United States Patent

[11] **3,598,941**

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Continuation-in-part of application Ser. No. 800,863, Feb. 20, 1969, now abandoned.

[54] **WATERPROOF ELECTRICAL SWITCH CONTROLLED BY PLUG INSERTION INTO AND REMOVAL FROM RECEPTACLE**
8 Claims, 6 Drawing Figs.

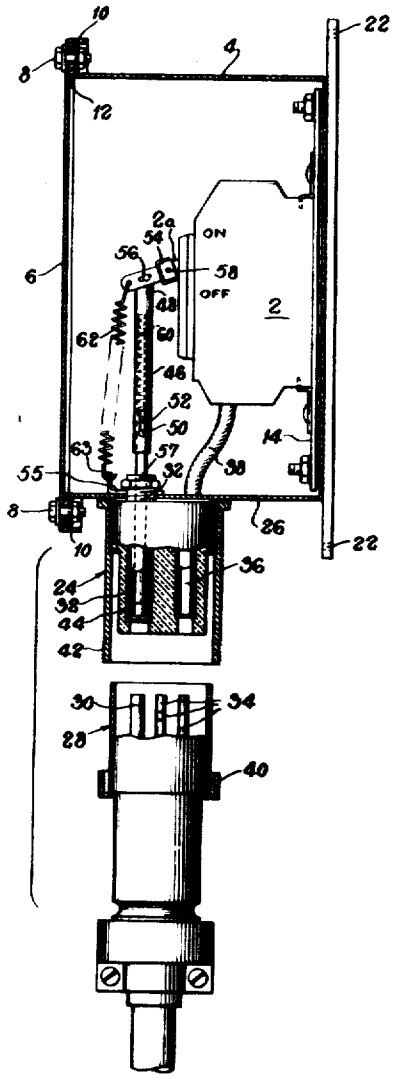
[52] U.S. Cl. ..... **200/51.09**, 339/60 M
[51] **Int. Cl.** **H01h 33/54**
[50] **Field of Search** ..... 200/51.09, 51.07, 51.08, 82 D; 339/60 R, 60 C, 60 M, 94 R, 94 A, 94 C, 94 L, 94 M

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ABSTRACT: A waterproof electrical switch or trip-free, circuit breaker controlled by the presence or absence of an electrical plug in a mating receptacle. During insertion of the plug into the receptacle, one of the plug pins engages and operates mechanism to turn the switch or circuit breaker on. Conversely, withdrawal of the plug from the receptacle turns the switch off or prepares the trip-free, circuit breaker for resetting. The switch preferably control energization of the receptacle. Thus, the receptacle is energized only when the plug has been inserted, and is deenergized in response to removal of the plug or tripping of the circuit breaker.



