Aug. 22, 1967 L. M. BECKER 3,337,778

RELAY APPARATUS

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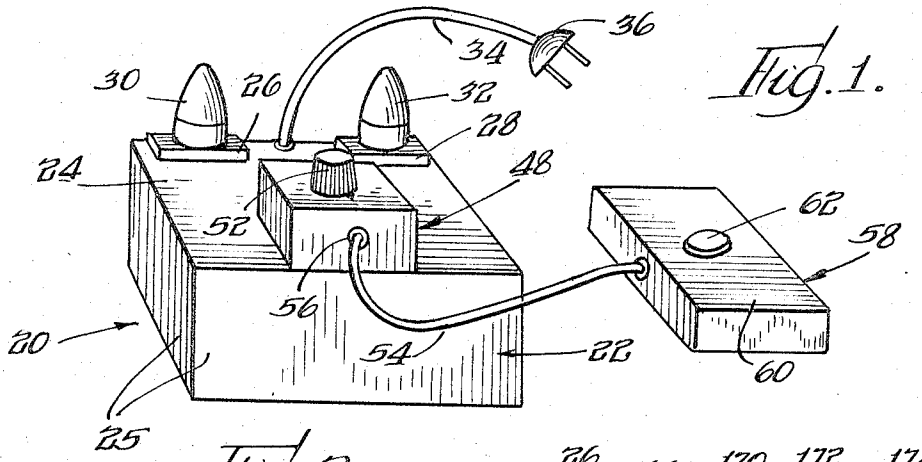


Fig. 1.

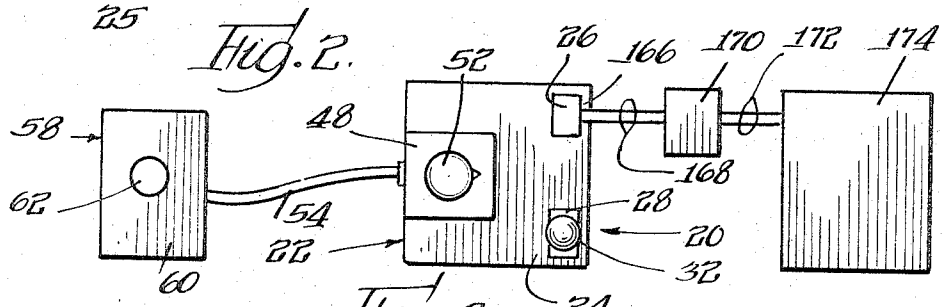


Fig. 2.

Fig. 3.

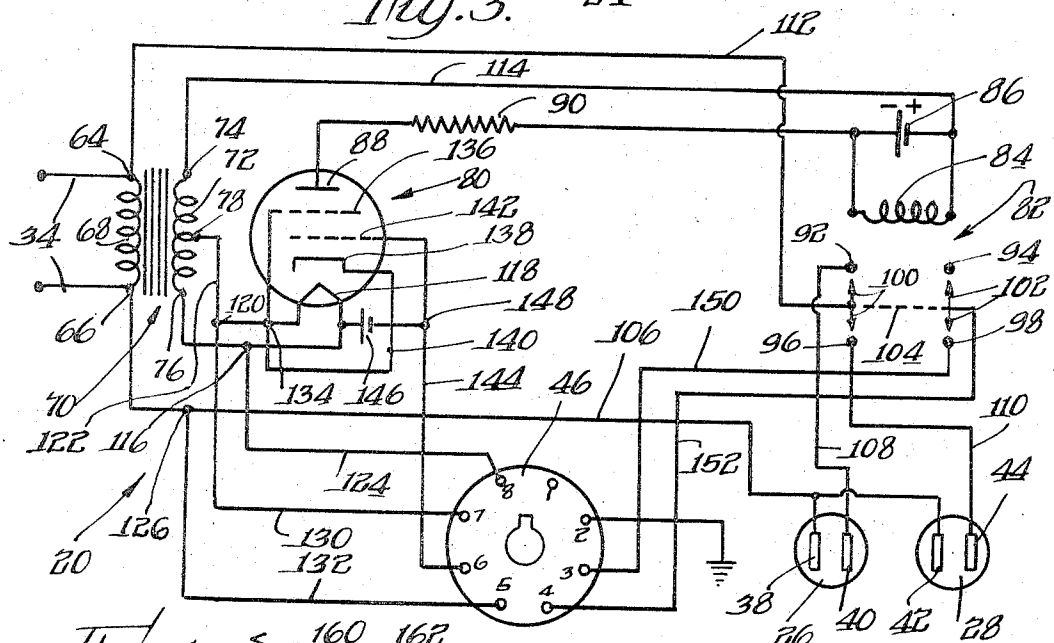
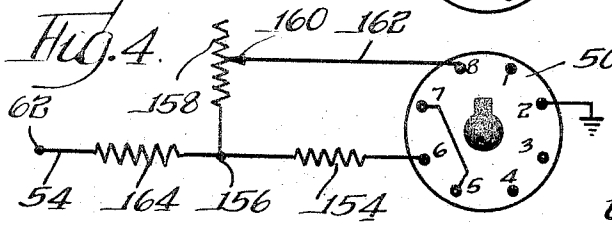


Fig. 4.



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Fig. 5.

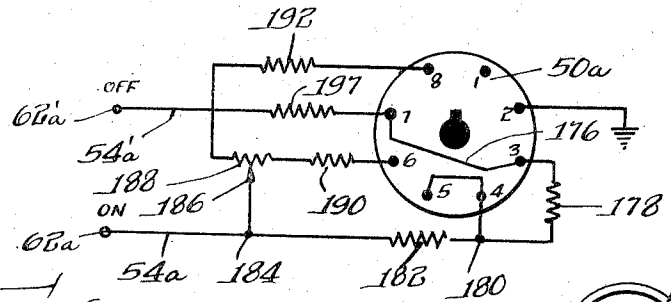


Fig. 6.

