductor or contactor is engaging at its apex the middle of the resistive conductor and it follows that in this position, all of the resistive unit is in circuit between its terminals. When the contactor 7c is moved to the left, or inwardly, the apex of the bow passes out of engagement with the middle of the resistive unit and contact is made by the bow at intermediate points of the conductor. This results in placing the end portions of the resistive conductor in series with the external circuit while the central portion of the resistive unit is short-circuited between the intermediate contacting portions of the bow. Further movement of this bow to the left results in increased portions of the resistive unit being short-circuited by the bow; and when the ends of the bow engage the end portions of the unit, all of the unit is short-circuited. It follows that the adjustment of the bow, or contact bar, by the actuating devices will determine the amount of resistance inserted or excluded from the control circuit and thereby determine the resultant lighting effect.

As regards the circuit controlled, the resistive unit 7 may be connected in series with the lamps of the lighting circuit giving a direct control of the consumption circuit where the lamp load is light. But for most purposes the lamp load is sufficiently great to require auxiliary controlling means, such as a reactor with a variable current controlling winding. Fig. 7 is a diagram showing direct control of the lighting circuit by the resistive unit 7 and the adjustable bar 7c being in series with the lighting circuit 8 between the supply lines from a source 9. Fig. 8 shows a simple form of control wherein the voltage applied to the lamp circuit 8 is controlled by a three-legged reactor 10 having windings 10a on the outer legs connected in series with each other and with the lamp circuit between the supply lines; and wherein a direct current control winding 10b is applied to the middle leg of the reactor and supplied with current from any suitable source indicated as a battery 11 through the adjustable resistance 7 controlled by the bar 7c. The particular apparatus for affecting the lighting circuit forms no part of the present invention as various forms and types of apparatus may be used for this purpose, it merely being necessary for the purpose of the control to provide some means for varying the circuit constants in its controlled circuit by each of the panels of the present invention. Likewise the particular form of resistive element and adjustable contact bar shown in Fig. 1 may be replaced by some other form of adjustable device for affecting the circuit constants in the individually controlled circuit of each panel. The particular form of adjustable resistive device here shown and various applications thereof are disclosed and claimed in my pending application Serial No. 251,468, filed January 18, 1939.

The means for adjusting the resistive device is shown in Figs. 1 to 6. The resistive device is carried on a vertically slidable plate 12 which is supported by two guide pins 12a fixed to the plate 1, as shown in Figs. 1, 2 and 3. A spring 12c fixed at one end to the plate 12 and at the other end to the plate 1, pulls the plate 12 downwardly against the cam 6a on the shaft 6. As the cam and shaft are turned to the left or returned to the position shown, the plate 12 will slide down or up accordingly. The plate 12 carries two brackets 12d which, with a screw and nut, support the ends of the resistor 7. The plate also carries two guide brackets 12e in which slides the strip 13 in a forward and backward movement. This strip carries at the inner end the projecting head 13a. An insulating post 14 is mounted on the strip between the two guide brackets and supports two wires 15 which in turn are fastened at their ends to the contact bar 7c. These wires exert a spring tension tending to hold the contact bar in good electrical contact with the resistor. A spring 16 is fastened to the plate 12 at 16a and extends upwardly and presses against the post 14, thus tending to move the slider 13 and parts carried thereby rearwardly.

A transfer bar, or guide, 17 is movably supported at its ends in slotted brackets 17a which are fixed to the plate 1. The transfer bar is movable forwardly and backwardly in the brackets and has projecting end portions 17b outside of the brackets which retain its ends in the brackets. The spring 16, by pressing the slider 13 inwardly, maintains the head 13a in engagement with the transfer bar. When the shaft 6 is turned counter-clockwise, its cam 6a will allow the plate 12 to move downwardly under the pull of the spring 12c, and as the lower end of the transfer bar or guide 17 is shown further to the left in Fig. 1 than the upper end, the spring 16 will move the slider 13 and head 13a to the left as it moves down the bar. This will cause the contact bar 7c to decrease the amount of resistance in the circuit. Thus the adjusted position of the transfer bar will determine the amount of resistance in circuit and its inclination will determine the change of resistance as the head 13a is shifted along the bar from one position to another. Moreover this change is a gradual one as the head 13a moves in either direction along the bar.

The position of the transfer bar 17 is adjusted by two movable elements 18 and 19 which are slidably mounted in openings through a block 20 fixed to the plate 1. The slider 18 is mounted in the upper end of the block at its middle portion while the slider 19 is mounted in its lower end at its inner portion, as shown in Fig. 3. The slider 18 carries a head 18a at its front end, which projects toward the plate 1 into the path of the transfer bar 17 and serves to adjust the position of the upper end of the bar. The slider 19 carries a head 19a at its front end which projects away from the plate 1 into the path of the bar 17 and serves to adjust the position of the lower end of the bar. The rear ends of the sliders 18 and 19 are pivotally connected respectively to tail pieces 21, 22. The piece 21 carries a pin 21a which projects into the path of adjusting levers to be described later. The piece 22 carries a pin 22a which projects into the path of other adjusting levers. A vertically slidable plate 23 serves to guide these tail pieces and to shift them when desired. This plate is mounted on the ends of posts 23a fixed to the plate 1 and is slotted to permit vertical movement on the ends of the posts, as well shown in Fig. 4. A pin 23b projects from the plate 23 towards the plate 1 and engages a slot 21b in the tail piece 21 to guide it. A pin 23c similarly projects from the plate 23 towards the plate 1 and engages a slot 22b in the tail piece 22 to guide it. The slidable plate 23 is operated by a lever 24 pivoted at its elbow to the plate 1. A pin 24a at one end of the lever pro-

jects into a slot 23*d* in the upper end of the plate 23. The other end of the lever is pivotally connected to the inner end of the rod 5*a*. The front end of this rod has notches 5*b* on its lower side or edge adapted to engage the edge of the offset portion of the panel 1*a* and thereby hold it in either of two fixed positions. When the knob 5 and its rod is pushed inwardly and so held by its outer notch, the lever 24 holds the plate 23 in its lower position as shown in Fig. 1. The tail pieces 21 and 22 are then held in line with their sliders 18 and 19 respectively and are then subject to adjustment by the aforementioned levers. When the knob 5 and its rod is pulled outwardly and held by its inner notch, the lever 24 raises the plate 23 to the position shown in Fig. 2. The tail pieces 21 and 22 are then held out of line with their sliders, as shown in Fig. 2, and are then not subject to adjustment by the levers for a purpose later explained.

Another means is provided for independent adjustment of the transfer bar 17. This comprises another slider 25 which passes through the middle outer portion of the block 20 and is guided thereby, as well shown in Fig. 3. The front end of this slider is bent towards the plate 1 forming a portion 25*a* extending towards the plate, as particularly shown in Figs. 3 and 5; and has projections 25*b* extending upwardly and downwardly so as to come opposite the rear of the heads 18*a* and 19*a* of the sliders 18 and 19. The slider 25 has a tail piece 26 pivoted to its inner end. This tail piece has a pin 26*a* at its inner end projecting away from the plate 1 which is adapted to be engaged by an adjusting lever to be described later. The tail piece is slotted at 26*b* to receive a guiding pin 23*c* fixed to the plate 23 and extending away from the plate 1. When the plate 23 is in the position shown in Fig. 1, the tail piece 26 is out of line with its slider and cannot be adjusted by its lever; but when the plate 23 is in the position shown in Fig. 2, the tail piece 26 is in line with its slider and can then be adjusted by its lever. When the parts are in the position shown in Fig. 2 and the tail pieces 21 and 22 are not subject to adjustment by their levers, the spring 16 forces the sliding strip 13 to the left as shown in Fig. 2 because the sliders 18 and 19 are not then subject to adjustment by their levers and this results in the transfer bar 17 and sliders 18 and 19 being moved to the position shown in Fig. 2. This brings the heads 18*a* and 19*a* of their sliders against the extensions 25*b* of the slider 25; and this causes the contact bar 7*c* to be moved to the resistance-all-out position. Under these conditions, it is evident that when the slider 25 is adjusted, it will move the sliders 18 and 19 and transfer bar 17 and head 13*a* of the sliding strip 13 to any desired adjusted position and thereby afford an independent means for adjustment of the contact bar, regardless of the position of the head 13*a* on any part of the transfer bar.