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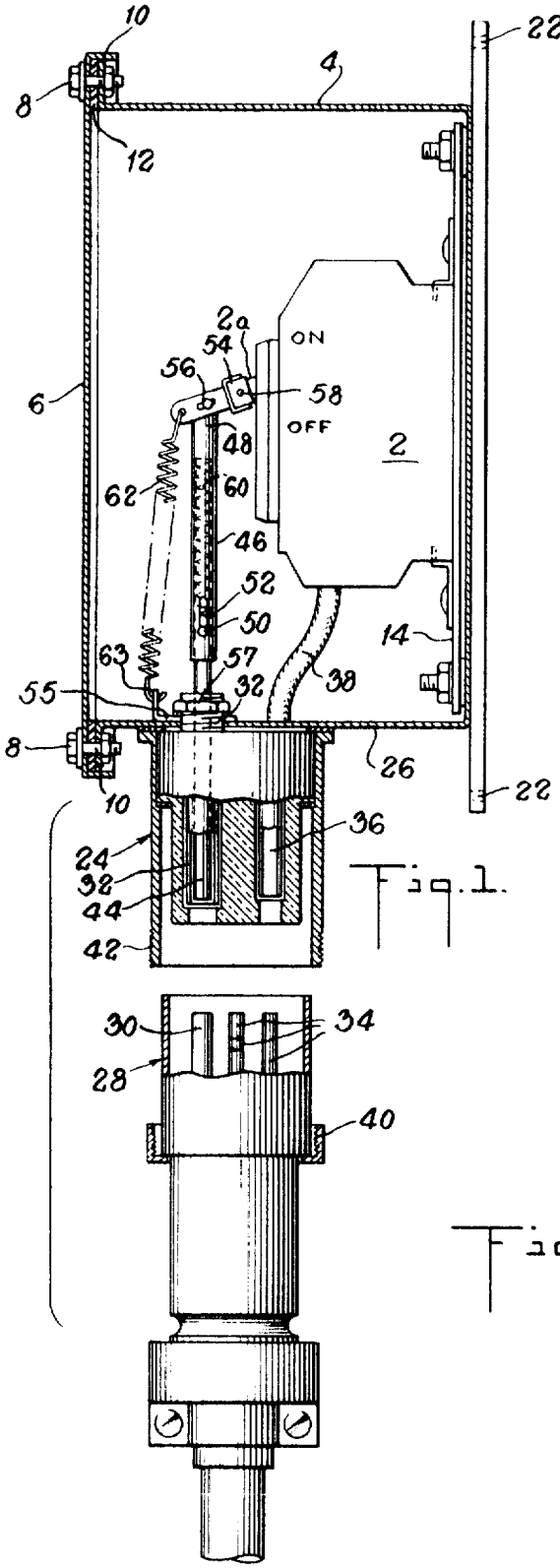