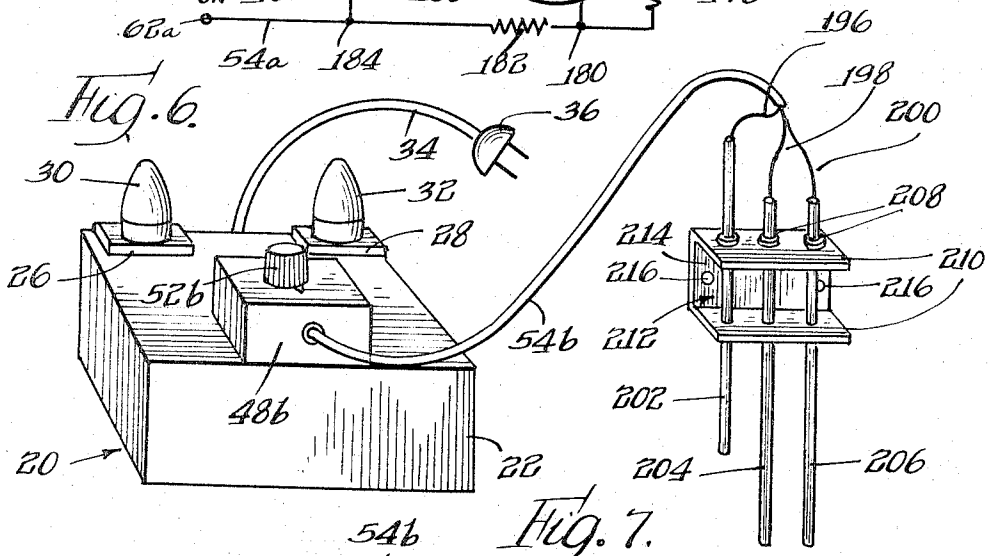


Fig. 7.

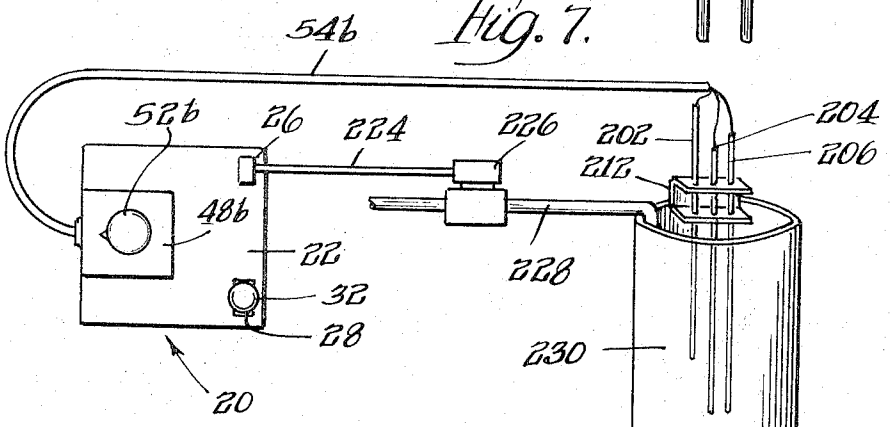
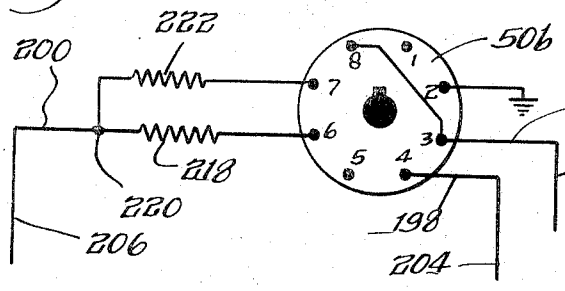


Fig. 8.



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Fig. 9.

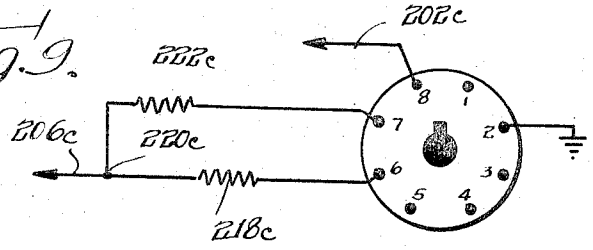


Fig. 10.

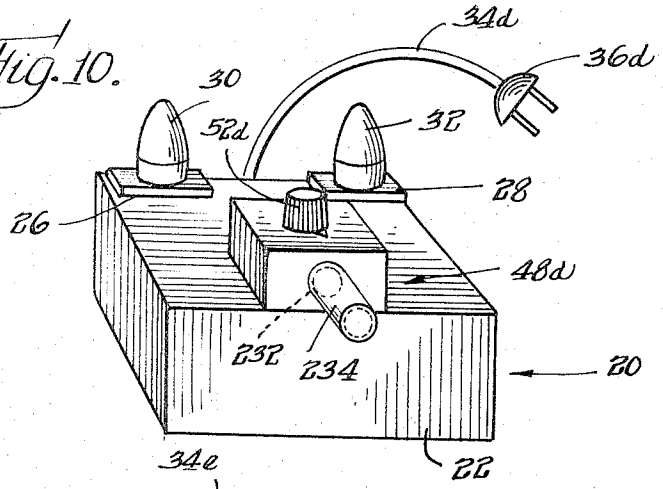


Fig. 11.