The means for adjusting the sliders 18 and 19 to their proper positions as required by the different scenes is accomplished by the set-up handles, three of which are shown, as already explained. Each of the set-up disks 2 is provided on its side with an eccentric or cam 27. A movable element or cam follower 28 engages each of the cams 27 at the upper end of the element and is pivotally mounted at its lower end on a pin 28*a* which is fixed to the plate 1. A small coiled spring 28*b* is located at the side of each element 28 and has one end fixed to the pin 28*a* and the other end in engagement with a pin 28*c* located on the upper end of each follower. These springs tend to keep the elements 28 in constant engagement with the cams 27. Engaging the upper end of each of the elements 28 is a rearwardly extending push bar or push rod 29. The rear ends of these rods or strips are slotted and engaged by pins 29*a* on post 29*b* fixed to the plate 1 serving as guides for the rear ends of the push rods 29. The front ends of these rods are guided between a pair of metal strips 30, the ends of which are supported by the plate 1. Springs 31 are connected at their lower ends to each of the rods 29 respectively and are connected at their upper ends to pins fixed to the plate 1, thereby tending to maintain the forward ends of the rods 29 in their uppermost permissible positions against pins 30*a* fixed to the strips 30. In their upper position they are in engagement with the upper ends of the pivoted elements 28. When any one of the set-up handles is adjusted, it will correspondingly adjust its element 28 and push rod 29, causing the latter to be moved more or less to the rear.

The adjustment of the set-up handles adjusts the sliders 18 and 19 through movement of the push rods 29 and through pivoted levers respectively related to each push rod. Consider first the upper push rod 29. The inner end of this rod is pivotally connected by a pin 29*c* to a pair of metal strips 32, 32*a* spaced from each other which form the levers for engagement with the pins 21*a* and 22*a*, as more particularly shown in Fig. 6. The lever 32 extends to and is adapted to engage the pin 21*a* of the tail piece 21. The lever 32*a* extends to and is adapted to engage the pin 22*a* of the tail piece 22. The lever 32 is pivotally mounted at about its middle portion on a forwardly extending plate 33 having a rounded front end, as shown in Fig. 1. The lever 32 has secured at its opposite sides plates 32*b* which extend rearwardly and embrace the opposite sides of the plate 33. Similarly the lever 32*a* is pivotally mounted at about its mid-point on another plate 33*a*. The plate 33 is carried by the forward end of a pin 34 which forms a plunger within a block 35 fixed to the plate 1. The rear end of the pin 34 is engaged by a cam 36 which is fixed to a rotatable shaft 37. When this shaft is turned to cause the cam 36 to force the plunger 34 to its extreme forward position, as shown in Fig. 1, the plate 33 is rendered effective as the pivot of the lever 32. Similarly the plate 33*a* is supported by the pin 34*a* which forms a plunger within the block 35. The rear end of this plunger is engaged by a cam 36*a* similar to the cam 36 and is mounted upon a rotatable shaft 37*a*. In the position shown in Fig. 1, this shaft is turned so that the cam 36*a* permits its plunger 34*a* to move to its rear position and consequently the plate 33*a* is rendered ineffective as a pivot for the lever 32*a*. Consequently in the position shown in the drawings, the set-up handle 3*a* is capable of adjusting the slider 18 through the lever 32 to any position desired but has no effect upon adjustment of the slider 19 because the pivot 33*a* of lever 32*a* is disabled and therefore movement of the lever 32*a* has no effect on the slider 19. However, if the cam 36 were turned so as to render the plate 33 ineffective as a pivot, and the cam 36*a* were turned so as to render the plate 33*a* effective as a pivot, then the reverse condition is set up making the lever 32*a* effective in adjustment of the slider 19 and rendering the lever 32 ineffective as to adjustment of the slider 18 upon turning the set-up handle 3*a*. The purpose of this inter-change will be explained later.

The control of the sliders 18 and 19 by set-up handle 3b will now be explained. The construction is similar to that already explained with reference to the upper set-up. The push rod 29 adjusted by set-up handle 3b is pivotally connected at its inner end to pin 29d connected between a pair of spaced levers 38, 38a which are located between the levers 32, 32a as shown in Fig. 6. The lever 38 is mounted on a pivot plate 33b and the lever 38a is mounted on a pivot plate 33c in a manner similar to that described with reference to the levers 32 and 32a. The plates 33b, 33c are respectively mounted on pins 34b, 34c and actuated by cams 36b, 36c mounted on shafts 37b and 37c. The lever 38 extends to and is adapted to engage the pin 21a of the tail piece 21, as shown in Fig. 6, and the lever 38a extends to and is adapted to engage the pin 22a of the tail piece 21. When the cam 36c is turned by its shaft to move its plunger 34c forwardly as shown in Fig. 1, the plate 33c is rendered effective as a pivot for the lever 38a and thereby enables adjustment of the set-up handle 3b to be effective in adjusting the position of the slider 19. At such times the cam 36b is turned so that its pivot plate 33b is rendered ineffective thereby rendering the lever 38 ineffective in adjusting the position of the slider 18. When the position of the cams 36b, 36c are reversed, the pivot plate 33b becomes effective while the plate 33c becomes ineffective and thereby enables the lever 38 to adjust the position of a slider 18 while the lever 38a is rendered ineffective in adjusting the position of the slider 19.

Similarly the push rod 29 which is actuated by the set-up handle 3c is connected at its rear end to a pin 29e between a pair of spaced levers 39, 39a which are mounted on pivot plates 33d and 33e. The lever 39 extends to and is adapted to engage the pin 21a of the tail piece 21 and the lever 39a extends to and is adapted to engage the pin 22a of the tail piece 22. Likewise the pivot plates 33d and 33e are respectively adjusted through their plungers 34d, 34e by cams 36d and 36e mounted on shafts 37d and 37e. These cams render the pivot plates 33d, 33e effective or ineffective according to the position in which the cams are turned in the manner already explained. Any additional number, of set-ups and levers and pivotal supports may be utilized, if desired, by additions of the character already described.

The method of making set-ups and the actuation of the resistance contact bar 7c for the control of the individual circuit affected by the one panel thus far described and the passing from one scene to another will now be described. Assume that the circuit controlled by the resistor unit of this panel in scene 1 is to be dark or at black-out; in scene 2 it is to be half-bright; and in scene 3 also to be half-bright. The set-up handle 3a will be moved to its lowest position and set-up handles 3b and 3c will be moved to about half-way positions, as shown in Fig. 1. The cam shafts 37 and 37c are adjusted to make the pivot plates 33 and 33c effective, as shown in Fig. 1. This causes the lever 32 to adjust the slider 18 and head 18a and upper end of the transfer bar 17 to their extreme forward positions, as shown in Fig. 1. This forces the sliding strip 13 and contact bar 7c to their extreme positions and causes all of the resistance to be included in the controlled circuit giving no illumination for the existing scene 1. The making of the plate 33c effective as a pivot results in the set-up handle 3b actuating lever 38a to adjust the slider 19 and head 19a and lower end of the transfer bar to a half-way position, as shown in Fig. 1. This adjustment has no effect on the existing scene 1 because the sliding strip 13 is not opposite the head 19a and thus causes no movement of the contact bar 7c. The head 19a has, however, adjusted the lower end of the transfer bar 17 to a position to give a half-bright condition in the circuit when shifting from scene 1 to scene 2. When the time for this change arrives, the operator turns the transfer shaft 6 and cam 6a counter-clockwise. This causes the plate 12 and parts carried thereby to move downwardly from the position shown in Fig. 1. The head 13a then travels along the guide or transfer bar 17 being forced against it by the spring 16. Thus there is a gradual transition from the all-resistance-in condition of Fig. 1 to a half-bright condition of the lighting circuit because when the head 13a is opposite the head 19a, the contact bar 7c has been brought to a position to include about half of the resistance in the controlled circuit. And during the travel of the head 13a along the transfer bar, the change has been accomplished by proportional increments in movement of the head 13a and contact bar 7a in the direction of the contact adjustment, because the transfer bar forms a straight line from the adjusted head 18a to the adjusted head 19a. This direct proportional movement enables the designer to base the constants of the controlled circuits and parts on such proportional movement of transfer; and these constants will affect the result obtained in the lighting circuit upon proportional movement of the adjustable element. For example, the size of wire or spacing of the turns in different portions of the resistive conductor controlled by the adjustable contact bar 7c may be varied to secure a desired change in lighting intensity based on a proportional change of movement of the adjustable element. It is obvious that the rate of change in passing from scene 1 to scene 2 will depend upon how quickly or how slowly the transfer shaft 6 is turned and this may be varied to suit the desired timing of the transition.

