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PATCHING SYSTEMS

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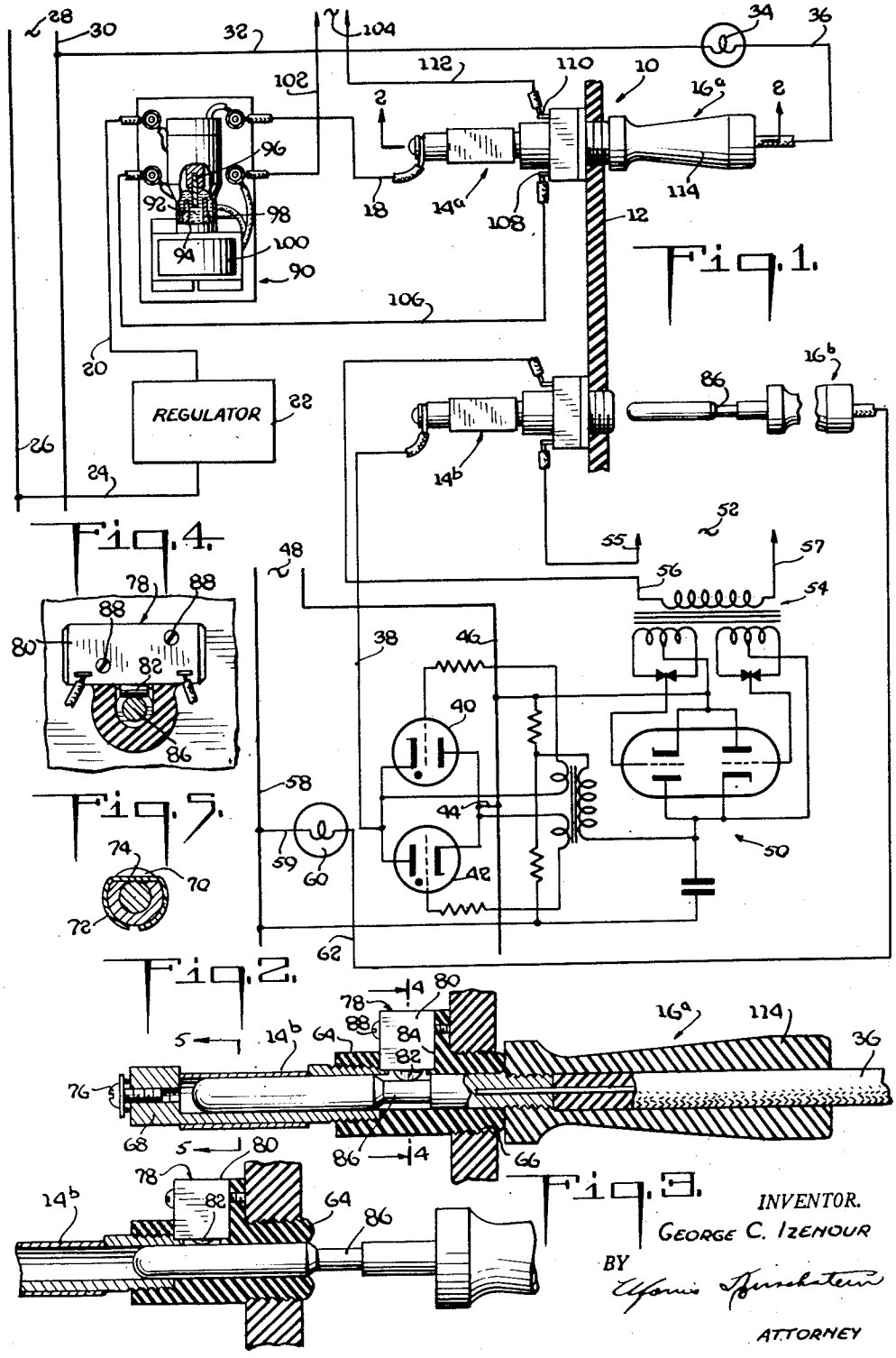


Fig. 1.

Fig. 4.

Fig. 5.

Fig. 2.

Fig. 3.

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PATCHING SYSTEMS

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This invention relates to patching systems.

