April 17, 1956 L. VOSS 2,742,593

DIMMING PROVISIONS APPLICABLE TO MULTI-CIRCUIT LIGHTING SYSTEMS

Filed July 20, 1953 2 Sheets-Sheet 1

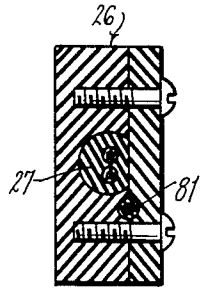


FIG. 3.

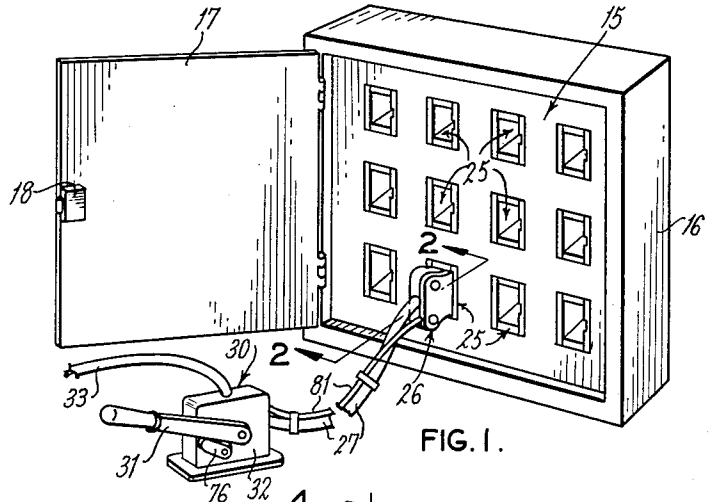


FIG. 1.

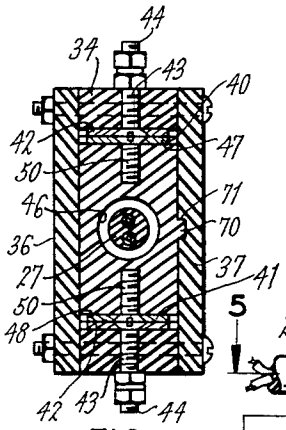


FIG. 4.

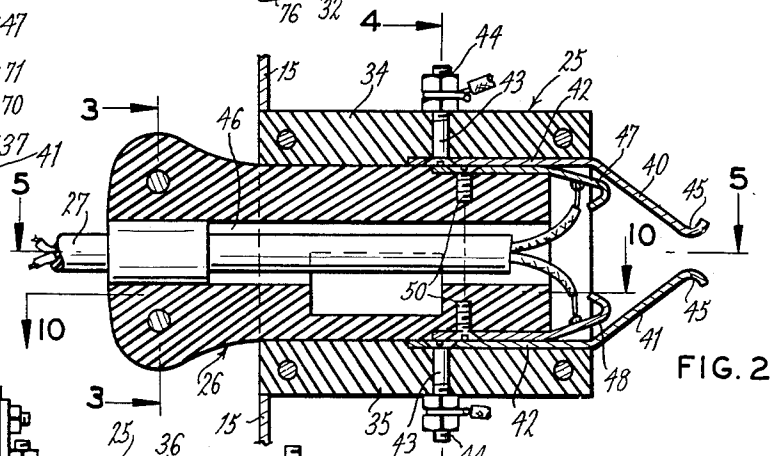


FIG. 2.

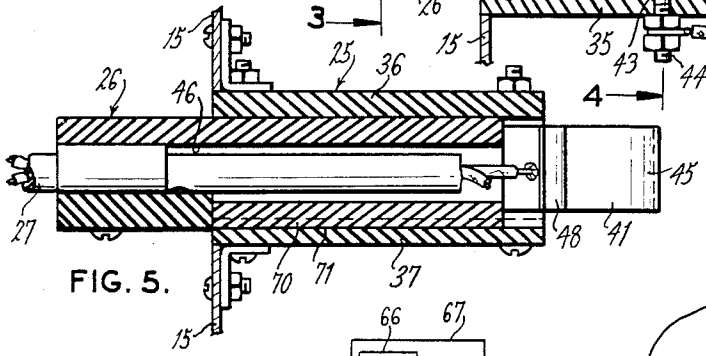


FIG. 5.