Fig. 1.

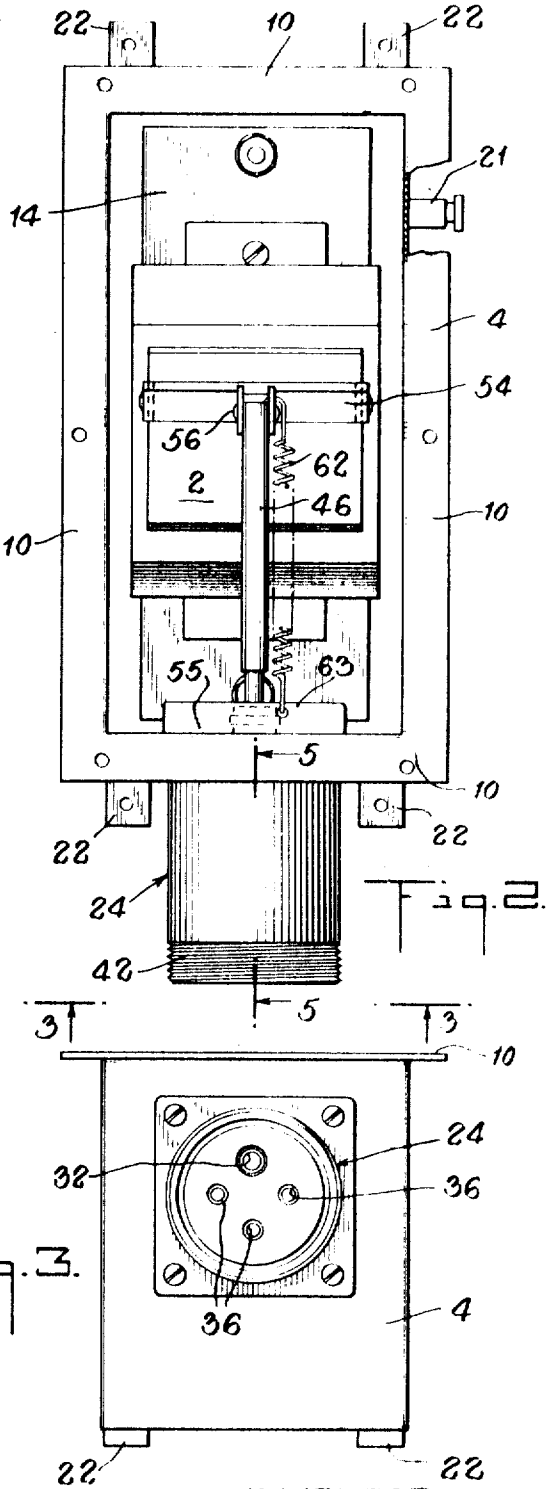
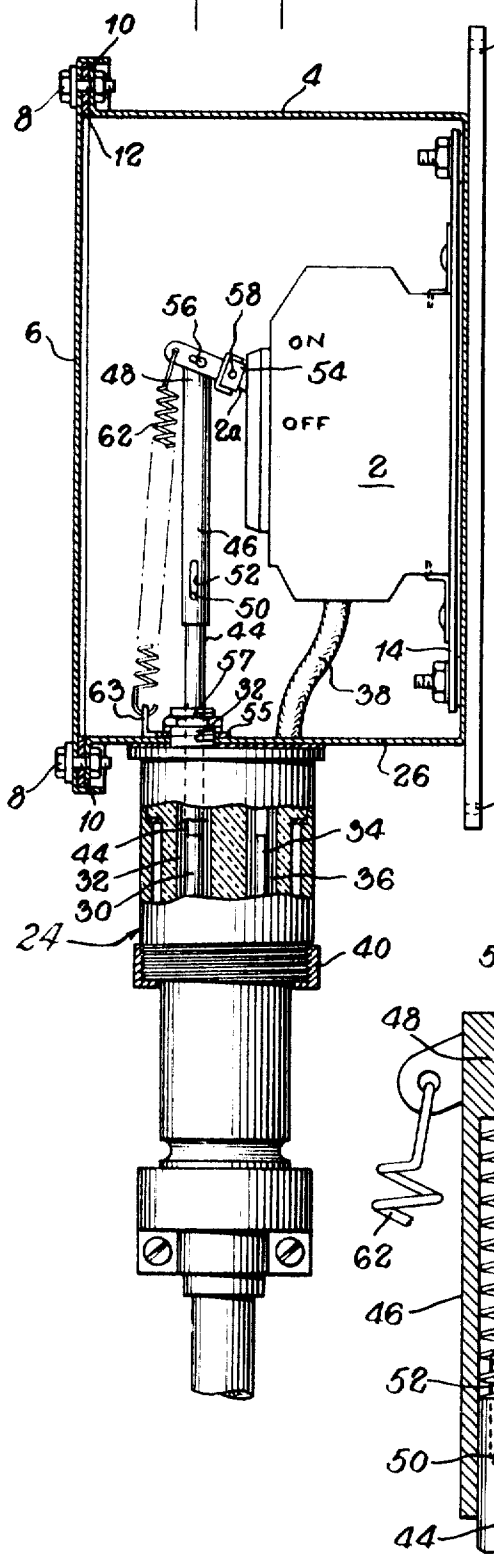