A patching system comprises a support, e. g. a panel, having a plurality of jacks each of which is connected, usually through a control device of some sort, to a source of power. The system further includes a plurality of plugs which are individually connected to different loads, usually lighting loads. When it is desired to energize a given load in a predetermined manner, as with the aid of some specific voltage regulator, the plug associated with that load is inserted in, i. e. "patched" to, the jack corresponding to the selected type of voltage regulation.

Patching systems are characterized by the fact that the jacks are "hot," i. e. are at operating voltage when no plugs are coupled therewith, so that immediately upon the insertion of a plug voltage will be applied to the load.

In existing patching systems when a plug is inserted in a jack sparking occurs as contact is made. Moreover, when the plug is withdrawn from the jack an arc flashes across the separating electrical contacts.

It is an object of my invention to provide a patching system which avoids the difficulties of hot patching arising from the presence of voltage on the jack at the time of coupling or uncoupling.

It is another object of my invention to provide a patching system of the character described which neither sparks upon coupling of the jack and plug nor arcs when they are uncoupled.

It is a further object of my invention to provide a patching system of the character described which requires less maintenance and is less dangerous to personnel than a hot patching system.

Other objects of my invention will in part be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of construction, combinations of elements and arrangements of parts which will be exemplified in the device hereinafter described and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which is shown one of the various possible embodiments of my invention,

Fig. 1 is a sectional view through a patching panel constructed in accordance with the present invention and schematically showing typical associated electric circuits;

Fig. 2 is an enlarged sectional view taken substantially along the line 2—2 of Fig. 1, the same illustrating the plug and jack in fully coupled position;

Fig. 3 is a view similar to Fig. 2, but illustrating the plug and jack as they appear when interengaged but not fully coupled; and

Figs. 4 and 5 are sectional views taken substantially along the lines 4—4 and 5—5, respectively, of Fig. 2.

In general I carry out my invention by providing a plug that is connected to an electric load, e. g. a lamp load, and a jack that is connected to a power source, e. g. a voltage regulator. Combined with the plug and jack is a secondary control means physically affiliated with the jack and governing the operation of a remotely thrown primary switch, e. g. a mechanical or electronic relay, in

the power circuit to the jack whereby operation of the remotely thrown switch is a function of the coupling of the plug and jack, the remotely thrown switch de-energizing the jack when the plug is in the jack but is not fully coupled therewith.

Referring now in detail to the drawings, the reference numeral **10** denotes a cold patching system constructed in accordance with my invention. Said system includes a panel **12** of insulating material which supports a plurality of jacks, only two of which **14***a*, **14***b* are shown here. Each jack is adapted to have a plug, two of which **16***a*, **16***b* are illustrated, coupled therewith.

In a typical installation embodying my invention all of the jacks may be connected to different voltage regulators of the same general type. However, to show the flexibility of the system I have illustrated the jack **14***a* associated with one type of voltage regulator and the jack **14***b* associated with a different type of voltage regulator. My invention, however, operates in essentially the same fashion regardless of the type of voltage regulation.

More specifically, the upper jack **14***a* in Fig. 1 is connected by a pair of lead lines **18**, **20** to a voltage regulator **22** that is fed through a lead line **24** from one bus **26** of a source **28** of power. The other bus **30** is connected by a lead line **32** to a lamp load schematically indicated by a lamp symbol **34** which is connected by a lead line **36** to the plug **16***a*. By way of example the regulator **22** constitutes a rheostat. It is customary for more than one jack to be connected to each regulator.

It will be seen that if the lead lines **18**, **20** were permanently joined the load **34** would be activated as soon as the plug **16***a* was inserted in the jack **14***a*. This arrangement obviously would be subject to all the difficulties of the existing hot patching system.