Having now passed from scene 1 to scene 2, the pivot plate 33 may be made ineffective which removes any effect of set-up handle 3a on the slider 18. This permits this handle to be adjusted to the condition required for scene 4. Pivot plate 33d is now made effective by turning shaft 37d and cam 36d. This causes lever 39 to adjust slider 18 and head 18a to a position corresponding to the adjustment of set-up handle 3c which was assumed to be set to give a half-bright illumination for scene 3, the same as for scene 2. This results in the transfer bar 17 being adjusted to a vertical position at about half-way between extreme positions. When the shift is made from scene 2 to scene 3 by turning the transfer shaft clockwise, the head 13a will move up along the then vertically positioned transfer bar and no change will be made in the controlled circuit. This permits pivot plate 33c to be made ineffective and releases handle 3b to be set as desired for another scene. Being now on scene 3 with a half-bright condition of the circuit, it may be assumed that handle 3a has been set for scene 4, say at full-bright. Pivot plate 33a is then made effective by turning shaft 37a and cam 36a. This permits slider 19 and head 19a to take the inner limiting position and causes the transfer bar to incline from a half-bright position of

scene 3 to the left for a full-bright position of scene 4. The shift from scene 3 to scene 4 is made by turning transfer shaft 6 counter-clockwise, permitting the head 13a to travel down the transfer bar and gradually move inwardly to the all-resistance-out and full bright position for scene 4.

The apparatus thus affords means for making the set-ups for successive scenes and as each scene is completed, the set-up for that scene is released for a set-up for another scene. Also in passing from one scene to the next, the change may be made from the existing scene controlled by any one set-up handle to a scene controlled by any other set-up handle in any order desired by merely making effective the adjustment of the end of the transfer bar which is not then affecting an existing scene to accord with the adjustment of the set-up handle for the next scene. In this adjustment of the end of the transfer bar which is to determine the next scene, the operator makes effective that lever which actuates the slider acting on that end of the transfer bar. That is, as already explained, each set-up handle moves two levers, one of which is utilized for adjusting the slider affecting one end of the transfer bar and the other of which is used for adjusting the slider affecting the other end of the bar. The actual adjustment of the desired slider is accomplished by making effective the lever which actuates that slider. For example, if in the existing scene the resistive unit is in the upper position as shown in Fig. 1, then for the next scene the slider affecting the lower end of the contact bar must be adjusted by making effective one of the levers which actuates that slider. This, as already explained, is accomplished by actuating the proper shaft and cam for making the selected lever effective. Any number of set-up handles and associated parts may be used in addition to the three handles shown which would, of course, permit a greater number of set-ups for future scenes where the character of the installation required such additional set-ups for facilitating the operation.

The independent adjustment of the resistive unit is accomplished by the handle 4a; and this is arranged to be utilized without disturbing the set-up handles from their positions as adjusted for a required performance. The disk 4 is provided with an eccentric or cam 27, follower 28 and push bar 29, the same as the set-up handles. The inner end of its bar 29 is pivotally connected to a lever 40 having side plates 32b similar to the other levers, these plates slidably embracing a fixed pivot plate 41 supported by the block 35. The lower end of lever 40 is provided with an extension 40a which extends in a direction away from the plate 1 so as to come opposite the pin 26a of tail piece 26 when the latter is in its straight-line position, as shown in Fig. 2. With the parts in the position shown in Fig. 1, the apparatus is subject to actuation determined by the set-up handles in the manner already explained. But when the knob 5 is moved to its forward position and shifts the plate 23 to its upper position, as shown in Fig. 2, the tail pieces 21 and 22 are shifted out of the path of the ends of the levers actuated by the set-up handles so as to render them ineffective in adjusting the transfer bar. This shifting also brings the tail piece 26 and its pin 26a opposite the extension 40a of the plate 40. The resistive unit can now be adjusted independently by the handle 4a to any position desired for control of the lighting circuit affected by this panel, the parts assuming positions and being operated as previously described. This facility for securing independent control is accomplished without in any way disturbing the set-up handles, or levers actuated thereby, or the setting of the pivots of these levers. When it is desired to revert to the operation of the apparatus for the scheduled scene production, the knob 5 is moved inwardly and locked in its inner position which shifts the plate 23 back to the position of Fig. 1, throwing the independent tail piece 26 out of effective action and the set-up tail pieces 21 and 22 into action for the resumption of scene productions.

Fig. 11 shows a front view of an assembled board formed by the stacking of a number of the panels already described side by side, thereby securing the control of a number of individual circuits. Any desired number of these panels may be assembled depending upon the number of circuits to be controlled. The front edge of the set-up disks 2 are shown in the upper part of Fig. 11, there being an upper row made up of seven set-up disks of the seven panels for seven individual circuits. These seven panels forming the board are designated at the top of Fig. 11 as panels P1 to P7. The handles of the upper row of set-ups are designated by the character 3a, corresponding with the designations used with reference to Fig. 1. The next row of set-ups similarly have their handles designated with the character 3b; and the third row of set-ups have their handles designated by the character 3c.

In order to prepare for the production of a series of scenes of different lighting effects, as by the control of circuits having different colored lamps and for securing different degrees of lighting by the different circuits appropriately selected for the different scenes, the set-up handles are adjusted to conform with the desired scenic effects. For example, referring to Fig. 11, the upper row of set-ups is shown with their handles 3a in different relative positions, those of panels P1, P2 being down for no illumination by their circuits, those of panels P3, P4, P5 and P7 being at half-bright positions, while the handle of panel P6 is in its upper position for enabling full illumination by its circuit. These positions determine the lighting effect for the first scene. For the next scene, the second row of set-up handles 3b is adjusted and it is assumed for this scene that the circuits of panels P1, P2, P4, P6 and P7 are to give a half-bright condition while the circuits of panels P3 and P5 are to give full illumination. For the third scene the third row of handles 3c is set-up for the results desired in the third scene and for this purpose set-up handle 3c of panel P1 is adjusted for half-bright, set-up handles 3c of panels P2, P4 and P5 are adjusted for full illumination, handle 3c of P3 is adjusted for no illumination, while the handle of panel P6 is adjusted for one-quarter-bright and that of panel P7 is adjusted for three-quarters-bright. The set-up handles are now adjusted for securing the lighting effects desired in three sequential scenes. If additional panels were added to the board of Fig. 11 for additional lighting circuits, the set-up handles thereof would be adjusted in the manner already described for the lighting effects to be produced by such additional circuits in the different scenes.

In assembling the panels forming the complete board, the shafts 37 to 37e which render the pivots of the levers effective or ineffective are extended back of each panel and form com-

mon shafts which enable or disable the respective pivots of the levers. Thus the cam shafts **37** to **37***e* shown in Figs. 1 and 6 are extended back of the panels to form common shafts for the respective enabling or disabling of the pivot plates **33** to **33***e* of each panel. These shafts are shown in Fig. 11 extended out through the left side of the control board and have crank handles **42** fixed to their ends so that the shafts may be individually turned as desired. The transfer shaft **6** likewise extends along the board below the plates **1** of the panels and forms a common shaft for simultaneously turning the cams **6***a* of all of the panels. This shaft **6** is shown at the left in Fig. 11 provided with a crank handle **43**. Each panel with the parts carried thereby is individually attached to a suitable supporting frame so as to be separately removable therefrom for inspection and repair; and the through shafts do not pass through the panel plates thereby permitting individual removal of the plates. The through shafts are suitably supported by the frame.