Fig. 2.

Fig. 3.

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Fig. 4.



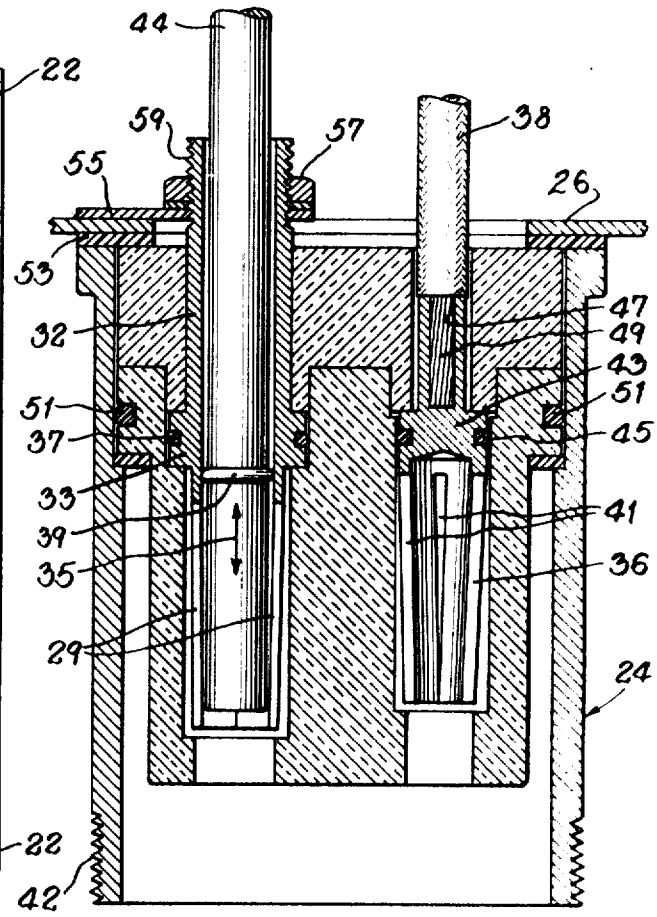


Fig. 5.

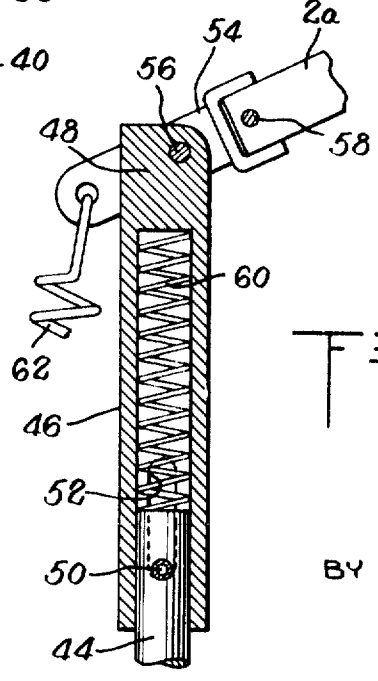


Fig. 6.

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WATERPROOF ELECTRICAL SWITCH CONTROLLED BY PLUG INSERTION INTO AND REMOVAL FROM RECEPTACLE

This application is a continuation-in-part of my copending application serial no. 800,863, filed Feb. 20, 1969, and now abandoned.

The invention relates to electrical switches or trip-free circuit breakers which are controlled by plug insertion into and removal from a mating receptacle. More particularly, the invention is directed toward providing such systems wherein the receptacle is waterproof when the plug is inserted therein or removed therefrom. Thus, the system may be used on shipboard without damage or injury even when the receptacle cap is open or no plug is inserted therein.

The prior art discloses various arrangements in which the operating handle of an electrical switch or a trip-free, circuit breaker is actuated by external mechanism. Furthermore, some prior art devices are waterproof when the plug is inserted in the receptacle but are susceptible to the introduction of water therein when the plug is removed therefrom.

Some of the prior art devices relate to the control of a switch by the insertion of a plug into and its removal from its mating receptacle. There is also some indication in the prior art that such a combination may be used with the so-called trip-free circuit breakers. By "trip-free circuit breakers" is meant those devices which trip internally on overload without moving the external, operating handle from its ON to its OFF position. However, such prior art devices do not provide a waterproof receptacle when the plug is removed and the receptacle is open. Moreover, these prior art devices are not waterproof when the plug is inserted in the receptacle.

In accordance with the present invention, mechanism is provided to operate the handle of a switch or circuit breaker to turn the switch on and off. This mechanism is operated and controlled by insertion of an electrical plug into a mating receptacle. Since such plug-receptacle combinations are often used on ships in various locations which are often awash with water, it is very important that they be waterproof.

In the preferred embodiment of the invention disclosed herein, the switch-operating mechanism includes a member extending into the receptacle and adapted to be engaged and moved by one of the pins of the plug when the plug is inserted into the receptacle. This movement of the member, through suitable linkage connecting it to the switch-operating handle, turns the switch on. Removal of the plug from the receptacle controls turning off of the switch or the return of the handle of a trip-free breaker to its OFF position, the power for the turning-off or return to OFF operation being provided by a return spring. Since a "trip-free" circuit breaker is one in which the toggle handle remains stationary during overload or short-circuit tripping and opening of the internal circuit breaker pole contacts, this permits overload or short-circuit tripping with the plug engaged. Resetting a "tripped" circuit is accomplished by withdrawing and reinserting the plug.