The jack **14***b* is connected by a lead line **38** to a pair of back-to-back gas-type electron-discharge devices **40**, **42** which constitute the output side of a regulatable power circuit such as is shown, described and claimed in my United States Letters Patent No. Re. 23,575 for Lighting Control Circuits dated November 11, 1952. The gas-discharge devices are fed by a lead line **44** from a bus **46** of a source **48** of electric power. The firing of the gas-discharge devices is controlled by a phase-shift bridge network **50** under the influence of a selectively variable input voltage **52** as set forth in detail in said reissue Letters Patent. A transformer **54** is fed through a pair of lead wires **55**, **56** and return wire **57**. The other bus **58** of the source **48** of power is connected by a lead line **59** to a lamp load **60** which is connected by a lead line **62** to the plug **16***b*. If the lead lines **55**, **56** were permanently joined, the load **60** would be activated as soon as the plug **16***b* was inserted in the jack **14***a*.

Both jacks are of the same construction so that only one of them will be described in detail. Each jack includes a conventional electrically conductive receptacle of the type which is designed to be engaged by a plug. Pursuant to my invention each jack further includes a secondary control means which governs a remotely thrown mechanical or electronic switch in the jack circuit.

More particularly and by way of example the receptacle portion of the jack **14***a* constitutes a sleeve **64** (see Fig. 3) of electrical insulating material whose forward end is externally threaded and screwed from the back into a tapped opening **66** in the patching panel **12**. The rear end of the sleeve is internally threaded to admit the forward threaded end of an electrically conductive tube **68** the rear end of which is closed. Said tube is provided with a wide transverse groove **70** whose base intersects the interior of the tube. A cylindrical split spring **72** embraces the tube, said spring having a depressed flat **74** which is received in the groove **70**. The flat protrudes slightly into the tube so as to frictionally engage a jack,

e. g. the jack 14*a*, when the same is inserted in the tube. The closed rear end of the tube is tapped for a terminal screw 76 by means of which the lead line 18 is fastened to the jack. The jack as thus far described is entirely conventional.

The secondary control means basically comprises a pair of contacts which are physically affiliated with the jack and are so positioned that they will be moved from one state to another, e. g. from closed to open position, as a plug is being inserted in the jack and will revert to their original, i. e. united, state when the plug is fully coupled with or entirely out of the jack.

In the form of my invention shown herein, the secondary control means is denoted by the reference numeral 78 and constitutes a momentary snap-acting switch of a type which per se is conventional. Said switch is housed in a casing 80 and includes a projecting actuating finger 82. The finger is biased outwardly by a spring (not shown) to an outermost extending position, this being the normal (idle) condition of the switch. When the finger is depressed, this usually being a comparatively slight amount, the switch is actuated thereby.

Within the casing are a pair of contacts which either are normally open or normally closed, the contacts being normally closed in the form of my invention now being described. In other words, as long as the actuating finger 82 is in idle position the contacts will remain closed; and if the finger is depressed a predetermined slight amount, the contacts will snap to open position. Upon release of the finger the contacts will re-snap to their normal closed position.

The sleeve 64 is formed with a transverse slot 84 whose base communicates with the interior of the sleeve. The switch 78 is mounted in said slot with the actuating finger 82 projecting into the base of the sleeve and in the path of travel of a plug entering the jack. The finger is disposed forwardly of the electrically conductive portion 68 of the jack so that when the plug is in physical but not electrical engagement with the jack the finger will be contacted by the plug. The tip of a plug entering the jack will force the finger toward actuated position. The switch is so mounted that the degree of movement of the actuating finger is sufficient to change the state of the switch from idle to actuated as long as the finger is engaged by a plug. Accordingly, as the plug is being inserted in or withdrawn from the jack the momentary snap-acting switch is changed from idle to actuated condition.

Further pursuant to my invention each plug 16*a*, 16*b* is provided with an annular groove 86 which, in the fully coupled position of the plug in the jack, is in registry with the actuating finger 82 of the momentary snap-acting switch. The groove is sufficiently deep to permit the actuating finger to spring back to its idle position. Thereby when the plug is fully coupled the switch automatically will be restored to idle position with its contacts closed but until this position is reached the switch will remain actuated. The switch is held in the indicated location by any suitable means as, for example by screws 88.

As noted heretofore the secondary control means governs the operation of a remotely thrown primary switch in a jack circuit. The switch associated with the jack 14*a* is a mechanical switch; that is to say, a relay 90 having contacts that physically move toward and away from one another. Although any form of relay may be used, for the sake of simplicity I have shown a mercury relay. Said relay, which is of standard construction, comprises a pool 92 of mercury enclosed in a steel jacket 94 which constitutes one power terminal of the relay. The other power terminal of the relay comprises a steel plunger 96. A ceramic cup 98 is located within the mercury pool concentrically of the plunger 96. Said cup is carried by a magnetic core (not shown) in the field of a solenoid 100. A spring (also not shown) biases the cup upwardly towards the plunger.