The set-up handles having been set up for the three sequential scenes, it may be assumed that all of the handles **42** have been turned to a position where all of the pivots of the levers are disabled. For producing scene **1** the handle of shaft **37** is turned for rendering the pivot plate **33** effective, this position being shown in Fig. 1. This action results in adjusting all of the sliders **18** of all of the panels to a position corresponding to the setting of the upper row of set-up handles of the control board in the manner already explained. This results in the resistive units of each of the panels being adjusted to give the lighting effect by the various circuits as predetermined by the upper row of set-up handles, it being assumed that the slidable plates **12** of each panel is held in its upper position by the cams **6***a* of the transfer shaft **6**.

In preparation for passing to scene **2**, the shaft **37***c* is turned by its handle to cause the pivot plates **33***c* of all the panels to become effective. This causes the levers controlled by the second row of set-up handles to adjust the position of the slider **19** of each panel to correspond with the setting of the second row of set-up handles. When the time arrives to change from scene **1** to scene **2**, the transfer shaft **6** is turned counter-clockwise by the crank handle **43**, shown in Fig. 11, which causes the resistive units of all the panels to be transferred from the position shown in Fig. 1 to a position where the heads **13***a* are opposite the heads **19***a* of the sliders **19**. This transfer of the units by the shaft from one position to the other may be done gradually and slowly with the result that the individual control circuits are changed from their conditions as determined by the upper row of set-up handles to a condition as determined by the adjustment of the handles of the second row of set-ups. Furthermore the sliding of the resistive units from the position shown in Fig. 1 to their lowest position results in an initiation of the control of all affected circuits at the same time and a gradual change throughout the transfer from their initial condition of scene **1** to their condition of scene **2**, at which all circuits arrive at the same time. This in general merges the relative lighting effect of the circuits of scene **1** gradually into the relative lighting effects of scene **2**. Reference to Fig. 11 shows the effects on the different circuits in passing from scene **1** to scene **2**. The circuit of panel P1 in scene **1** was at black-out and in scene **2** that circuit was half-bright; therefore this circuit gradually changes from a condition of no illumination to a half-bright condition in shifting from scene **1** to scene **2**. The same change occurred in the circuit of panel P2. The change in panel P3 was gradual from half-bright to full-bright. As to panel P4 the circuit was set-up for half-bright in both scene **1** and scene **2** and therefore the transfer caused no change in this circuit from the first scene to the next. The change by panel P5 was from half-bright to full illumination. The change by panel P6 was from full illumination to half-bright, while that of panel P7 was unchanged.

As soon as the transfer shaft handle has been shifted to the position for scene **2**, the shaft **37** is turned to a position so as to render all of the pivots **33** ineffective. This permits the upper row of set-up handles to be adjusted again, if desired, for scene **4**. As the disabling of the pivots **33** released the lower ends of the levers **32** from the sliders **18** of all the panels, the shaft **37***d* may now be turned to render the pivot plates **33***d* effective. As these plates actuate the pivots of the set-up levers **39**, the lower ends of such levers are caused to engage the pins **21***a* and adjust the sliders **18** of each panel according to the requirements predetermined by the setting of the third row of set-up handles. The apparatus is now in a condition to change from the existing scene **2** to scene **3**; and when the time arrives for such change, the transfer shaft **6** is turned in a clockwise direction and moves all of the resistive units from their lowest position gradually to their upper position shown in Fig. 1. The transition from scene **2** to scene **3** as thus accomplished, gives the gradual control of all the circuits from the condition of scene **2** to the condition of scene **3** in the same manner described with reference to the merging from scence **1** to scene **2**. The shaft **37***c* may now be turned to disable the pivots **33***c* which permits the second row of set-up handles to be reset for another scene. It should be noted that the transfer does not prevent the movement of the set-ups, and such movement during transfer results in a new position of the resistor controller as modified by the transfer action.

Assuming now that the upper row of set-up handles have in the meantime been reset for the fourth scene, the shaft **37***a* is turned to render the pivots **33***a* effective which readjusts the sliders **18** of all the panels in accordance with the new setting of the first row of set-up handles for scene **4**. When it is time to shift from scene **3** to scene **4**, the transfer shaft **6** is turned counter-clockwise to move the control units gradually from the position shown in Fig. 1 to their lowest position which results in a gradual change from the lighting effects of scene **3** to the lighting effects of scene **4** in the manner already described.

It will thus be understood that any desired lighting effects may be secured by first adjusting the set-up handles, then enabling and disabling the pivots of the levers in proper sequence and then turning the transfer shaft from one extreme position to the other giving a gradual and corresponding merging of all the affected circuits from their initial condition of one scene to that of the next scene. Any desired number of rows of additional set-ups may be added where it is desirable to have them in order to set-up for a sufficient number of scenes to avoid delay in the preparation of the set-ups when it is

desired to pass from one scene to the next. It will be understood that instead of passing from one scene to the next from the top row of set-ups down and then to the top row again, the change of scenes may be accomplished by passing from any existing scene controlled by one row of set-ups to another scene controlled by any other row of set-ups. Thus if the scene is on the upper row of set-ups and secured by control of the sliders 18, the change may be made to the condition controlled by the third row of set-ups by turning the shaft 37e and thereby render the pivots 33e effective in controlling the setting of the sliders 19. When the resistive units are shifted by the transfer shaft from the position shown in Fig. 1 to their lowest position, the scene will be gradually changed from that obtained by the setting of the upper row of set-ups to that obtained by the setting of the third row of set-ups. It is thus obvious that passage may be obtained from any selected scene to any other selected scene by operation of the proper shaft affecting the pivots of the next desired scene. In making the change from any one scene to the next, it will be appreciated that if the existing scene is accomplished by one set of sliders, say 18, then in passing to the next scene, a shaft of the pivot points must be selected which will cause sliders 19 to be adjusted for the desired next scene; and conversely if an existing scene is controlled by the sliders 19, then in passing to the next scene a shaft of the pivot points which will adjust the sliders 18 must be selected.

Another mode of operation of this apparatus is the obtaining of what may be termed pile-on which may be desirable for securing certain lighting effects. For example, assume the condition shown in Fig. 1 with the lighting effects determined by the setting of the upper row of set-ups of Fig. 11. The pivots 33 are then effective in adjusting the sliders 18 for obtaining the desired conditions. If now another set of pivots be made effective which will affect the sliders 18, the set-up which would result in the most advanced position of the sliders 18 will determine the result. This is called the predominate setting; and the respective circuits will be affected according to which of the set-ups predominate. For example, assume that the set-ups are adjusted as explained with reference to Fig. 11, and that the scene determined by the upper row of set-ups is the existing scene. Now assume that pivots 33b are made effective by turning the shaft 37b while the transfer shaft is unchanged in position. The result will be that the predominating set-up of the two upper rows of set-ups will determine the effect on the respective circuits. That is, the control of the circuits of panels P4, P6 and P7 will not be affected by the enabling action of the shaft 37b because in each case the set-up in the upper row predominates or is equal to that of the second row. However, the circuits of panels P1 and P2 will be brought from no illumination to half-bright, while those of P3 and P5 will be changed from half-bright to full-bright, as the set-ups of the second row predominate.

A further result may be accomplished by the disabling of the pivot 33 controlling the levers of the upper row of set-ups. Under these conditions the withdrawal of the lower ends of the levers 32 from actuation of the sliders 18 permits the levers 38, as influenced by the second row of set-ups, to become fully effective. Thus the condition of the circuits as determined by the second row of set-ups is derived from the combination determined by the two upper rows of set-ups by withdrawing the influence of the upper row of set-ups. In the same way, when the resistive units are at their lower position various combined effects and changes may be obtained by making effective or ineffective the levers which influence the sliders 19, as determined by the setting of the respective set-ups. It is therefore apparent that, aside from the control obtained by the operation of the transfer bar, additional controls may be obtained, depending upon the setting of the set-ups and the selection of the pivot points which are made effective and that a graduated transition from one condition to another may be made by slowly turning the shafts which affect the respective pivot points.

The means for obtaining separate independent control of any circuit of any panel without disturbing the previous setting of the set-ups has already been described. The knobs 5 for changing to the independent control, one for each panel, are shown in Fig. 11.