Such an arrangement makes it possible to control energization of the receptacle in response to whether or not the plug is in the receptacle. Thus, by suitably electrically connecting the switch to the receptacle so that the receptacle is energized only when the switch is on, it will be seen that the receptacle will be normally deenergized, and become energized only when the plug is placed in the receptacle. Hence, the receptacle when open, i.e., without the plug in, presents no shock or other hazards, particularly since the receptacle, even when open, is waterproof.

Furthermore, the usual sparking on insertion or removal of the plug can be avoided by providing that during plug insertion, the receptacle energization occurs after the plug first makes electrical contact with the receptacle; and that during plug removal, the receptacle is deenergized before the plug breaks electrical contact with the receptacle.

It is therefore an important object of the present invention to provide a waterproof plug and receptacle of the type permitting control of the operation of a switch by the plug being inserted into and withdrawn from the receptacle.

It is a further object of the invention to provide such a combination wherein it is possible to control energization of a receptacle by insertion of a plug into the receptacle and removal of the plug therefrom.

It is a still further object of the invention to provide such a system which prevents sparking when a plug is inserted into and removed from a receptacle.

These and other objects, advantages, features and uses of the invention will become apparent to those skilled in the art from the following detailed description of a preferred embodiment of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a vertical, sectional view partly in elevation of a preferred embodiment of the invention, showing the plug out of the receptacle and the switch in the OFF condition;

FIG. 2 is a front elevational view of the receptacle of FIG. 1 with the cover plate of the box removed;

FIG. 3 is a plan view taken on line 3–3 of FIG. 2 viewed in the direction of the arrows;

FIG. 4 is a view similar to that of FIG. 1 showing the plug inserted in the receptacle;

FIG. 5 is an enlarged sectional view, taken on the lines 5–5 of FIG. 2, viewed in the direction of the arrows; and

FIG. 6 is an enlarged view of the linkage between the rod and the operating handle of the switch.

In the drawings, wherein, for the purpose of illustration, is shown a preferred embodiment of the invention, reference numeral 2 designates an electrical switching means. Switching means 2 can be any conventional type of switch, combined switch and circuit breaker, or trip-free circuit breaker. It includes the usual externally projecting setting adjusting or operating handle member 2*a*, preferably of the toggle type, settable to its respective lower and upper OFF and ON positions (FIGS. 1 and 4).

Switching means 2 may be housed in an enclosure or box 4. The latter can conveniently comprise an integral sheet or cast metal member formed to provide an open-sided enclosure adapted to be closed by a cover plate 6 removably secured by screws 8 to an outwardly turned peripheral flange 10 of box 4. A gasket 12 between cover plate 6 and flange 10 provides a watertight and dustproof seal.

Switching means 2 is mounted in box 4 in any suitable fashion. For example, as shown in the drawings it can be held in a standard clip-type mounting base 14 which is welded or fastened by rivets or screws to box 4. Box 4 may be provided with one or more cable clamps or watertight stuffing tubes 21 (FIG. 2) through which the power input cable or wiring may be passed for connection to the line side of switch 2.

Box 4 can be secured to any suitable support by bolts or screws (not shown) adapted to be passed through apertured ears 22 or other types of mounting brackets on the box.

A plug receptacle assembly 24 of any suitable form is mounted to the bottom wall 26 of box 4. The plug receptacle assembly as shown in the drawing is of the three wire, four pole sleeve type, adapted to receive a corresponding four prong plug 28. The wire connections from plug receptacle 24 extend through openings in the bottom wall 26. Receptacle 24 is secured to the box 4 in any suitable manner, for example in the same way that cover plate 6 is secured to the box. The four pins of plug 28 are adapted to be received respectively in the four sleeves of the receptacle 24. As will be described in detail shortly, one of the plug pins 30 in addition to providing an electrical grounding connection with its sleeve 32, mechanically controls closure of switch 2 when the plug is inserted, and opening of the switch or release of the operating handle when the plug is withdrawn. One or more of the other three plug pins 34 cooperates in usual fashion with their respective associated sleeves 36 to establish electrical contact therewith. While it is preferred that the ground connection be used for

the purpose described, other pins either hot or dead, may also be used.