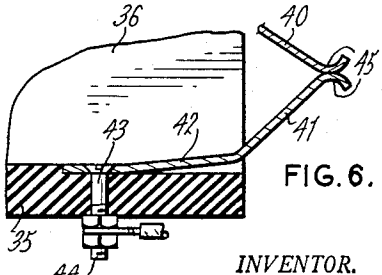


FIG. 6.

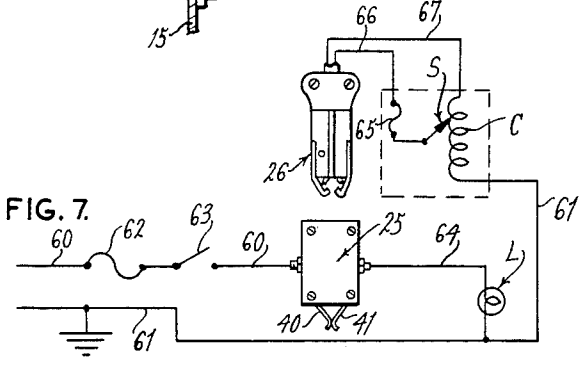


FIG. 7.

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DIMMING PROVISIONS APPLICABLE TO MULTI-CIRCUIT LIGHTING SYSTEMS

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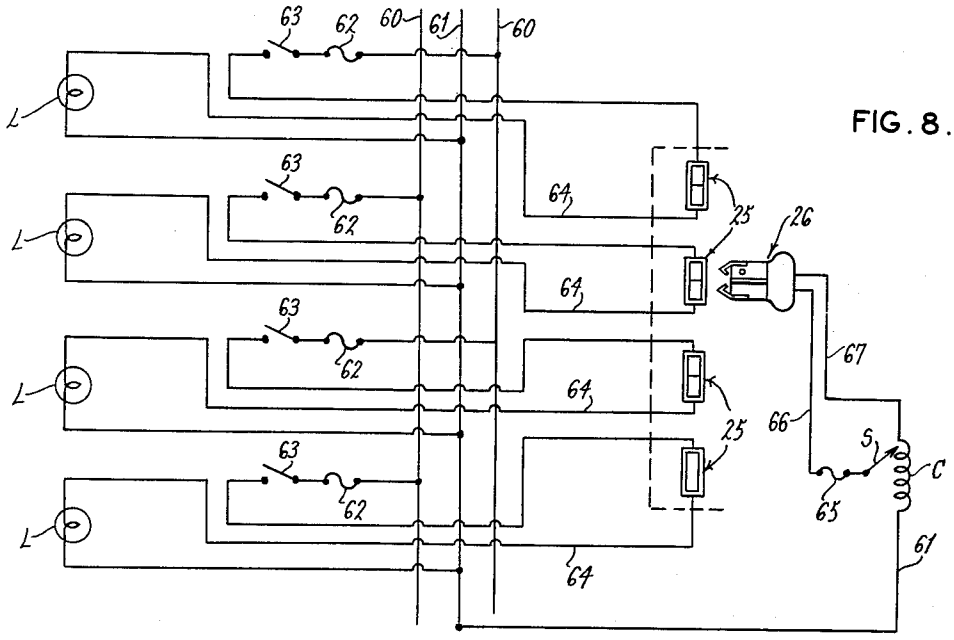


FIG. 8.

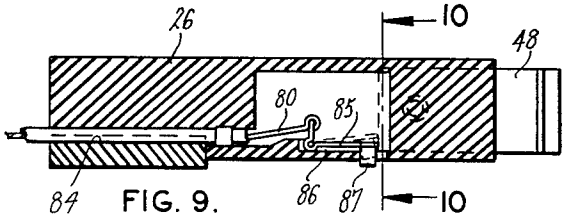


FIG. 9.

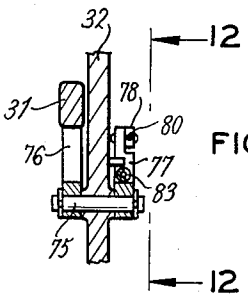


FIG. 11.