Master operation of the various individual circuit controllers will now be described. This is additional to that already described and is desirable in certain scenes for gradually dimming the lighting of the existing scene from the initial condition of each affected circuit to a final condition of no illumination, or to any intermediate condition of lighting. The gradual brightening of the lamps of the active circuits may then be accomplished by reversing the movement of the master and in these changes of illumination, the relative intensities of the lamps of the active circuits will be maintained. Provision is also made for enabling and disabling the control of any circuit by any selected master, as well as cross control, pile-on control and other desirable manipulations.

Referring to Figs. 1 and 6, there are shown six shafts 44 to 44e which are the master shafts. They extend back of the individual panels and permit the panels to be individually removed without disturbing these shafts which are suitably journaled in the main frame. Each of the master shafts have fixed thereto a series of cams which are the master cams, there being one cam on each shaft for each of the panels comprising the complete board or section of a complete board, where the board is made up of a number of sections. The cams on the shafts for the panel shown in Figs. 1 and 6 are designated 45 to 45e. The upper master cam 45 is shown engaging a lever 46 which is pivoted at 47; and the front end of the lever is turned downwardly and has a projection 48 extending inwardly towards plate 1 so as to engage the side of the push rod 29, as shown in Fig. 6. The lever 46 is pivotally mounted at 47 upon one end of another lever 49 which in turn is pivotally mounted at its elbow 50. This is a fixed pivot on a supporting bracket 51 which is fixed to the plate 1 and extends from near the top of the plate to about its middle portion. The upper end of the lever 49 is pivotally connected to a push rod 52 which extends forwardly through the front portion 1a of the panel and is provided with a knob 53 at its front end. The underside of the rod 52 is notched to engage the portion 1a of the panel in its inner and outer positions. When rod 52 is locked in its inner positions, as shown in Fig. 1, the pivot 47 is fixed. Under this condition turning of the master shaft 44 and its cam 45 counter-clockwise will turn lever 46 on its pivot and cause the extension 48 of the

lever to force the push rod 29 downwardly against the tension of spring 31. However, when the push rod 52 is locked in its outer position, the pivot 47 is raised by the lever 49 causing the rear end of the lever 46 to move up and away from the path of the cam 45. The turning of the master shaft then has no effect upon the lever 46 or upon the movement of the push rod 29. It is by this means that the master is enabled or disabled in its effect upon movement of the rod 29.

Similar parts 46*a* to 53*a* corresponding to those just described are provided also to actuate the upper push rod 29 by the master shaft 44*a* and cam 45*a*. The lever 46*a* is shorter than the lever 46 and the cam 45*a* is proportioned to actuate the push rod 29 the same amount as by the cam 45. Similarly a pair of levers 46*b* and 46*c* are provided to actuate the push rod 29 that is affected by set-up handle 3*b*, the parts being proportioned to actuate this rod 29 the same amount as the upper rod 29 is actuated by its levers. Similar parts are designated 44*b* to 53*c* which correspond to those already described and operate in the same way. Likewise a pair of levers 46*d* and 46*e* are provided to actuate the push rod 29 that is affected by the set-up handle 3*c*; and parts corresponding to the upper set previously described are designated 44*d* to 53*e*.

When any one of the master shafts is turned counter-clockwise its cams will actuate the levers of the different panels and cause the push rods 29 of the different panels to be moved from the position shown in Fig. 1 about their pivots 29*a* and the front end of the push rods will travel down the back surface of the cam followers 28 to positions opposite the pivots of the followers 28, provided the knobs 53 are in positions to enable the masters. This has the effect of changing the control of the circuits of the different panels from their existing condition to a condition of no illumination when the proper master shaft is operated, or to a partial dimming if the master is turned only a portion of its full movement. And this dimming commences at the same time in all the affected circuits from their initial condition and continues simultaneously to the condition of no illumination for all of the affected circuits at the end of full movement of the master shaft. It follows that the relative intensities of illumination of the affected circuits is maintained approximately during the dimming by the masters. When the master shafts are turned in the reverse direction the illumination by the circuits is brought gradually to their initial condition because the springs 31 cause the rods 29 to be maintained in contact with the ends of the master levers as they are withdrawn.

Specific examples may be considered by reference to Fig. 1. Here the handle 3*a* is down and has pushed its rod 29 to cause the resistive unit to assume the resistance-all-in position to cause no illumination. When the master shaft 44 is turned counter-clockwise and is properly enabled, the projection 48 moves the push rod 29 about its pivot 29*a* to a position opposite the pivot 28*a* of the follower. As the back edge of the follower 28 is vertical and the pivot 29*a* is opposite the middle of the follower 28, there is no appreciable movement of the rod 29 endwise, which results in no change of adjustment of the circuit which remains at a condition of no illumination. The same results would occur if the master shaft 44*a* were turned. Now consider the circuit as affected by the handle 3*b*. This is at the half-bright position and if the scene of this set-up were on, then the turning of master shaft 44*b* or 44*c* would move the front end of the rod 29 of this set-up from the position shown to a position opposite the pivot 28*a*. In this movement the rod 29 is gradually forced rearwardly and turns the lever 33*a* slidably on its pivot plate 33*c* and adjusts the resistive unit from a half-bright position to a position of no illumination. A similar change would occur for the set-up of the handle 3*c* upon turning either of the master shafts 44*d* or 44*e*, provided that scene was on, as the handle 3*c* is shown set at the half-bright position.

Reference to Fig. 11 will show the specific change in the lighting effects which takes place when the masters are operated in any selected scene. Assume that the aforementioned scene 1 is on the upper row of set-ups, with the circuits of panels P1 and P2 giving no illumination, those of panels P3, P4, P5 and P7 being at half-bright and that of panel P6 being at full-bright. The operation of either master shaft 44 or 44*a* will bring all of these circuits from their initial condition gradually and simultaneously to a condition of no illumination. The reversing of the master shaft will bring them back gradually and simultaneously to their initial condition. Obviously the master shaft may be turned only sufficiently to bring the circuits to any intermediate condition of partial illumination in either direction. In case any other scene is on, the turning of the proper master shaft will similarly affect the existing scene, the scene of the second row of set-ups being subject to either master shaft 44*b* or 44*c*, and the scene of the third row of set-ups being subject to either master shaft 44*d* or 44*e*.

In some cases, in the use of the masters, it is desired to dim the lights of certain of the circuits while permitting others to remain unchanged at their existing condition in a scene. The circuit of any panel may be removed from the influence of any master by means of the enabling and disabling rods and knobs 53 to 53*e* already described. For example, in scene 1 on the upper row of set-ups, assume it is desired to keep the circuit of panel P6 at full-bright while the master is affecting all the other circuits of the remaining panels; then by pulling out the disabling rod 52 of panel P6 and locking it in its outer position, the circuit of that panel will not be affected by the master shaft 44. If it is the master shaft 44*a* which is to be operated, then the rod 52*a* is placed in disabling position. In this way any selected circuit or circuits may be relieved from the influence of any master in any selected scene at any time.

By the use of two master shafts, such as 44 and 44*a* for each set-up, additional changes may be obtained. For example, assume the parts in the position shown in Fig. 1 and that certain of the rods 52 of some of the panels are moved to enabling position while the others remain in disabling position, then the turning of shaft 44 will, as already explained, cause the dimming of the lights of the affected circuits. Now assume that the rods 52*a* corresponding to the rods 52 in enabling position are likewise placed in enabling position and that certain additional rods 52*a* are also placed in enabling position. Now the turning of master shaft 44*a* from its initial position will have no effect on the circuits whose controllers have been moved to dim portion by the master shaft 44 but will cause the additional circuits affected by master shafts 44*a* to be con-

trolled to dim the lights. If now the first operated master shaft 44 be turned back from its full dim position, no change results because the cams 45a on shaft 44a will maintain the controllers previously affected by the shaft 44 in their dim position. When the shaft 44a is turned back to its initial position, it will cause the controllers to brighten the lamps of the circuits originally affected by the operation of the shaft 44 as well as to brighten the lamps of the additional circuits whose controllers were affected by the shaft 43a. This method of operation has first caused the dimming of the lamps of some of the circuits from their initial condition, then dimming of the lamps of additional circuits from their initial condition and then the brightening of the lamps of all of the controlled circuits to their original condition. If, however, the master shaft 44 had initially been turned to a position of partial dimming, the result would have been to first bring the lamps of certain circuits to partial dimming, then the lamps of such circuits and of additional circuits to black-out and then finally bring all of the circuits back to their initial condition before the operation of the master shafts.

In a similar manner, by the enabling and disabling of the levers actuated by the cams on the pair of master shafts, various lighting effects may be obtained by modification of an existing scene, as determined by the enabling or disabling of the levers actuated by the cams of the respective shafts and the mode of operation of the two master shafts. The method of control by first moving the controllers of certain circuits to dim by one master, then additional controllers by the other master and then withdrawing the first master secures pile-on scene control by the masters, the results depending upon which controllers are affected by the enabling of the levers actuated by the two master shafts.

Another method of control obtained because of the provision of double masters for each scene is known as cross control. This is accomplished by first moving by one master shaft certain of the controllers of some of the panels to dim as determined by the enabling means and then operating the other master shaft to dim the lamps of its selected circuits as determined by the enabling means while at the same time the first master shaft is returned to its initial position for the purpose of brightening the lamps which were originally dimmed. That is, by reverse movement of the master shafts, one set of lamp circuits may be caused to dim their lamps while another set of lamp circuits are caused to increase the intensity of the lamps.

A further method of operating the masters relates to the use of different rows of set-ups resulting in scene pile-on control and cross control, as well as other accomplishments. For example, assume the parts in the position shown in Fig. 1 with the additional assumption that the enabling shaft 37d is turned to make the pivot plate 33d effective. This, as already explained gives a scene which is the combination of the results obtained by the setting of the upper row of set-ups and the third row of set-ups. Each of the masters of the upper row of set-ups and of the third row of set-ups may be operated in the manner already described for control of their circuits but additional results may be obtained by the relative operation of the master shafts of the upper row of set-ups and of the shafts of the third row of set-ups. For example, cross control may be obtained by operating either one of the upper pair of master shafts and either one of the third pair of master shafts, turning one master shaft in one direction while the other is being turned in the opposite direction, or both shafts of one pair may be turned in one direction while both shafts of the other pair are turned in the opposite direction. The results obtained will depend upon the adjustment of the set-ups in the upper and third rows and upon which levers actuated by each cam are enabled or disabled. Likewise scene pile-on may be obtained by turning one or both of the shafts of the upper pair to a dimming position, then operating one or both shafts of the third pair to a dimming position and then reversing the movement of the first pair. The results obviously will depend upon the condition of the set-ups and which levers are enabled or disabled. These and other methods of operation may be applied to any row or rows of set-ups and to any of the master shafts.

The master shafts are subject to a superimposed operation by a grand master; and the relationship is made such that any master shaft may be made selectively operative by the grand master. This is accomplished by providing enabling and disabling means for rendering the grand master effective or ineffective in actuating the master shafts. Moreover, the parts are so constructed and related that when the grand master is operated, the master shafts affected will be moved simultaneously and gradually from their then existing positions, whether at full-bright, half-bright, or any other position, to full dim position, or to any other position, and thereby maintain approximately the same relative relationship of the masters during the dimming process. Likewise when the grand master is reversed in its movement, the affected masters will be brought simultaneously and gradually to their initial positions while maintaining approximately their relative relationship during the brightening operaton. In general these results are accomplished in a manner similar to that by which the master shafts affected the circuits subjected to their influence and as determined by the set-ups, which has already been described.

The means for operating the master shafts and their operation by the grand masters are shown in Figs. 9, 10 and 11. Referring to Figs. 9 and 10, the master shafts 44 to 44e already described, are shown journaled in a vertically extending plate 54 located at the right portion of the main board. Each master has an arm extending upwardly therefrom indicated by the characters 55 to 55e. A push rod 56 to 56e is pivotally connected to the end of each of these arms which extend toward the front of the board and engage, at their ends, followers 57. These parts are displaced laterally from each other, as shown in Fig. 10, in order to provide room for the various parts. On the rear of the front master panel is supported a series of vertically extending plates 58 to 58e which are displaced sidewise and provide means for respectively supporting the followers 57, these followers being respectively supported at their lower ends by pivots 59. The front ends of the push bars 56 to 56e are guided in slots provided by strips 60 at the rear of each supporting plate, these strips being spaced from their respective plates to provide slots for receiving the front ends of the push rods and which also serve as stops to limit their movement in a vertical direction. Springs 61 tend to hold the front ends of the push rods in their upper limiting positions.

Mounted on each of the plates 58 to 58e is a cam 62 provided with an operating handle, these handles being designated by the characters 63 to 63e. The handles extend through slots in the front of the master panel, as shown in Figs. 9 and 11. Each of the cams 62 engages the upper end of its respective follower and when the master handles 63 to 63e are in their upper positions, as shown, the upper ends of the followers and the push rods are in their limiting forward positions. When any one of these handles is moved downwardly, it causes its respective cam to move its follower and push rod rearwardly and thereby turn its master shaft counter-clockwise. This, as already explained, serves to actuate the parts to cause a dimming of the lights of any circuit affected by the master. The reverse movement of any master handle causes an increase in the illumination of the circuits affected by the master in the manner already explained. The master handles 63 to 63e thus afford means for individually actuating each of the master shafts.

The grand master handle 64 is pivotally mounted at the base of the master panel and a link 65 is pivotally connected to the arm of the handle and extends rearwardly through the panel and is pivotally connected at its rear end to an arm 66 fixed to a shaft 66a which extends through to additional boards similar to the one shown. This shaft is journaled in the plate 54 and has a rearwardly extending arm 66b fixed thereto and slotted at 66c. On the opposite side of the supporting plate 54 from the lever 66 and rearwardly from the plate is mounted a vertically movable rod 67 which is guided by brackets 67a extending rearwardly from the plate 54. The lower end of the rod 67 carries a pin 67b which extends sidewise through a slot in the plate 54 and into the slot 66a of the lever 66. It is evident that when the master handle 64 is moved inwardly from the position shown in Fig. 9, it will turn the shaft 66a and raise the rod 67 from the position shown to its upper position. The rod 67 is provided with six sidewise extensions 68 to 68e which have upturned ends which respectively engage the rear ends of pivoted levers 69 to 69e. These levers are pivotally mounted on the rear ends of right-angle levers 70 to 70e which in turn are pivotally mounted on the ends of studs 71 to 71e which extend sidewise from the plate 54 except the stud 71d which extends sidewise from the end plate 72 of the board. To the upper ends of the levers 70 to 70e are pivotally connected push rods 73 to 73e. These rods extend forwardly through the front of the master panel and are provided with knobs 74 to 74e at their front ends. These push rods are adapted to be locked in their forward and rearward limiting positions by notches on their lower edges which engage the front master panel in the same way as the previously described push rods 52 to 52e. When the knobs 74 to 74e are in their rearward position, as shown in Fig. 9, the levers 70 to 70e form fixed pivots for the levers 69 to 69e. Under this condition, the raising of the rod 67 by movement of the grand master handle will cause the extensions 68 to 68e from the rod 67 to raise the rear ends of the levers 69 to 69e. The front ends of these levers are provided with extensions 75 to 75e which respectively engage the upper edges or sides of the push rods 56 to 56e. Consequently, when the grand master is moved to raise the rod 67, it will cause the levers 69 to 69e to move the forward portions of the rods 56 to 56e downwardly from the position shown in Fig. 9. This downward movement causes the front ends of these rods to travel down along the backs of the followers 57 to a limiting position opposite the pivots 59. However, when the knobs 74 to 74e which are the enabling and disabling knobs for the masters, are moved to their forward position, the levers 70 to 70e are rotated about their fixed pivots and raise the pivot points of the levers 69 to 69e away from engagement by the extensions 68 to 68e. Under such condition, the movement of the grand master will have no effect upon any of the masters.