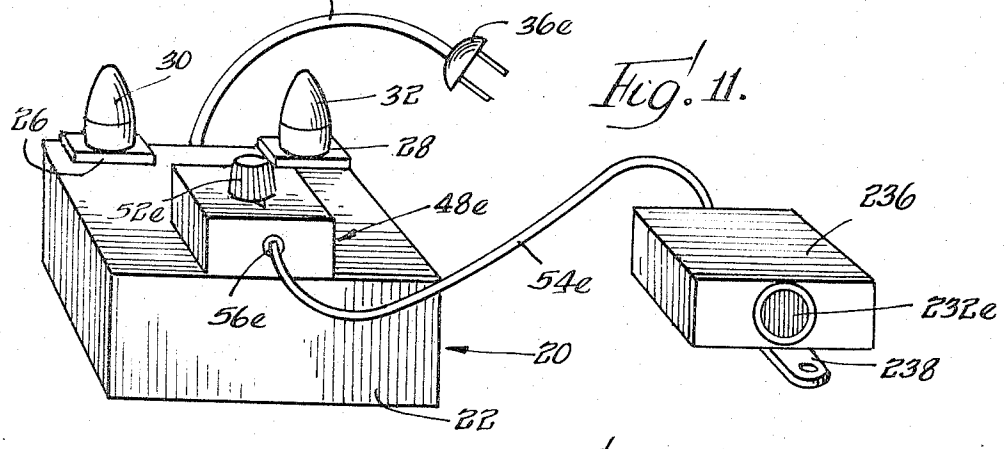
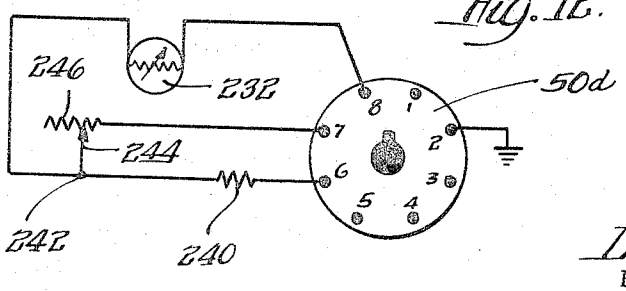


Fig. 12.



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Fig. 13.

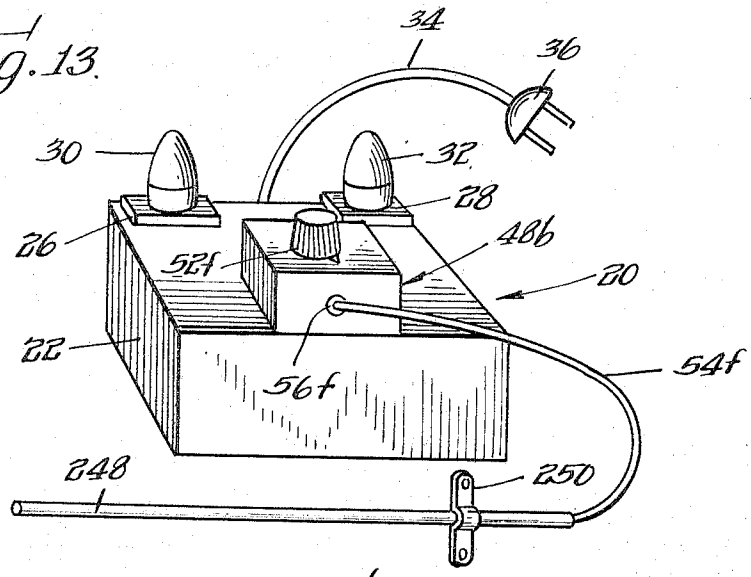
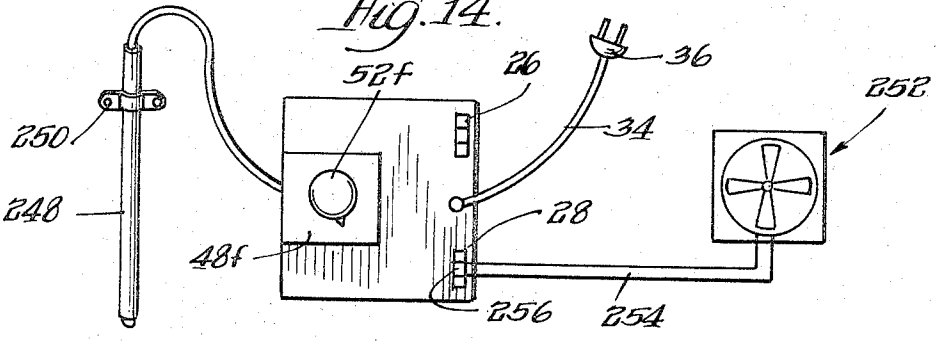


Fig. 14.



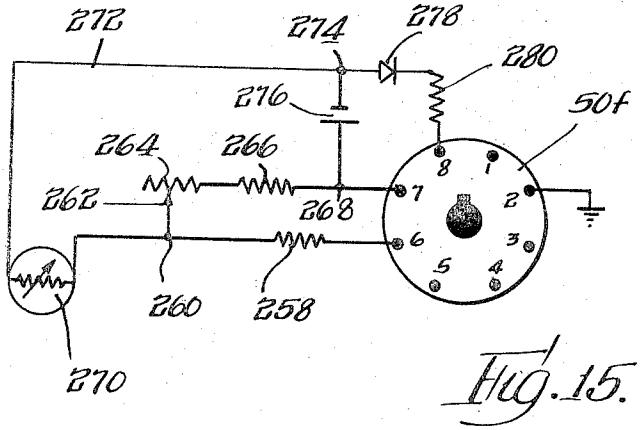


Fig. 15.

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3,337,778

RELAY APPARATUS

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Filed Nov. 21, 1963, Ser. No. 325,264
4 Claims. (Cl. 317—149)

ABSTRACT OF THE DISCLOSURE

A device including a relay for controlling the "on-off" condition of one or two electric outlets, said device having a plurality of alternatively usable, plug in sensing devices for selectively operating said relay.

This invention relates to an electronic control system, more particularly adapted for widely varied use as an electronic relay.

A great many relays are known in the electronic arts for effecting various control functions. However, by and large each such relay has been limited to one particular function. In accordance with the present invention, a relay is arranged in connection with a plurality of plug-in controls, and with a plurality of plug-in controlled elements for extremely versatile, and substantially universal operation. Such a device is of particular value to a hobbyist or experimentalist, and also has great worth for applications which, because of relatively small volume, would otherwise scarcely stand the cost of a relay installation. However, since the present system allows a single relay to be used with any of a number of controlling devices and any of the number of controlled elements, it is economically well adapted for small volume installations.