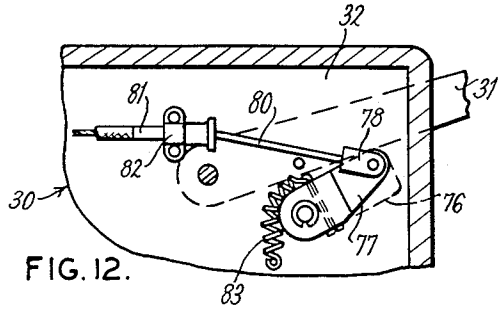


FIG. 12.

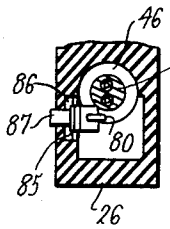


FIG. 10.

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United States Patent Office 2,742,593 Patented Apr. 17, 1956

2,742,593

DIMMING PROVISIONS APPLICABLE TO MULTI-CIRCUIT LIGHTING SYSTEMS

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Application July 20, 1953, Serial No. 368,856

4 Claims. (Cl. 315—254)

This invention relates to dimming provisions applicable to multi-circuit lighting systems, and more particularly to an improved highly simplified arrangement enabling any selected one of a plurality of lighting circuits to be subjected at will, to dimming influence, particularly by a "floating" dimmer arrangement, hereinafter defined.

The use of dimming equipment in auditorium and theatrical lighting systems is, per se, old and well known. For many years all such systems were thought to require a dimmer unit permanently wired into any given stage, house or auditorium circuit desired to be subjected to dimming effects; for example, in stage and auditorium installations, the dimming circuits were permanently wired into border lights, house lights, foot lights and floor pockets. It was accordingly impossible to use the dimmer thus fixedly associated with an individual circuit, for any other lighting load which it may have been desired to dim.

More recently, the innovation of interconnecting and "patch" panels introduced a desired flexibility into controlboards by allowing the connection of any stage or house circuit to any control board circuit. However, it is noted that the expense of installing dimmers has not been reduced; for the dimmers are still inflexibly wired to controlboard circuits, which means that an installation of dimmers involves the installation of all parts of a theater controlboard and the discarding of existing panelboard switches and fuses or circuit breakers.

In smaller installations it is often impossible within the limits of fixed appropriations or other funds to provide theater controlboard facilities. This is particularly the case of public and other schools, wherein a survey by this applicant covering a number of such institutions, reveals woefully inadequate provisions of desirable circuit controls, and particularly dimming controls suitable for amateur theatricals and other scholastic stage events.

Patent No. 2,200,682, Runkel, introduced the notion of a floating dimmer, but did not work out a simple, inexpensive installation. To introduce a dimmer into a circuit by the Runkel system requires a special switch, which, of course, increases complexity of operation, and makes necessary the discarding of existing panelboard switches.

It is accordingly a major and general objective of the present improvements to realize a simple, low-cost system for the general field of usage aforesaid, in which there is utilized a floating dimmer arrangement, by which is meant facilities enabling the use of one or any dimmer unit in any selected load circuit of the school, auditorium or theater installation. Dimmer equipment may thus be originally provided as a single unit, and additional dimmer units added from time to time within the scope of the funds available for such purpose or to care for any increase in number of load circuits or enlargement of facilities, as required. It is contemplated that the present improvements may be installed adjunctively to existing panelboards (with their switches and fuses or circuit breakers) without necessarily disturbing

same, but solely by the use of additional relatively inexpensive and easily installed equipment for dimming purposes.

A further highly important objective, realized in the present improvements, consists in the provision of a floating dimmer arrangement in which a given dimmer may be applied to or removed from any load circuit in such manner that no interruption or even "blinking" of such circuit is evidenced by the introduction or removal of the dimmer, nor by any switching of the dimmer connections.

Yet another object of importance is realized in a marked circuit simplification by reason of the floating dimmer assembly to be described, in comparison with the investment required by reason of number of conductors, weight of copper, labor of installation, etc. in the case of systems providing dimming circuits partly or wholly distinct from those normal load circuits utilized under conditions when the dimmer is not in service.