It will be understood that the particular circuitry established by plug inserted into receptacle is of no significance to the present invention, other than that switching means **2** is part of that circuitry and energizes receptacle **24** when the switch is closed. In fact, in certain applications there may not be any electrical connection between the switch and the receptacle, as for example, if it is merely desired to control the switch by plug insertion. For illustrative purposes, switch **2** is shown electrically connected by lead **38** to one of the sleeves **36** of receptacle **24**. It should be noted that the particular specific details of the receptacle and plug, including the number of cooperating pin-sleeve pairs, is immaterial so far as the present invention is concerned.

After insertion of plug **28** into receptacle **24**, an internally threaded sleeve **40** of the former is screwed onto an externally threaded boss portion **42** of the latter to hold the two securely together.

The means whereby insertion of plug **28** into receptacle **24** will cause switching means **2** to close, and removal of the plug will cause the switching means to open, will now be described.

Loosely and slidably disposed in sleeve **32** of the receptacle is a rod **44**, which functions as an actuating member to operate the handle of **2***a* of switch **2**. The upper end of rod **44** is loosely received in a short casing **46** whose upper end is closed as shown at **48**. A pin **50** secured to the upper end of rod **44** extends through aligned elongated slots **52** in casing **46**. A yoke **54** embraces the upper end of casing **46**, and is pivotally connected thereto by pin **56** extending through closed end **48**. Yoke **54** is rigidly secured to switch handle **2***a* by a pin **58**. A compression spring **60** is disposed in casing **46** between rod **44** and closed end **48**. Rod **44** is biased downwardly by a tension spring **62** connected between end **48** and flange **63**. Tension spring **62** must be of sufficient strength to cause handle **2***a* to return to the OFF position when the plug **28** is removed from the receptacle **24**.

The positions of the above-described parts when plug **28** is out of receptacle **24** is as shown in FIG. **1**. Under the tension of spring **62**, rod **44** is held in its lowered position. Through pin **50** bearing on the lower ends of slot **52**, casing **46** is likewise in lowered position, whereby switch handle **2***a* is in its OFF position.

When plug **28** is inserted into receptacle **24**, plug pin **30** engages rod **44** and pushes it upwardly. Through compression spring **60**, this movement of the rod is transmitted to casing **46**, which through pin **56** and yoke **54** will shift switch handle **2***a* upwardly to its ON position. The use of compression spring **60** to transmit upward, switch-closing movement of rod **44** to casing **46** enables any excess travel of the rod to be taken up in compression spring **60**, thereby avoiding damage to the switch handle **2***a* and the associated switch mechanism. Slot **52** permits any additional overtravel of rod **44** to be taken up by movement of the rod pin **50** in slot **52**. The plug-inserted switch-on final condition of the parts is shown in FIG. **4**.

Of course, as the above switch-closing (or turning on) operation is being effected by plug pin **30**, it is also sliding into and making electrical contact with its related sleeve **32**. Simultaneously, the other plug pin **34** slide into their related receptacle sleeves **36** to establish electrical connection therewith. Preferably, the parts are so arranged that pin **30** and pins **34** make electrical contact with their related receptacle sleeves **32** and **36** before rod **44** has been moved far enough to turn switch **2** on and thereby energize the receptacle. This will prevent sparking at the plug pins.

Withdrawal of plug **28** from receptacle **24** will cause operating handle **2***a* to be automatically moved down to turn switch **2** OFF. As the plug is being removed, tension spring **62** acting on yoke **54** will cause rod **44** to follow plug pin **30** downwardly. The rod pin will engage the lower ends of casing slots **52**, moving the casing **46** downwardly. This will cause yoke **54** pivoted to the sleeve to swing switch handle **2***a* down to the OFF position. The final, switch-open position of the parts is as shown in FIG. **1**.

If switch **1** includes a circuit breaker of the trip-free type requiring additional travel of switch handle **2***a* to reset the breaker after it has tripped, the parts are arranged and constructed so that the amount of downward (i.e., switch-opening) movement of rod **44** is sufficient to provide this extra movement.