Merely by way of example, the relay can be operated by a touch sensor to operate in response to touch. As a further development thereof, it can be operated by an on-off sensor, whereby a first touch will cause operation of a relay, and a second touch will cause return of the relay to its normal or quiescent condition. Other controlling or operating devices within the contemplation of this invention include a liquid level sensor, a liquid detecting and warning sensor, a photoelectric sensor, or a thermoelectric sensor.

The devices that can be controlled are practically limitless, including sounding devices such as chimes, lighting devices, water level controls, warning against rain or basement flooding, coupled with automatic control or prevention, if so desired, and so on almost to infinity.

In view of the foregoing, it is an object of this invention to provide an improved relay system.

In particular, it is an object of this invention to provide a relay device with a plurality of different plug-in controlled devices and controlled elements.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of a relay device in combination with a touch control sensor and a pair of lights operated by the relay;

FIG. 2 is a top view of a system based on FIG. 1;

FIG. 3 is an electrical wiring diagram thereof;

FIG. 4 is an electrical wiring diagram in conjunction with FIG. 3 and showing a plug-in component;

FIG. 5 is a modified electric wiring diagram showing control by means of an on-off sensor;

FIG. 6 is a perspective view of the relay used in connection with a liquid level sensor;

FIG. 7 is a schematic, somewhat block diagram of the

device of FIG. 6 as used for controlling water level in a tank;

FIG. 8 is a modified electric wiring diagram of the electronic sensor;

FIG. 9 is another modified electric wiring diagram with a liquid presence detector or sensor;

FIG. 10 is a perspective view of the relay in conjunction with a direction sensitive photoelectric sensor;

FIG. 11 is a similar perspective view showing the relay system with a remotely disposed photoelectric sensor;

FIG. 12 is a modified schematic wiring diagram showing the device as used with a photoelectric sensor;

FIG. 13 is a perspective view of the relay system with a thermoelectric sensor;

FIG. 14 is a schematic, somewhat block diagram showing the system of FIG. 13 connected for automatic control of an attic fan; and

FIG. 15 is a modified schematic wiring diagram corresponding to FIGS. 13 and 14.

Referring now in greater particularity to the drawings, and first to FIGS. 1–3, there will be seen the basic relay unit identified generally by the numeral 20. The unit 20 includes a generally rectangular box or housing 22, having a rectangular, somewhat squarish top 24, and sidewalls 25 of substantially greater length than height. Accordingly, the housing has a generally shallow appearance.

Near the backside of the top 24, as viewed in FIG. 1, there is provided a pair of controlled outlets 26 and 28. These are in the nature of conventional electric receptacles for receiving normal two-prong plugs. For exemplary purposes in FIG. 1, there is shown a plastic encased neon light 30 plugged into the receptacle 26, and another plastic encased neon light 32 plugged into the receptacle 28.

The unit 20 further is provided with a conventional flexible drop cord 34 having a plug 36 on the end thereof. This is connected internally of the housing 22 to electric circuitry shortly to be discussed in connection with FIG. 3. In FIG. 3 it will be seen that the receptacle 26 is provided with two contacts 38 and 40, and that the receptacle or outlet 28 is similarly provided with two contacts 42 and 44. A normal operation of the circuitry is such that the outlet or receptacle 28 is "on" when the plug 36 is plugged into an ordinary wall outlet, and the outlet or receptacle 26 is "off."

Near the front edge of the unit, as viewed in FIG. 1, there is provided a conventional octal socket, shown at 46 in FIG. 3. A plug-in adapter unit 48 is provided on its under surface with an octal plug 50 (FIG. 4) for detachable interfitting with the octal socket 46. Both the plug and socket 50 and 46 are hidden in FIG. 1 by the plug-in unit 48.

The plug-in unit 48 is of generally rectangular configuration, being made of the same shape as the housing of the relay unit. A rotatable knob 52 on the top of the unit 48 is fixed to the shaft of a rheostat hereinafter to be discussed in conjunction with the electric wiring diagram. A flexible electric wire 54, in the present example comprising a single insulated strand, extends through a grommet 56 in the side of the plug-in unit 56 to a remote unit 58. In the present example the remote unit comprises a rectangular block 60 of insulating material, such as wood, having a metallic contact 62 thereon electrically affixed to the flexible lead wire 54. The contact 62 conveniently is a fixed metallic button, and electrical actuation is by means of body capacity when one touches the button.

Attention now should be directed particularly to FIG. 3 comprising a schematic wiring diagram of the basic relay unit 20. The flexible lead or drop cord 34 comprises a pair of wires, as in the usual case, and these wires are respectively connected to the opposite ends 64 and 66 of

the input winding 68 of a power transformer 70. The power transformer has a secondary winding 72 with ends 74 and 76, and a center tap 78.

The unit 20 also includes a thyratron tube 80. A type 5696 tube has been found to be quite satisfactory. In addition, the circuit of the unit 20 includes a relay 82 having an actuating coil 84 with a capacitor 86 connected across the coil. The capacitor conveniently is polarized, being positive and negative as indicated on the drawing with the negative end connected to the plate 88 of the tube 80 through a resistor 90, for example of 1000 ohms. A suitable value for the capacitor 86 is six microfarads. The relay further includes a first pair of fixed contacts 96 and 98. In addition, the relay includes movable contacts 100 and 102, respectively alternately engageable with the contacts 92 and 96 and 94, 98. These contacts are carried by the armature of the relay, indicated by the broken lines 104.

The contacts 38 and 42 of the outlets 26 and 28, respectively, are connected in common by means of a wire 106 to the end 66 of the input winding 68 of the transformer 70. The contact 40 of the outlet 26 is connected by means of a wire 108 to the fixed relay contact 92. This relay contact normally is not engaged by the contact 100, and hence the outlet 26 is normally "off." The contact 44 of the outlet 28 is connected by a wire 110 to the fixed contact 96. A relay armature 104 normally is held down by spring biasing, so that the contact 100 engages the fixed contact 96. The movable contact 100 is connected by a wire 112 to the top end 64 of the input winding 68 of the relay 70. Hence, it will be seen that the outlet 28 is normally "on."