A still further object of the invention is realized in a novel, entirely safe, two-part connector for use with a floating dimmer, and through the use of which the dimmer may be quickly, conveniently and safely interposed in or removed from any selected load circuit, entirely with a single uni-directional movement, and without any specific training or skill of the degree sometimes required in the operation of conventional more elaborate dimming and switching control boards or panels.

A valuable additional object, embodied in an optional accessory, is realized in improved interlock provisions particularly applicable to dimmers of auto transformer type, in coaction with the plug and receptacle connectors of a floating dimmer system, and utilized to preclude localized overvoltage conditions sometimes otherwise occurring when the dimmer control knob or handle is in other than a predetermined position when the dimmer is connected into the load circuit.

The foregoing and numerous other objects and advantages will more clearly appear from the following detailed description of a presently preferred embodiment, particularly when considered in connection with the accompanying drawing, in which:

Fig. 1 is an isometric view showing the face portion of a panel containing a plurality of receptacles, one serving each of the lighting circuits desired at times to be dimmed, Fig. 1 also showing one of the floating dimmer assemblies connected into a lighting load circuit through one of the panel receptacles;

Fig. 2 is an enlarged sectional view taken in a vertical plane through one of the plug and receptacle assemblies of a dimmer connector embodying the present improvements, Fig. 2 being located by line 2—2 of Fig. 1;

Fig. 3 is a transverse vertical sectional view taken along line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken transversely of the plug and receptacle assembly with the parts cooperatively connected, and located by line 4—4 of Fig. 2;

Fig. 5 is a horizontal sectional view taken longitudinally of the plug and receptacle assembly of Fig. 2, and located by line 5—5 of Fig. 2;

Fig. 6 is a fragmentary sectional view similar to that of Fig. 2, but showing the receptacle contacts in shorting relation, as when the plug is removed from the receptacle;

Fig. 7 is a circuit diagram showing the relation of conductors, reactance dimmer, plug and receptacle, in one of the load circuits;

Fig. 8 is a circuit diagram embracing an aggroupment of four individual load circuits and indicating the circuit relation of same to the panel of Fig. 1, in order better to show the facility for interposing an individual floating

dimmer unit in any load circuit of a system embodying a plurality of such circuits;

Fig. 9 is a fragmentary horizontal section through the right hand wall portion of a somewhat modified form of plug, embodying an interlock provision between the plug and dimmer;

Fig. 10 is a fragmentary vertical sectional view as taken along line **10—10** of Fig. 9;

Fig. 11 is a vertical sectional view through a front wall member of a dimmer case, showing certain of the interlock actuating elements serving to correlate the position of the plug with respect to the receptacle, and in relation to the position of the dimmer control handle, and

Fig. 12 is a fragmentary elevational view of a portion of the front wall of the dimmer casing, as viewed from the inside of the wall, and located by line **12—12** of Fig. 11; each of Figs. 9, 10, 11 and 12 illustrating an optional interlock provision for the purpose described.

In the following description as well as in the claims, the term "auditorium" is employed in a broad and generic sense, as covering any gathering place, whether outdoors or indoors, utilizing a plurality of lighting load circuits, and wherein for any esthetic, display or other reason, it is desired selectively to subject the lighting circuits to dimming control.

It is conventional in theatre installations, in certain school and other auditoriums, sometimes also in churches, night clubs, and other public gathering places, to provide a centralized control panel carrying switching means, which may be conventional, serving the several load circuits, together with fuses and perhaps other control equipment.

One example of a low cost, compact panel is indicated generally at **15**, showing the panel as enclosed in the cabinet **16** preferably provided with the door **17** and latch-lock unit **18**, the door and lock preventing unauthorized access to the panel and to the receptacles to be described.

Any suitable plurality of receptacles, individually generally designated at **25**, are mounted, by preference in flush relation, in the panel **15**. Each of the receptacles **25** is adapted cooperatively to receive a companion plug generally designated at **26**, the plug being connected through a duplex cable **27** to a dimmer generally indicated at **30**.

The dimmer **30** may be of resistance or reactance type, although by great preference is preferably of the latter character, so-called reactance or auto-transformer dimmers possessing well known advantages requiring no present discussion. The dimmer includes a dimming control which may consist of a knob or as shown, a handle **31**, and an enclosing casing, the front wall of which is indicated at **32**. In the case of a reactance dimmer, a single grounding conductor is provided and indicated at **33**.