The various results obtained by the operation of the grand master and its effect upon the individual masters may be understood by considering first the effect upon one of the masters, such as that operated by the handle 63. In the position shown in Fig. 9 the handle 63 is in its upper position and consequently its master shaft 44 is in the position shown in Fig. 1 and has not affected the scene controlled by the upper row of set-ups. If, however, the enabling knob 74 is in the position shown in Fig. 9 and the grand master handle is moved to raise the rod 67, then the push rod 56 will be moved from the position shown in Fig. 9 and as its front end travels down the back of the follower 57, the master shaft 44 will be turned gradually counter-clockwise. This, as previously explained, will cause the push rods 29 of the upper row of set-ups to move down the back of the followers 28 and cause the dimming of the lamps of the existing scene affected by the upper row of set-ups, as regards the panels which are rendered effective by the enabling knobs 53. The moving of the grand master and rod 67 in the reverse direction will permit the push 56 to travel up the back of the follower 57 by action of its spring 61 and thereby bring the circuits affected by the upper master to their initial conditions which, of course, may be full-bright or any intermediate condition, depending upon the adjustments of the upper row of set-ups, as already explained. Suppose, however, before movement of the grand master from the position shown in Fig. 9, the master handle 63 had been moved downward to an intermediate position. This would have caused the push rod 56 to have been moved rearwardly a corresponding amount and cause the partial dimming of the circuits affected by the master shaft 44. Under this condition, the movement of the grand master to raise the shaft 67 will, as already described, move the front end of the push rod 56 downwardly from the position shown in Fig. 9 along the back of the follower. This results in the grand master causing a dimming of the lamps affected by the master shaft 44 from the assumed intermediate condition to the condition of no illumination; and this dimming by the grand master commences when the front end of the push rod 56 is in its uppermost position and continues until it arrives opposite the pivot 59.

The operation of the grand master will affect any of the other master shafts in the same manner, the enabling and disabling rods 73 and 73e affording means for selecting which of the master shafts are to be affected by the grand master. In case two or more master shafts are operated by the grand master, and the master handles are in different relative positions, the operation of the grand master will always maintain the relative conditions determined by the setting

of the master handles during a dimming or during a brightening direction of movement of the grand master. This is due to the fact that the grand master moves the front ends of the push rods **56** to **56***e* over their full range of movement, regardless of the particular setting of the master handles. The grand master and parts affected thereby thus afford means for selective operation of any of the master shafts in any desired combination and maintain the relationship as determined by the setting of the master handles during movement of the grand master in either direction.

It will be understood that where additional boards similar to that described are used, the master shaft **66***a* will be extended through each of the additional boards and serve to actuate the master shafts of the additional boards in the same manner as described with reference to the board shown; and by the enabling and disabling means already described, any master shaft of any of the boards may be actuated by the grand master selectively as may be desired.

Although a single grand master handle has been described for actuating the push rods **56** to **56***e*, it is evident that another grand master handle and operating means could be applied to the push rods **56** to **56***e* in the same manner that a pair of master shafts and levers are shown applied to the push rods **29** of the set-ups, in case such additional operating means were desired for special purposes.

Although masters have been described for affecting the circuits of the different set-ups selectively, as may be desired, the means for adjusting the circuit controlling devices independently by means of the handles **4***a* may likewise be subjected to actuation by a master. Thus in Fig. 1, the independent handle **4***a* is provided with a cam and follower for moving its push rod **29** in the same way that the set-up handles are furnished with similar means. Consequently there may be applied, if desired, to the push rods **29** of the independent handles the same pair of master shafts and levers with enabling and disabling means as are shown and described with reference to the set-up handles. Such addition would be a duplication of that described as applied to the set-up handles which would operate in the same manner to selectively actuate the push rods **29** of the independent handles. This means is omitted from the drawings for the sake of clearness.

It will be understood from the foregoing that the disclosed apparatus is capable of many and varied adjustments and may be operated in many different ways for securing particular results as may be desired in special instances. Although one embodiment of the invention has been described, it is capable of being embodied in various forms of apparatus and various relationship of parts without departing from the scope of the invention.

I claim:

1. Apparatus for controlling an adjustable device for affecting a circuit, comprising a series of more than two set-up handles, a guiding element, each of said handles being adjustable independently of the others for selecting any desired adjustments of said element to any adjustment between limits of movement of said device, mechanical means related to said handles and said element for adjusting said element to correspond with any selected position of each of said handles, and mechanical means for gradually shifting said device from the adjustment determined by one of said handles to the selected adjustment determined by any one of the other of said handles.

2. Apparatus for controlling an adjustable device for affecting a circuit, comprising a plurality of set-up handles, a guiding element, each of said handles being adjustable for selecting any desired adjustments of said element to any adjustment between limits of movement of said device, mechanical means related to said handles and said element for adjusting said element to corespond with any selected position of each of said handles, mechanical means for gradually shifting said device from the adjustment determined by one of said handles to the selected adjustment determined by another of said handles, and means for selectively rendering portions of said first named mechanical means effective or ineffective for determining the adjusted position of said element to correspond with the selected adjustment of any one of said handles.

3. Apparatus for controlling an adjustable device for affecting a circuit, comprising a plurality of set-up handles, a guiding element each of said handles being adjustable for selecting any desired adjustments of said element to any adjustment between limits of movement of said device, mechanical means related to said handles and said element for adjusting said element to correspond with any selected position of each of said handles, mechanical means for gradually shifting said device from the adjustment determined by one of said handles to the selected adjustment determined by another of said handles, and means comprising a lever having a shiftable pivot selectively rendering portions of said first named mechanical means effective or ineffective for determining the adjusted position of said element to correspond with the selected adjustment of any one of said handles.

4. Apparatus for controlling an adjustable device for affecting a circuit, comprising a series of more than two set-up handles for determining desired adjustments of said device corresponding to the position of said handles respectively, a mechanical guide adjusted at different portions thereof by movement of said handles, and means for shifting said device along said guide from a position corresponding to one of said adjusted portions determined by one of said handles to a position corresponding to another of said adjusted portions determined by any one of the other of said handles for obtaining a gradual adjustment of said device from its first position to its second position.

5. Apparatus for controlling an adjustable device for affecting a circuit, comprising a plurality of set-up handles for determining desired adjustments of said device, a mechanical guide adjustable at different portions thereof, mechanical means between said handles and said guide for adjusting different portions of said guide according to the position of said handles, adjustable means affecting said mechanical means for selectively rendering same effective or ineffective in adjusting different portions of said guide, and means for shifting said device along said guide from a position corresponding to one of said adjusted portions to a position corresponding to another adjusted portion for obtaining gradual adjustment of said device from one position to another.

6. Apparatus for controlling an adjustable de-

vice for affecting a circuit, comprising a plurality of set-up handles for determining desired sequential adjustments of said device, mechanical means related to said handles and said device for gradually adjusting said device from a condition determined by one of said handles to a condition determined by another of said handles, and means for rendering said mechanical means ineffective while preserving the set-up of said handles and for enabling independent adjustment of said device.

7. Apparatus for controlling an adjustable device for affecting a circuit, comprising a plurality of set-up handles for determining desired sequential adjustments of said device, mechanical means related to said handles and said device for gradually adjusting said device from a condition determined by one of said handles to a condition determined by another of said handles, means for independently adjusting said device, and means for rendering said mechanical means ineffective while preserving the set-up of said handles and for enabling said independent adjustment of said device and for also rendering said independent adjusting means ineffective while rendering said mechanical means effective for adjustment of said device.

8. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuit respectively, comprising a series of more than two set-up handles for each of said devices respectively, mechanical means related to said handles and their respective devices for gradually adjusting said devices from a condition determined by certain of their respective handles to a condition determined by any other of their respective handles, and a single element for actuating said means.

9. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively, and mechanical means related to said handles and their respective devices for gradually and simultaneously adjusting said devices from a condition determined by certain of their respective handles to a condition determined by any other of their respective handles.

10. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively, mechanical means related to said handles and their respective devices for gradually and simultaneously adjusting said devices from a condition determined by certain of their respective handles to a condition determined by other of their respective handles, and means for selectively rendering portions of said mechanical means effective or ineffective for determining the adjusted positions of said devices to correspond with the positions of their respective selected handles.

11. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their said circuits respectively, comprising a plurality of set-up handles for each of said devices respectively, mechanical means related to said handles and their respective devices for gradually adjusting said devices from a condition determined by certain of their respective handles to a condition determined by other of their respective handles, means for independently adjusting each of said devices, and means for rendering said mechanical means ineffective while preserving the set-up of said handles and for enabling said independent adjustment of said devices and for also rendering said independent adjusting means ineffective while rendering said mechanical means effective for adjustment of said devices.

12. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively, a mechanical guide related to each of said devices respectively adjusted at different portions thereof by movement of said handles, and means for simultaneously shifting said devices along their respective guides from their position corresponding to the adjusted portions by certain of said respective handles to a position corresponding to other adjusted portions by any other of said respective handles for obtaining gradual adjustment of said devices from one position to the other.

13. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively, a mechanical guide related to each of said devices respectively adjusted at different portions thereof by movement of said handles, means for simultaneously shifting said devices along their respective guides from their position corresponding to the adjusted portions by certain of said respective handles to a position corresponding to other adjusted portions by other of said respective handles for obtaining gradual adjustment of said devices from one position to the other, and means for selectively rendering the adjustment of said guides by said handles effective or ineffective for determining the adjusted position of each of said devices to correspond with the positions of selected handles of each of said devices.

14. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively, a handle for independent adjustment of each of said devices respectively, a mechanical guide relates to each of said devices respectively adjusted at different portions thereof by movement of said set-up handles, means for simultaneously shifting said devices along their respective guides from their position corresponding to the adjusted portions by certain of said respective set-up handles to a position corresponding to other adjusted portions by other of said respective set-up handles for obtaining gradual adjustment of said devices from one position to the other, and means for disabling the adjustment by movement of said set-up handles while preserving the set-up of said set-up handles and for enabling the adjustment of each of said devices by said handles for independent adjustment.

15. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, and master

means operatively related to intermediate portions of said intermediate mechanical means for simultaneously moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said handles.

16. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, and master means operatively related to intermediate portions of said intermediate mechanical means for simultaneously and proportionally moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said handles.

17. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, and master means operatively related to intermediate portions of said intermediate mechanical means for simultaneously and proportionally moving said devices from their various positions as determined by adjustment of said handles to a common uniform position independently of movement of said handles.

18. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, and master means operatively related to intermediate portions of said intermediate mechanical means for simultaneously and proportionally moving said devices from their various positions as determined by adjustment of said handles to different desired positions and for returning said devices simultaneously and proportionally to their initial positions independently of movement of said handles.

19. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means operatively related to intermediate portions of said intermediate mechanical means for simultaneously moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said handles, and means for selectively disabling said devices from movement by said master means.

20. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, intermediate mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means operatively related to intermediate portions of said intermediate mechanical means for simultaneously and proportionally moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said handles, and means for selectively disabling said devices from movement by said master means.

21. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for indivdually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, mechanical means related to each of said plurality of set-up handles and their respective devices for gradually and simultaneously adjusting said devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, and master means for simultaneously moving said devices from their various positions as determined by adjustment of said set-up handles in each of said conditions to different desired positions independently of movement of said set-up handles.

22. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, mechanical means related to each of said plurality of set-up handles and their respective devices for gradually and simultaneously adjusting said devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, master means for simultaneously moving said devices from their various positions as determined by adjustment of said set-up handles in each of said conditions to different desired positions independently of movement of said set-up handles, and means for selectively disabling said devices from movement by said master means.

23. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, a handle for independent adjustment of each of said devices respectively, mechanical means related to each of said set-up handles and each of said devices respectively for gradually and individually adjusting the respective devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, means for disabling said mechanical means while preserving the set-up of said set-up handles and for enabling the adjustment of said devices by said handles for independent adjustment respectively, and master means for simultaneously moving said devices from their various positions as determined by said set-up handles to

different desired positions independently of movement of said set-up handles.

24. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, a handle for independent adjustment of each of said devices respectively, mechanical means related to each of said set-up handles and each of said devices respectively for gradually and individually adjusting the respective devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, means for disabling said mechanical means while preserving the set-up of said set-up handles and for enabling the adjustment of said devices by said handles for independent adjustment respectively, master means for simultaneously moving said devices from their various positions as determined by said set-up handles to different desired positions independently of movement of said set-up handles, and means for selectively disabling said devices from movement by said master means.

25. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means for simultaneously moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously moving said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, and means for selectively disabling said devices from movement by each of said master means.

26. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, mechanical means related to each of said plurality of set-up handles and their respective devices for gradually and simultaneously adjusting said devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, master means for simultaneously moving said devices from their various positions as determined by adjustment of said set-up handles in each of said conditions to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously moving said devices from their various positions as determined by adjustment of said set-up handles in each of said conditions to different desired positions independently of movement of said set-up handles, and means for selectively disabling said devices from movement by each of said master means.

27. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively, a handle for independent adjustment of each of said devices respectively, mechanical means related to each of said set-up handles and each of said devices respectively for gradually and individually adjusting the respective devices from a condition determined by certain of said set-up handles to a condition determined by other of said set-up handles, means for disabling said mechanical means while preserving the set-up of said set-up handles and for enabling the adjustment of said devices by said handles for independent adjustment respectively, master means for simultaneously moving said devices from their various positions as determined by said set-up handles to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously moving said devices from their various positions as determined by adjustment of said set-up handles in each of said conditions to different desired positions independently of movement of said set-up handles, and means for selectively disabling said devices from movement by each of said master means.

28. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively, mechanical means for each of said series respectively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, and means for simultaneously transferring the adjustments of said devices from one of said series of combinations to any other of said series of combinations.

29. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively mechanical means for each of said series respectively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, and means for simultaneously and proportionally transferring the adjustments of said devices from one of said series of combinations to any other of said series of combinations.

30. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively mechanical means for each of said series respec-

tively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, means for simultaneously transferring the adjustments of said devices from one of said series of combinations to any other of said series of combinations, and master means for simultaneously moving said devices from each of their positions in said different series to different desired positions independently of movement of said set-up handles.

31. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a series of more than two set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively mechanical means for each of said series respectively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, means for simultaneously transferring the adjustments of said devices from one of said series of combinations to any other of said series of combinations, and master means for simultaneously and proportionally moving said devices from each of their positions in said different series to different desired positions independently of movement of said set-up handles.

32. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively mechanical means for each of said series respectively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, means for simultaneously transferring the adjustments of said devices from one of said series of combinations to another of said series of combinations, master means for simultaneously moving said devices from each of their positions in said different series to different desired positions independently of movement of said set-up handles, and means for selectively disabling any of said devices from movement by said master means in any of said series of combinations.

33. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising a plurality of set-up handles for each of said devices respectively for determining desired sequential adjustments of each of said devices respectively in successive series of combinations, a guiding element for each of said devices respectively mechanical means for each of said series respectively for adjusting said elements in accordance with the adjustments of said set-up handles in the different series, means for simultaneously transferring the adjustments of said devices from one of said series of combinations to another of said series of combinations, master means for simultaneously moving said devices from each of their positions in said different series to different desired positions independently of movement of said set-up handles, additional master means for simultaneously moving said devices from each of their positions in said different series to different desired positions independently of movement of said set-up handles, and means for selectively disabling any of said devices from movement by either of said master means in any of said series of combinations.

34. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means for simultaneously moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, and grand master means for simultaneously moving said master means.

35. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means for simultaneously and proportionally moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously and proportionally moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, and grand master means for simultaneously and proportionally moving said master means.

36. Apparatus for controlling a plurality of separately adjustable circuit controlling devices for individually affecting their circuits respectively, comprising an adjustable handle for each of said devices respectively, mechanical means related to each of said handles and each of said devices respectively for gradually and individually adjusting the respective devices upon movement of said handles, master means for simultaneously moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, additional independently operable master means for simultaneously moving certain of said devices from their various positions as determined by adjustment of said handles to different desired positions independently of movement of said set-up handles, grand master means for simultaneously moving said master means, and means for selectively disabling said master means from movement by said grand master means.

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