The upper contact 74 of the secondary winding 72 is connected by means of a wire 114 to the right end of the relay winding 84. As previously has been indicated, the left end is connected through the resistor 90 to the plate 88 of the thyratron. Hence, whenever the thyratron fires or is conducting, the relay is actuated, and the contacts 100 and 102 are lifted from the contacts 96 and 98 respectively into engagement with the contacts 92 and 94. The contact 94 is not connected to anything.

The bottom end 76 of the secondary winding 72 is connected to a junction 116. This junction is connected to one side of the tube filament or heater 118, while the other side of the filament or heater is connected to a junction 120 which is connected by a wire 122 to the transformer secondary center tap 72. The junction 116 also is connected by means of a wire 124 to contact No. 8 of the receptacle 46. The junction 120 is connected by means of a wire 130 to contact No. 7 of the receptacle 46. A wire 132 leads from a junction 126 on the wire 106 to contact No. 5 on the plug 50.

The wire from the junction 120 to the filament 118 is provided with a junction 134. The second or screen grid 136 of the tube 80 is connected to this junction, while the cathode 138 is connected by a wire 140 to the junction 134.

The control grid 142 is connected by means of a wire 144 to contact No. 6 of the receptacle 46. A capacitor 146 is connected between the right side of the filament 118 and a tap or junction 148 on the wire 144.

Contact No. 2 of the receptacle 36 is grounded, as indicated, while contact No. 1 is not connected.

Attention now is directed to FIG. 4, wherein plug 50 is shown in juxtaposition to the receptacle or socket 46. Contact No. 1 of the plug is not connected, while No. 2 is grounded. Pins 3 and 4 also are not connected. Reverting for the moment to FIG. 3, it will be seen that contact 3 is connected by means of a wire 150 to the fixed contact 98 of the relay, while contact 4 is connected by means of a wire 152 to movable contact 102. With the plug connections shown in FIG. 4, the connections of the contacts 3 and 4 are insignificant.

Pin 5 is wired direct to pin 7, while pin 6 is connected to a resistor of, for example, 3.3 megohms identified by the numeral 154. The resistor is connected to a junction 156. This junction is connected to one end of a variable resistor, potentiometer or rheostat resistor 158 having a sliding tap 160 thereon connected by a wire 162 to the plug pin 8. The position of the tap 160 on the resistor 158 is determined by rotation of the knobs 52 of the plug-in unit 48. Finally, the junction 156 is connected through a resistor 164 to the flexible wire 54, and hence to the contact button 62.

The biasing of the thyratron tube 80 is such that it normally is non-conducting. Hence, the receptacle or outlet 28 is "on" and the outlet 26 is "off" as heretofore discussed. When the button 62 is touched, capacity to ground of the body of the person touching the button upsets the biasing and the thyratron 80 fires or conducts. The conduction is of self-rectifying nature, with the thyratron conducting only on the half cycles when the plate 88 is positive. Such conduction is through the relay coil 84, and this actuates the relay, whereby the movable contact 100 is moved from the fixed contact 96 to the fixed contact 92, thereby turning on the outlet 26 and turning off the outlet 28. The capacitor 86 keeps the relay from chattering on alternate half cycles.

With reference to FIG. 1, it is the right neon light 32 that is normally on, while the left light 30 is normally off. The condition is reversed when the button 62 is touched. Removal of contact from the button 62 causes the thyratron to revert from its normal non-conductive state, thereby allowing the relay also to return to its normal non-actuated state.

Attention now should be directed to FIG. 2 which is generally similar to FIG. 1, and incorporates the circuitry of FIGS. 3 and 4. The neon lamp 30 has been removed from the outlet 26 in FIG. 2, and in its place there is a plug 166 connected by a two-wire line 168 to a transformer 170. A reduced voltage is transmitted from the transformer through a two-wire line 172 to a chime 174, such as a door chime. As will be appreciated, the neon light 32 normally is on, and when the button 62 is pressed the chime 174 is operated and the light 32 is extinguished. As will be appreciated, the neon lights are used simply by way of illustration, and the chime 174 is merely exemplary of a practical device to be operated thereby.

There are a great many other possibilities, and for example, a novelty display could be turned on, an entrance chime might be used as well as a door chime, a secretary call system could be used, etc. Button 62 has been shown only by way of example, and anything else to be touched by the hand could be provided in place of the button. For example, the wire 54 could be connected to a door knob to actuate an alarm when the door knob is touched. Conversely, any device could be plugged into the outlet 26 which is desired to turn off on occasion. For example, a radio or TV set could be plugged into the outlet 26, whereby to turn it off during commercial or when it is desired to carry on a conversation.

The rheostat 158, 160 in connection with the foregoing example gives some control over the amount of body capacity necessary to fire the thyratron 80, and hence to actuate the relay. The rheostat is adjusted in accordance with the particular conditions encountered in connection with any given installation.

In accordance with the example as heretofore shown and described, the thyratron tube conducts only when the sensor button 62 is touched. In other words, the relay condition reverses from its normal condition when the sensor button is touched, and reverts to its initial condition when the hand is moved away from the sensor button 62.

Without changing the construction of the basic relay unit 20 in any way, it possible to make a minor modification in the plug-in and remote units such that the relay will remain in whatever condition of operation it is set until a subsequent operation sets it to the opposite condition. In particular, a wiring diagram for such a

modification is shown in FIG. 5. The plug is identified at **50***a* to indicate that the plug is similar, but that the wiring associated therewith is different. The first pin remains unconnected as heretofore, while pin **2** is a ground pin. Pin **3** is shorted direct to pin **7** as indicated at **176**. In addition, pin **3** is connected through a resistor **178**, for example, a one megohm resistor to a junction **180**. The junction **180** is connected direct to pin **4**, and is also connected to a resistor **182**, for example a 1.5 megohm resistor. The opposite side of the resistor **182** is connected to a junction **184**, and this junction is connected by a wire **54***a* to a sensor button **62***a*, indicated on the drawing as being an "on" button, since it turns the thyratron on, as will be apparent hereinafter.