Each of the receptacles **25** consists of a hollow open end tubular body and is preferably of rectangular section, comprising a top wall element **34**, a bottom wall **35** and side wall elements **36** and **37**. Such elements need not all be separate, as some of them may be combined in a suitable molded plastic receptacle body. In any event the wall portions of the receptacle should be of a material having at least reasonably high dielectric properties.

Each receptacle **25** is provided partly internally thereof, with a pair of fixed contacts preferred to be of spring copper, hence of some resilience, and shown as formed of a strip material, one such contact being indicated at **40** and a companion contact at **41**. Each of the paired contacts **40—41** includes a substantially planar portion **42** to which is connected a terminal screw **43** providing a binding post **44** externally of the receptacle. Somewhat inwardly, i. e. rearwardly of the panel and extended rearwardly off the body of the receptacle, are more sharply convergent leg portions of the elements **40—41**, terminating near their free ends in rounded, normally engaging, shorting contact portions **45**.

The receptacle described may be considered as one part

or element of a two part connector, the other part of which is a companion plug readily insertable in and removable from the receptacle. The plug, generally designated at **26**, is preferably of a section conforming substantially to the bore within the receptacle **25** so as to be readily slidable therein with working clearance. The plug is preferably formed of an insulating or dielectric material and is provided with an internal longitudinal bore **46** for the accommodation of a duplex conductor **27**, the leads of which project from the bore for connection to spaced plug contacts **47—48**. These are formed similarly to the elements **40** and **41** of the receptacle, and are provided with converging free ends, substantially as shown by Fig. 2, the strip contacts **47—48** being secured to the body of the plug **26** as by screws **50**.

The relation between the length of plug, the length of the plug contacts, and that of the receptacle contacts, and the location of these paired cooperating members in respect to each other are such that as the plug **26** starts to enter the receptacle **25**, the contacts **47** and **48** will respectively engage the contacts **40** and **41** prior to any action of the plug in separating these same contacts. It will be noted from Fig. **6** that the contacts **40—41** converge slightly within the bore of the plug. Due to this arrangement, a definite preliminary inward movement of the plug will occur prior to engagement of these sloping portions, by the plug contacts. When this occurs, the contacts **40—41** are opened, but distinctly in sequence to the first electrical interposition of the dimmer in the load circuit, one leg of which is normally closed, in the absence of the dimmer plug, through the shorted contacts **40—41**.

Upon withdrawal of the plug the reverse sequence of events results first in the resumption of a shorting relation through the receptacle, specifically through contacts **40—41**, so that that leg of the load circuit in which contacts **40—41** are located, is definitely completed therethrough, prior to electrical removal of the dimmer and dimmer plug from such leg of the circuit.

The proportions of the plug and receptacle, and the locations of their contacts, are such that the plug contacts are safely within the receptacle before controls are made, thus protecting the operator. The sizes of the plug and receptacle are varied according to capacities, thus safeguarding equipment.

Considering now the circuit relation of the dimmer and dimmer plug to the load circuit optionally served thereby, reference is made to Fig. 7, wherein a conductor **60** represents a hot line and **61** a neutral or grounded leg of a two wire circuit. The leg **60** is shown diagrammatically as provided with a fuse or other circuit protective device indicated at **62**, and a switch shown at **63**. A conductor **64** continues the hot leg of this two wire circuit, to the lighting load L. The grounded or neutral leg **61** is connected to an end terminal of a coil C of the dimmer, the latter acted upon by the slide S connected through a fuse **65**, thence via wire **66** to one of the plugs **26**. A conductor **67** is connected to the opposite end of the coil C of the auto transformer serving as the dimmer.

From the foregoing it will have appeared that under normal off and on switching conditions not requiring brightness control of the given lighting load, two legs of the circuit serve the load L through elements **60**, **62**, **63**, contacts **40—41** and wire **64**, thence through the neutral leg **61**. This circuit prevails when the plug **26** is withdrawn from the receptacle **25**. When, however, the plug is fully inserted in the receptacle, full dimming control is available since the hot leg of this circuit proceeds via wire **60**, contact **40**, one of the plug contacts, conductor **67** to the coil, slide S, fuse **65** through the opposite plug contact thence to contact **41** and conductor **64**, to the illuminants L.

In Fig. 8 is shown a plurality of the circuits similar to or identical with those of Fig. 7, but better depicting

the facilities and advantages of the floating dimmer arrangement in a multi-circuit system. Each of the several load and dimming circuits bearing similar reference characters in Fig. 8, a description of one such circuit will suffice for all, it being noted that in Fig. 8, showing the usual three wire system providing selectively for 120 v.–240 v. connections, each of the outside or hot lines is designated at **60** for better correlation with Fig. 7, while the center or neutral wire is indicated at **61**. The reference numerals otherwise correspond to those of Fig. 7.

It should be noted as a preference to provide the plug **26**, for example centrally and longitudinally of its right hand wall, with a guide rib **70** operating in a conforming slot **71** therefor presented as a channel in the right hand wall **37** of the receptacle. Thus the plug is not only guided smoothly into and out of the receptacle, but the noted relation of the parts compels insertion of the plug always in the same definite relation to the receptacle. This provides an arrangement sometimes referred to as a polarized connector.

It should further be noted that the circuit arrangement described, together with the construction of the plug and cooperating receptacle are such that, upon application of the dimmer to, or its removal from the load circuit, no blinking, interruption, or other disturbance of lighting intensity will result, as is sometimes the case in installations wherein a separate double-throw switch or the like is employed to place the dimmer into the circuit. This important advantage of the present system results from the complete electrical interposition of the dimmer in the hot side of the load circuit, prior to any interruption of either leg of the load circuit, as for example might occur in case the contacts **40—41** were opened ahead of the time of engagement of these elements by the plug contacts. Further, with the use of a reactance dimmer, the steps of gradation of lighting intensity incident to dimming either up or down, are virtually infinite in number, this being an inherent advantage of this type of dimming equipment. It is of course true that switch **63** which normally will remain closed, may be opened and closed at will, this switch being usually an item of the conventional lighting panel, but not normally requiring actuation incident to dimmer insertion.

By reason of the preferred usage of an auto transformer type of dimmer, it is advisable to protect this unit with a fuse or circuit breaker, such as indicated diagrammatically at **65**. This provision is indicated inasmuch as the dimmer unit can be shorted if the slide S is at any point other than full-on as the plug **26** is being inserted or being withdrawn from the receptacle **25**, assuming the switch **63** to be closed. Such shorting may occur when the dimmer slide is in other positions, since full 120 v. potential may be impressed on both sides of the plug for a brief instant upon insertion of the plug, prior to separation of the receptacle contacts **40—41**. Similarly, upon withdrawal of the plug, this condition may obtain for an instant after contacts **40—41** resume closed positions. Thus under the noted conditions in the absence of a protective device, the subjection of the slide and one end of the auto transformer coil to the 120 volt potential, may short the unit.

As an optional and accessory provision, entirely additive to the structure and features above described, there may be provided an automatic interlock between the dimmer and the plug **26**, serving to prevent insertion of the plug to a depth in the receptacle to result in contact, by correlating the plug with a predetermined position of the dimmer control handle such as **31**.

This interlock provision is shown in one simplified mechanical form by Figs. 9, 10, 11 and 12. The front wall **32** of the case is provided with a short rock shaft **75** to which is secured an arm **76**, adapted for engagement by the dimmer handle **31** when the latter is in or close to its full-up position. The opposite end of the shaft **75** carries an arm **77** to which is pivotally connected an eye

element **78** bonded to a small cable element **80** of one of the usual control cable assemblies, the sheath over most of the length of which is indicated at **81** and is positioned as by clips **82**. A return spring **83** acts against the arm **77**, to which one end of the spring is fastened, the other end of this tension element being anchored to a fixed pin.