The parts are so proportioned that in the above-described plug withdrawal operation, preferably the switch **2** is opened by sufficient movement of its handle **2***a* to deenergize the receptacle before the plug pins **30** and **34** have been moved out of electrical contact with their related receptacle sleeves **32** and **36**. Thus, plug withdrawal sparking will be avoided.

To permit the receptacle of the invention to be waterproof when open even with the decks of the vessel, on which it is installed, awash, suitable O-rings and other barrier constructions are provided in the receptacle. The details are shown in FIG. **5**.

Sleeve **32** is drilled through so that there is an opening through the receptacle into the interior of the box and is slotted as shown at **29**. Rod **44** is inserted in sleeve **32**, which is enlarged at **33**, and moves in the directions of arrows **35** on insertion and removal of the plug. O-ring **37** of elastomeric or similar material is provided around enlarged portion **33** and O-ring **39** is provided around rod **44**. Movement of rod **44** is such that O-ring **39** does not move beyond the solid wall portion of sleeve **32**. This effectively maintains the end of sleeve **32** nearest box **4** waterproof. The slotted portions of the sleeves provide a more positive electrical connection due to their spring action.

Sleeve **36** is drilled and slotted at **41** to receive a pin **34**. It is solid as shown at **43** and an O-ring **45** is placed around the solid portion **43**. The end opposite sleeve **36**, beyond the solid barrier **43**, is drilled as shown at **47** to receive and connect to bared, uninsulated portion **49** of electrical lead **38**. The entire receptacle body is surrounded by O-ring **51** which prevents entry of water into box **4** through the space between the shell and insert of the receptacle.

Gasket **53** is provided to seal the junction between box **4** and receptacle **24** and ground strip **55** is connected to sleeve **32** by means of nut **57** which engages the threads **59** on sleeve **32**. Thus, it can readily be seen that receptacle **24** is waterproof even when the plug is removed and there is no cover over the open receptacle.

It will be understood that the foregoing disclosure of a specific preferred embodiment of the invention is exemplary only, since the invention can be practiced in many variants and forms. Accordingly, it is intended that the foregoing disclosure be illustrative only and not in any way limiting the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege I claim are defined as follows:

1. In a waterproof device having an electrical switch with an operating handle and an electrical receptacle for receiving a multipin electrical plug wherein one pin of the plug engages an open sleeve having a solid wall portion and a slotted wall portion so as to actuate a movable rod upon insertion into the receptacle to move the electrical switch operating handle from its OFF position to its ON position, the improvement which comprises:

- a waterproof O-ring around the rod located such that the O-ring remains within the solid wall portion of the sleeve regardless of the position of the rod
- at least one sleeve of the receptacle having a longitudinal opening at each end thereof separated by a solid portion and a waterproof O-ring surrounding the solid portion to preclude passage of water from one side of the solid portion to the other;
- one of the longitudinal openings being shaped to receive a pin of the plug;
- the other of the longitudinal openings being shaped to receive and connect to a bared end of an electrical lead; and
- additional waterproof means to preclude passage of water from one end of the receptacle to the other.

2. The invention of claim **1** including:

a box for mounting the electrical switch therein;

means for mounting the electrical receptacle to the box so as to prevent passage of water therebetween;

the electrical receptacle having a shell and an insert and including a waterproof O-ring between the shell and the insert to prevent passage of water therebetween.

3. The invention of claim 2 including:

a longitudinal hollow casing mounted at one end thereof to the operating handle of the electrical switch and at the other end thereof to the rod; and

restoring means connected between the operating handle and the box so that when the plug is removed from he receptacle, the electrical switch is moved from its ON to its OFF position.

4. The invention of claim 3 wherein:

the hollow casing is provided with a slot therein and the rod

is provided with a pin adjacent the end mounted to the hollow casing;

the pin being engaged within the slot so as to be movable with respect thereto; and including:

a lost motion means mounted in the hollow casing to compensate for any overtravel of the rod.

5. The invention of claim 4 wherein the lost motion means is a spring.

6. The invention of claim 5 wherein the restoring means is a spring.

7. The invention of claim 4 wherein the restoring means is a spring.

8. The invention of claim 3 wherein the restoring means is a spring.