The junction **184** also is connected direct to a sliding tap **186** on a resistor **188**, for example of three megohms. One side of the resistor **186** is connected to a resistor **190**, for example 4.7 megohms, to pin **6** of the plug **50***a*. The other side of the resistor **188** is connected to a resistor **192**, for example a one megohm resistor, to pin **8** of the plug **50***a*.

Pin **7** is connected to a resistor **197**, for example a one megohm resistor. The opposite side of the resistor **194** is connected by a wire **54***a'* to a second sensor button **62***a'*. The sensor button **62***a'* is labeled on the drawing as an "off" button, since it subsequently turns the thyratron off.

The biasing in this instance is such that the normal relay condition of FIG. 3 prevails until such time as the "on" sensor button **62***a* is touched. Assuming the tap **186** to be set properly by a knob corresponding to the knob **52**, the bias is upset so that the thyratron tube fires, whereby to reverse the relay condition. The bias now is such that the tube remains firing, even though the hand is removed from the button **62***a*.

Subsequently, when the "off" sensor button **62***a'* is touched, the bias is altered to the point that the thyratron tube stops firing, whereupon the relay returns to its initial condition. The sliding tap **186** on the resistor **188** can be set to a position where the thyratron will remain firing only as long as the button **62***a* is touched, whereby the same remote unit can be used to achieve the desired results heretofore explained with regard to FIG. 5, or to obtain the results initially discussed with regard to FIG. 4. Thus, in a sense, one can have his cake and eat it too.

Various remote controls similar to those possible with the first four figures are possible, as will be obvious. In addition, it will be apparent that a movie or slide projector can be turned on and a lamp turned off simultaneously and with the resulting condition prevailing until the second button is touched.

In the preceding examples of the invention response has been to touch, and more particularly to body capacity to ground. The invention is also adaptable to a liquid level sensing device, and by extension to a liquid level control device. In this connection, attention is directed to FIGS. 6–8, wherein the basic relay unit **20** remains the same as heretofore, and wherein the neon lights **30** and **32** are retained in FIG. 6.

As noted, the basic relay unit remains the same as heretofore. The plug-in adapter unit **48***b* appears the same externally, including a potentiometer adjusting knob **52***b*. The differences therein will be explained hereinafter with regard to the electric circuit of FIG. 8. The wire or connector **54***b* in the present instance comprises a three wire cable, including wires **196**, **198** and **200** (FIG. 6). The wires are respectively connected to conductive probes **202**, **204** and **206**. These probes are mounted by means of a plurality of insulating grommets **208** in the parallel flanges **210** of a sheet metal bracket or channel **212**. The web **214** of the channel is provided with apertures **216** for mounting the channel or bracket to a support. As will be apparent, the probes **204** and **206** extend down to the same level, while the probe **202** terminates above the bottoms of the probes **204** and **206**.

Turning now to FIG. 8, the schematic wiring diagram of the device of FIG. 6 is shown. The plug **50***b* is of the standard type heretofore discussed, and pin **1** therefore is not connected. Pin **2** is grounded, as heretofore. Pin **3** is connected direct to pin **8**, and is also connected by the wire **196** to the higher or shorter probe **202**.

Pin **4** is connected by the wire **198** to one of the longer or deeper probes **204**, and pin **5** is not connected. Pin **6** is connected to a resistor **218**, for example of 100,000 ohms, to a junction **220**. This junction is connected through a larger resistor **222**, for example one megohm, to pin **7** of plug **50***b*. The junction **220** is connected by the remaining lead wire **200** to the other longer or deeper probe **206**.

In the present instance the biasing is such that when both of the probes **204** and **206** (and hence also probe **202**) are not mutually in contact with water the thyratron fires, and the relay is operated, whereby the controlled outlet **26** is "on" and the controlled outlet **28** is "off." When the two probes **204** and **206** first are electrically interconnected by water, nothing happens. However, when the water level rises sufficiently to contact those two probes and also probe **204**, the thyratron is cut off, the relay drops out, atnd the outlet **28** becomes "on" and the outlet **26** becomes "off." When the liquid level drops relative to the probes, the probe **202** first leaves the water or other conductive liquid, and the thyratron remains in its non-conducting condition. It is not until the probes **204** and **206** have also left the water that the thyratron fires.

Since the relay "holds" in whichever position it was before the two longer probes alone are contacted by water or other conductive liquid, the device in the present example is well adapted for liquid level control. A specific example thereof is shown in FIG. 7, wherein the device remains exactly the same as described in connection with FIGS. 6 and 8, except that the neon bulb is removed from the left outlet **26**. The right outlet **28** may be left with nothing plugged into it, or a neon lamp or other form of signal may be plugged thereinto so that the owner or operator might be advised of the condition of operation. Instead, the plug of an electric wire **224** is inserted in the controlled outlet **26**. The wire **224** leads to a solenoid controlled valve **226** in a water supply line leading to a tank **230**. The probes **202**, **204** and **206** depend into the tank. As long as the thyratron is not firing and the relay is in the initial or off position, and the two probes **204** and **206** are in the water, nothing happens. However, when the water level falls below the bottom of the two probes **204** and **206**, the thyratron fires to reverse the relay condition, and thus to turn the outlet **26** "on." This causes the solenoid control valve **226** to open, whereupon water enters the tank **230** through the supply line or pipe **228**. Water continues so to enter the tank even after contacting the two probes **204** and **206**, until a third probe **202** also is encountered. It will be apparent that the probes can be moved up and down through the rubber grommets **208**, whereby to set the relative and absolute limits of water in the tank. When the third probe is encountered the thyratron stops firing, the relay goes to its off position, and the controlled outlet **26** is turned "off," thereby effecting closing of the solenoid control valve **226**, and shutting off the water supply to the tank. Water remains shut off until the water level drops below the bottom of the two probes **204** and **206**, as heretofore described.

Conversely, a reverse action can be obtained if desired, whereby to remove water from a tank or a sump or the like. A motor driven pump replaces the solenoid valve, and the motor is plugged into the controlled outlet **28**. Operation will be exactly the same except for reversal of the "on" and "off" conditions.