The control cable extends across and interiorly of the front wall **32** of the dimmer case, thence outwardly as indicated in Fig. 1, into the plug **26**, the connections within which are best shown by Fig. 9. Fig. 9 may be considered as a horizontal section through a portion of the plug, and includes a small bore **84** for the control cable whence the forward end of the slidable wire element **80** is connected to a small bell crank lever **85** set into a recess **86** in the plug. The opposite somewhat longer end of the lever **85** carries a barrier, shown as a plunger **87**. It will appear from Figs. 9 and 12 that the plunger **87** will normally be extended from the side of the plug under the influence of the spring **83** and the cable, but that when the dimmer handle is in the full-up position substantially as shown by Fig. 1, the plunger **87** will be retracted so that it does not project from the plug.

It will now have become obvious that when the dimmer handle and slide are positioned in such manner that no shorting can occur through the dimmer, the plug may be freely inserted in the selected receptacle, but that at other times, the plunger **87** will prevent such insertion. The arrangement is by preference such that it is always possible to depress the plunger **87** by hand, provided it is desired to insert the plug (for example with the switch **63** open) with the dimmer slide and handle in intermediate positions, as may be sometimes desired. It is of course contemplated that such interlock may take the form of a simple solenoid or other electrical interlock (not shown).

It is felt that the various functional results obtainable by the floating dimmer as described, having been referred to in the course of description of the parts and their circuit relation, will have revealed the operation as fully apparent. It will further have appeared that the structure and arrangement described will serve fully to realize each of the several objectives above enumerated, and others expressed and implied in the more extended description.

Although the invention has been described by detailed reference to a single preferred embodiment, the detail of description should be understood solely in an informative, rather than in any restrictive sense, numerous variants being possible within the fair scope of the claims hereunto appended.

I claim as my invention:

1. In a lighting system for an auditorium, theatre or the like, a plurality of separately controllable load circuits, each of the load circuits having paired conductors constituting the opposite legs of such load circuit, a dimmer including a coil and a slide, switching means in one leg of the load circuit and normally located in series therewith, and including normally engaged, paired, series contacts, and a pair of contacts respectively connected to the coil and slide of the dimmer, an over current protective means interposed in the circuit between said dimmer slide and its said connected contact, the last said pair of contacts being movable into and out of engagement with the series contacts to separate same and interpose the dimmer in and selectively to remove the dimmer from the same leg of the circuit.

2. In a lighting system for an auditorium, theatre or the like, a plurality of separately controllable load circuits, each characterized by paired conductors constituting opposite legs of the circuit, one of said legs constituting a grounded or neutral leg and a companion conductor constituting a hot line side of the load circuit, a protective device and a switch in the hot line side of each load circuit, a receptacle having paired, normally engaged,

shorting contacts normally located in series in the hot line side of the load circuit between said switch and the load, a dimmer of auto transformer type, including a winding, one terminal of said winding having direct connection to ground, a movable member or slide, coacting with said winding for the interposition of variable reactance values in the load circuit, for the purpose of selectively dimming the lighting load served thereby, a two-pole polarized plug coacting with the receptacle as a quick-detachable connector and switching device, one of the terminals of said plug being connected to the slide element of the dimmer, a circuit protective device between the last said plug terminal and the slide, and another terminal of the plug being connected directly to the end of said dimmer winding opposite to its said grounded end, the plug effecting in sequence, electrical connection of its terminal to said shorting contacts, and thereafter acting to separate the shorting contacts.

3. In a system of light circuit controls, a light circuit, a controllable dimmer of reactance type, provided with a control member, a two-part shorting connector, one part of which is normally in the lighting circuit and the companion part in circuit with the dimmer, and an interlock device conditioned by the dimmer control member, for selectively rendering the connector operative and inoperative in accordance with the position of the dimmer control member.

4. In a system of light circuit controls, a light circuit, a controllable dimmer provided with a manual control member, a two-part shorting connector, one part of which is normally in the lighting circuit, and the companion part in circuit with the dimmer, a retractable barrier carried by one of said parts of the connector in a location normally preventing the application of the two connector parts into operative assembly, a reciprocable member on the dimmer and located in one extreme of the path of movement of the dimmer control member for actuation thereby, and a connection between the retractable barrier and said reciprocal member enabling the retraction of the barrier to provide for completion of connection between the parts of the connector when, but only when, the dimmer control member is in a predetermined position.

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