Energization of the solenoid pulls the cup down, away from the plunger. When the cup is depressed, this corresponding to energization of the solenoid and being the position illustrated in Fig. 1, the mercury pool bridges the space between the plunger and the steel jacket. When the solenoid is de-energized the spring forces the cup upwardly causing it to act as a barrier and breaking the pool of mercury in two between said plunger and jacket.

The lead line 18 hereinbefore referred to which runs from the jack 14*a* is connected to one power terminal, i. e. the plunger, and the lead line 20 to the other power terminal, i. e. the steel jacket, so that as long as the relay is actuated the power terminals are joined through the pool of mercury. However, as soon as the relay is de-energized the flow of power is broken.

One of the solenoid terminals is connected by a lead line 102 to a low voltage source 104 of electric power. The other solenoid terminal is connected by a lead line 106 to one of the terminals 108 of the momentary snap-acting switch 78. The other terminal 110 of said switch is connected by a lead line 112 to the other terminal of the source 104 of low voltage electrical power.

In the operation of the patching system with reference to the jack 14*a*, let it be assumed that the plug 16*a* has been withdrawn. The actuating finger 82 of the momentary snap-acting switch 78 will be in its full projecting, i. e. idle, position so that the switch contacts will be in their normal closed position and the solenoid 100 will be actuated whereby the relay 90 is closed. Accordingly, power is applied from the bus 26 through the regulator 22 and relay 90 to the jack 14*a*.

Nevertheless, when the plug 16*a* is thrust into the jack no sparking will take place. This is due to the engagement between the tip of the plug and the actuating finger, as shown in Fig. 3, when the plug first is inserted in the jack and before the plug reaches the tube 68. Said plug pushes back the actuating finger and changes the switch 78 from its normally closed position to an open position. In the open position the solenoid 100 is deenergized to permit the ceramic cup to spring up and break the flow of power through the relay thereby de-energizing the jack 14*a*. Thus, as the plug is being inserted into the jack power temporarily is removed from the jack and it is not restored until the plug is thrust fully home in the position shown in Fig. 2 wherein the actuating finger 82 having snapped back to its idle position permits the contacts of the momentary snap-acting switch to reclose thereby reclosing the mercury relay and applying power to the electrically conductive portion of the jack which now is in electrical engagement with the plug.

Likewise, when the jack is being withdrawn from the plug initiation of the withdrawal action will depress the actuating finger to remove power from the jack while the jack and plug still are in electrical contact, and this power will not be restored until the plug has cleared the electrically conductive portion of the jack.

The terminals of the snap-acting switch in the jack 14*b* are connected to the lead lines 55, 56. As long as these lead lines are joined through the switch, i. e. as long as the switch is idle, in-phase control voltage is applied to the grids of the gas-filled electron discharge tubes 40, 42 and power will be fed from said tubes in accordance with the regulation determined by the selectively variable voltage 52. When a plug is introduced into the jack 14*b* the normally closed contacts of the momentary snap-acting switch associated therewith will open thus causing the voltage of the tubes 40, 42 to be 180° out of phase with respect to their anodes and thereby preventing firing of said tubes, whereby during introduction of a plug into the jack 14*b* or withdrawal of a plug therefrom no current will flow from the regulated power circuit.

It will be appreciated that the gas-discharge tubes act as electronic relays with the grid circuits constituting the triggers which correspond to the solenoid of a mechanical

relay and with the filament-plate circuits constituting the power circuits which correspond to the load contacts of a mechanical relay.

For safety and convenience the plugs are provided with conventional insulating handles **114**.

It thus will be seen that I have provided a device which achieves all the objects of my invention and is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein described, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A cold patching system including a jack, a jack support, a plug, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

2. A cold patching system including a jack having an electrically non-conductive forward portion and an electrically conductive rear portion, a jack support, a plug, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element at the forward portion and extending into the path of travel of the plug in the jack, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

3. A cold patching system including a jack having a front electrically non-conductive sleeve and a rear electrically conductive tube, a jack support, a plug, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element at the sleeve and extending into the path of travel of the plug in the sleeve, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

4. A cold patching system including a jack, a jack support, a plug, a remotely thrown normally closed primary mechanical relay having a pair of normally closed contacts and an electrical control element, circuit means electrically connecting said contacts in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of the control element, said means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug operating said control means to actuate the control element of the relay so as to open the relay contacts, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

5. A cold patching system including a jack, a jack support, a plug, a remotely thrown normally closed primary mechanical switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

6. A cold patching system including a jack, a jack support, a plug, a remotely thrown primary switch having an electric control member and a pair of normally closed contacts, circuit means electrically connecting said contacts in series with the jack, a momentary secondary control means physically affiliated with the jack, said secondary control means having a pair of contacts, circuit means connecting the contacts of the secondary control means with the control member of the primary switch, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating the contacts of said secondary control means to operate the control member of the primary switch so as to open the primary switch contacts, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

7. A cold patching system including a jack, a jack support, a plug, a remotely thrown primary switch having a pair of normally closed contacts and an actuating solenoid, circuit means electrically connecting said contacts in series with the jack, a momentary secondary control means physically affiliated with the jack and including a pair of contacts, circuit means connecting the contacts of the secondary control means with the solenoid, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating the contacts of the secondary control means to operate the solenoid so as to open the contacts of the primary switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

8. A cold patching system including a jack having an insulated forward portion and an electrically conductive rear portion, a jack support, a plug, a remotely thrown primary switch including a normally closed pair of contacts and an electric control member, a momentary secondary control means, means mounting said secondary control means adjacent the insulated forward portion of the jack, said secondary control means having a pair of contacts, circuit means connecting the contacts of the secondary control means with the control member of the primary switch, said control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact with the jack, said actuating element upon engagement with the plug actuating the contacts of the secondary control means to operate the control member of the primary switch so as to open the primary switch contacts.

9. A cold patching system including a jack, a jack sup-

port, a plug, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an annular groove in registry with said actuating element when the plug is fully coupled with the jack.

10. A cold patching system including a jack having a front electrically non-conductive sleeve and a rear electrically conductive tube, a jack support, a plug, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control switch mounted on said jack and having an actuating element extending into the interior of said sleeve in the path of travel of the plug entering the jack, said secondary control switch electrically governing the operation of the primary switch, said actuating element upon engagement with the plug actuating the secondary control switch to open the primary switch, said plug having an annular groove in registry with said actuating element when the plug is fully coupled with the jack.

11. A cold patching system including a plurality of live jacks, a jack support, a plug at the end of a load cable, a plurality of remotely thrown normally closed primary switches, circuit means electrically connecting each switch in series with a different jack, a plurality of momentary secondary control means, each means being physically affiliated with a different jack and electrically governing the operation of the associated switch, each secondary control means including an actuating element extending into the path of travel of the plug entering the associated jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the associated jack, said actuating element upon

engagement with the plug actuating said secondary control means to open the associated switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the associated jack.

12. A cold patching system including a live jack, a jack support, a plug on the end of a load cable, a remotely thrown normally closed primary switch, circuit means electrically connecting said switch in series with the jack, a momentary secondary control means physically affiliated with the jack and electrically governing the operation of said switch, said secondary control means including an actuating element extending into the path of travel of the plug entering the jack and being disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating said secondary control means to open said switch, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

13. In combination in a cold patching system, a jack adapted when idle to be electrically connected to a source of electric power, a plug adapted to be on the end of a load cable, a momentary secondary control means including an actuating element which governs operation of the control means by physical movement only, means mounting said secondary control means adjacent the jack with the actuating element extending into the path of travel of the plug entering the jack and disposed to be engaged by the plug when the plug is in physical contact but out of electrical contact with the jack, said actuating element upon engagement with the plug actuating said secondary control means and thereby adapting the latter to open a normally closed primary switch in series with the jack, said plug having an indentation in registry with said actuating element when the plug is fully coupled with the jack.

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