In some instances it is desirable simply to detect the presence of water, without necessarily providing for any level control. For example, if rain should come in an

open window, or fall into an open convertible automobile, it is desirable that an alarm be sounded or that an automatic device be actuated for closing the window or raising the roof. A simplification of the circuit of FIG. 8 is possible for such instances, and reference should be had to FIG. 9 for such a simplified circuit. Pin 2 is grounded as heretofore while all of pins 1, 3, 4 and 5 are not connected. Pin 6 is connected through a resistor 218*c* to a junction 220*c*. This junction is returned through a resistor 222*c* to pin 7. The resistors may be of the same value as those in FIG. 8, for example the resistor 218*c* may be 100,000 ohms, and the resistor 222*c* may be one megohm. The junction 220*c* is connected to a probe 206c. The No. 8 pin is connected to a probe 202*c*.

In the circuit of FIG. 9 the biasing is such that the thyratron is normally in the conducting or firing condition. When the two probes 202*c* and 206*c* are electrically interconnected by the presence of water the biasing is changed so that the thyratron stops firing. This causes the outlet 26 to be turned "off" and the outlet 28 to be turned "on." Accordingly, a light may be turned on, an alarm sounded, or an automatic device actuated, and plugged into the outlet 28, thereby to indicate the presence of water, and compensate therefor if desired.

The relay device is also readily adapted for use with a photosensitive sensor or sensing device. One such adaptation is illustrated in FIG. 10 wherein the basic relay unit 20 remains identical with the form heretofore described, and has a pair of neon lamps 30 and 32 respectively plugged into the control outlets 26 and 28, as heretofore. As will be understood, the lamps could be replaced with remote lights or lamps with flexible drop cords plugged in the outlets 26 and 28, or they could be replaced with any other electrical device to be actuated, all as heretofore discussed. The important change in the present invention resides in the plug-in unit 48*d*, which continues in the form of a rectangular housing having electronic components therein hereinafter to be described, and further having on the top thereof a rotatable rheostat knob 52*d*. It is to be understood that the plug-in unit 48*d* has an octal plug on the bottom thereof received in the octal socket on the top of the basic relay unit 20. On one face of the plug-in unit 48*d* there is provided a light sensitive device 232. Preferably this is a photosensitive resistor, such as a well known cadmium sulphide cell. A tube 234 surrounds the cell and extends outwardly from the unit 48*d* to render the cell sensitive to light from only a predetermined direction. The tube 234 may be painted black to eliminate reflections, and may have an optical system incorporated therein, if so desired.

In other instances in which control is effected by means of light, it may be desired to have the photosensitive cell at a remote location. Such a minor modification is illustrated in FIG. 11 wherein the basic relay unit 20 and parts associated therewith remain exactly as heretofore, except for the plug-in unit 48*e* having the rheostat control knob 52*e* on the top thereof. This plug-in unit is the same as that in FIG. 10, except that in place of the photocell 232 mounted in the housing of the unit 48*e*, there is a flexible two-wire electric connector 54*e* extending from the trunk thereof through a grommet 56*e*. This wire leads to a remote housing 236 having apertured flanges 238 thereon for mounting of the housing 236. A housing is provided on one surface with a photosensitive resistor 232*e* of the same type in FIG. 10. In the present instance no surrounding tube is provided about the photosensitive resistor, whereby it is considerably less directional in effect than is the case in FIG. 10 with the surrounding tube.

It will be apparent that the devices of FIGS. 10 and 11 operate in substantially the same manner, and can be used for similar purposes, such as to turn on a night light, to turn on flood lights, to open garage doors, to announce entrance of customers to a store, and so on and so forth indefinitely.

The electronic circuitry for both FIGS. 10 and 11 is the same, and this is shown in FIG. 12.

The numerals used in FIG. 12 correspond to those in FIG. 10, but the correspondence to FIG. 11 will be obvious. Pins 1, 3, 4 and 5 of the plug 50*d* are not connected. Pin 2 is grounded, as in the past. Pin No. 6 is connected to a resistor 240, for example of 1.8 megohms. This resistor is connected to a junction 242, and the junction is connected to a sliding tap 244 controlled by the knob 52*d*, and contacting a resistor 246, for example a 200,000 ohm resistor. The resistor 246 is returned direct to pin 7.

A junction 242 also is connected through the photosensitive resistor 232 to pin No. 8.

The biasing is such that when the resistor 232 is exposed to light the thyratron is in its normal non-conducting state. Hence, the controlled outlet 28 is in the "on" condition, while the controlled outlet 26 is in the "off" position. When the photosensitive resistor is exposed to light, the biasing changes so that the condition is reversed, the thyratron firing and the outlet 26 being "on" and the outlet 28 being "off."

The relay device is also quite readily adapted for use with a temperature sensitive sensor, more particularly a thermoelectric sensor. Utilization of such a device is illustrated in FIGS. 13–15. The basic relay unit 20 remains exactly the same as heretofore, and again is provided with plug-in lamps 30 and 32 (which again can be neon lamps) in the control outlets 26 and 28 respectively. On the other hand, one or more of the lamps can be an incandescent lamp and used for heating, as in a chicken brooder. The plug-in unit 48*f* again is provided with a rheostat control knob 52*f* on the top thereof. A two strand lead wire 54*f* extends from the plug-in unit 48*f* through a grommet 56*f* in the sidewall thereof. The lead wire 54*f* extends to a metal tube 248 containing a temperature responsive resistor. A metal or the like strap 250 is provided for securing the tube in suitable operative position.

As will be appreciated, the thermoelectric sensor is useful for controlling nearly any sort of apparatus which is to be controlled as to temperature, such as an oven, a fire warning or other high temperature alarm, or a low temperature alarm, a cut-off control according to temperature, etc. The thermoelectric sensor is shown in FIG. 14 in conjunction with an attic fan. The parts are identical with those shown in FIG. 13, except that the neon bulbs have been removed from the control outlets 26 and 28.

An attic fan 252 is provided with a lead wire 254 having a plug 256 thereon plugged into the controlled outlet 28. As will be set forth shortly hereinafter, the controlled outlet 28 is "off" at normal temperatures, and is turned "on" at higher temperatures whereby to operate the fan. The temperature necessary for operation can be adjusted by means of the knob 52*f*.

The electric wiring diagram of the circuitry within the plug-in unit 48*f* is to be found in FIG. 15. Pin 2 of the plug 50*f* is grounded, as in the previous examples, while pins 1, 3, 4 and 5 are not connected. Pin 6 is connected to a resistor 248, for example a 10,000 ohm resistor. This resistor in turn is connected to a junction 260. The junction is connected to a sliding tap 262 on a resistor 264, for example of 200,000 ohms. This resistor is, in turn, connected to a resistor 266, which is connected to a junction 268. This junction is connected to pin 7 of the plug 50*f*.

The junction 260 is connected through a temperature sensitive device or thermoelectric sensor 270, for example a thermistor. The thermistor 270 in turn is connected through a wire 272 to a junction 274. The junction 274 is connected by means of a capacitor 276, for example a 50 microfarad capacitor, to the junction 268. The junction 274 also is connected through a rectifying diode 278 to a

resistor **280**, for example of 100 ohms, which is, in turn, connected to a pin **8** of the plug **50***f*.

As will be apparent, the diode **278** provides for the application of DC potential to the thermistor **270**, while the capacitor **276**, which is a polarized capacitor, insures against rapid voltage fluctuation across the thermistor which could cause undesirable operation of the relay. The biasing is such that the thyratron is in a conducting or firing condition for relatively low temperatures. Upon higher temperatures, the bias changes so that the thyratron shuts off. In other words, the outlet **26** is "on" and the outlet **28** is "off" at relatively low temperatures, while the condition is reversed for relatively higher temperatures. Setting of the tap **262** on the resistor **264** determines the temperatures at which the reversal of operation takes place, and this naturally will be adjusted in accordance with any given installation and set of circumstances. Thus, in FIG. 14 the fan **252** is controlled by the outlet **28** which is normally "off," but which is switched "on" at higher temperatures. Thus, when the tube **248**, in the nature of a probe, is placed in an attic in which the fan **252** is located, response of the thermistor **270** within the tube **248** to the temperature of the attic will cause the fan to be switched "on" when the temperature rises above a predetermined degree.

The specific examples of the invention as heretofore shown and described are for illustrative purposes only. Various changes in structure will no doubt occur to those skilled in the art, and will be understood as forming a part of the present invention insofar as they fall within the spirit and scope of the appended claims.

The invention is claimed as follows:

1. Relay apparatus comprising a basic unit including a housing, A.C. power supply means in said housing and including A.C. electric power input means to said housing, a controlled electric outlet on said housing, a relay, said relay in one position connecting said electric power supply means to said electric outlet and in another position effecting disconnection thereof, separable electric connection means on said housing comprising a socket having a plurality of terminals, electric circuit means interconnecting said power supply means and said separable electric connection means and said relay to determine the position of operation of said relay; said electric circuit means including an electric valve having a cathode element, anode element, and a control element, non-rectifying means interconnecting said power supply means, said anode element and said relay independently of said socket for operation of said relay upon conduction of said electric valve, non-rectifying means interconnecting said cathode element and said power supply means independently of said socket and forming a return path, means interconnecting said control element and one of said socket terminals, and means connecting at least one other of said socket terminals to said power supply means; and detachable controlling means comprising a housing, sensing means, separable connecting means complementary to said basic unit separable connecting means and comprising a plug having a plurality of terminals corresponding to and engageable with the terminals of said socket, said plug being detachably associated with said socket, and electric circuit means interconnecting said sensing means and said detachable controlling means separable connecting means and coacting with said basic unit circuit means normally to bias said electric valve off and changing in impedance to bias said valve for conduction on alternate half cycles upon operation of said sensing means to control the position of said relay in accordance with the condition sensed by said sensing means, said just mentioned electric circuit means comprising means connecting said sensing means to the plug terminal corresponding to the socket terminal connected to said control element, and additional means connecting said sensing means to the plug terminal corresponding to a socket terminal connected to said power supply means.

2. Relay apparatus as set forth in claim **1** wherein said power supply means includes a transformer having a center tapped secondary, one end of said secondary being connected to said relay and through said relay to said anode, the other end of said secondary being connected to said cathode and to another of said socket terminals, and the center tap being connected to yet another socket terminal.

3. Relay apparatus as set forth in claim **2** wherein said electric valve comprises a thyratron tube wherein the control element is a grid, and further including a suppressor grid and a filament, the anode being connected to said relay and through said relay to one end of the center tapped secondary, the center tap being connected in common to the cathode element, to the suppressor grid, and to one side of the filament, and the other side of the transformer secondary being connected to the other side of the filament.

4. Relay apparatus as set forth in claim **1** wherein the power supply input means has two sides, and further including a second separable electric outlet, each of said outlets having two terminals, means connecting one side of said power input means in common to corresponding terminals of said outlets, said relay having two fixed contacts and two positions of operation, means connecting one of said fixed contacts to the other terminal of one outlet, means connecting the other fixed contact to the other terminal of the second outlet, said relay further having a movable contact alternately engageable with said two fixed contacts according to the position of said relay, and means connecting said movable contact to the other side of said power input means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,337,778 August 22, 1967

Lester M. Becker

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 56, for "controlled devices" read -- controlling devices --; column 3, line 13, after "contacts" insert -- 92 and 94, and a second pair of fixed contacts --; column 4, line 6, for "knobs 52" read -- knob 52 --; line 55, for "commercial" read -- commercials --; line 71, for "it possible" read -- it is possible --; column 6, line 3, for "pin 1 therefore" read -- pin 1 thereof --; line 24, for "atnd" read -- and --; column 8, line 62, for "10,000 ohm" read -- 100,000 ohm --; column 9, line 15, for "temperatures" read -- temperature --.

Signed and sealed this 20th day of August 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents