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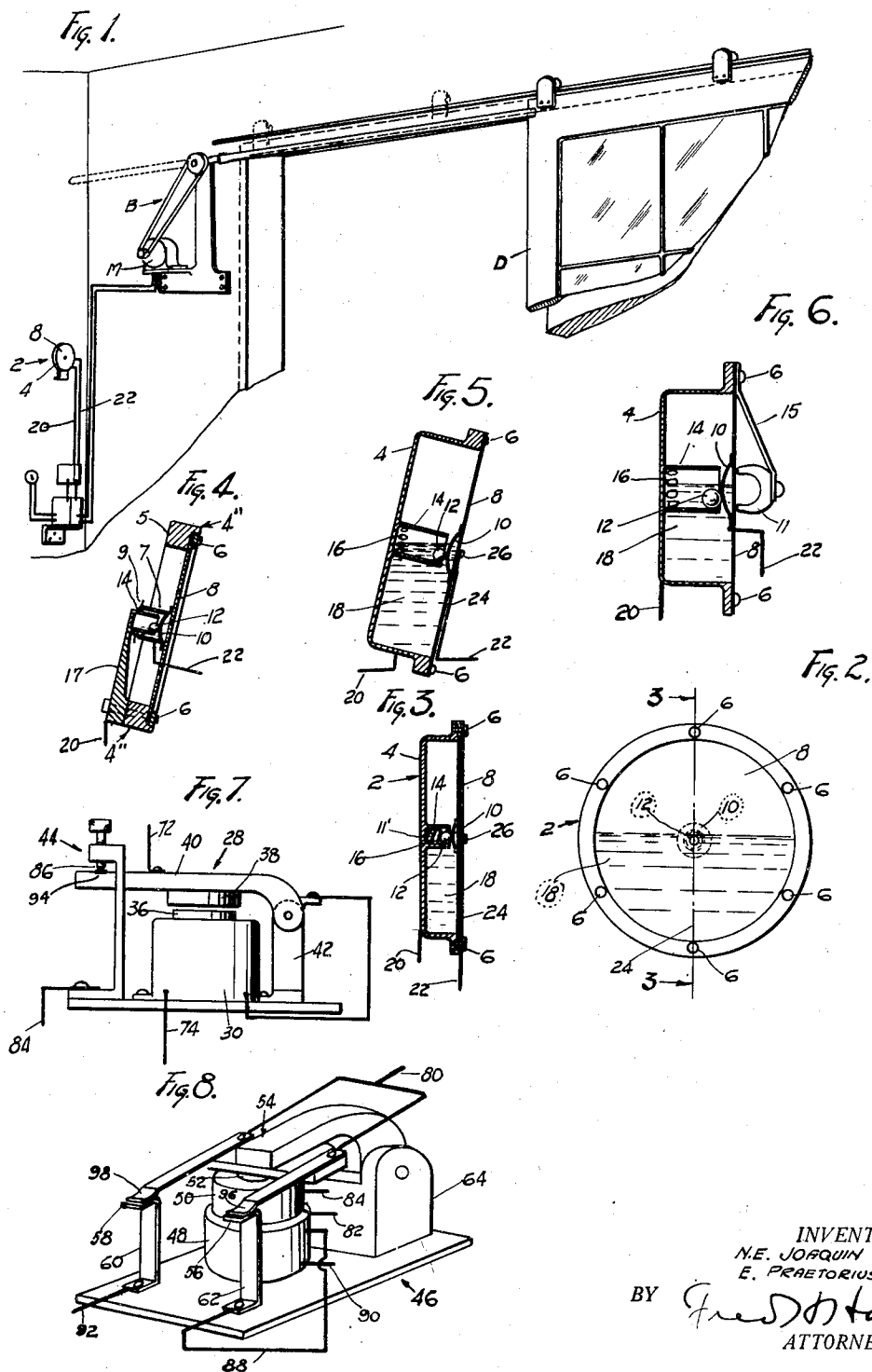
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SOUND AND LIGHT WAVE APPARATUS

Filed Dec. 24, 1930

2 Sheets-Sheet 1



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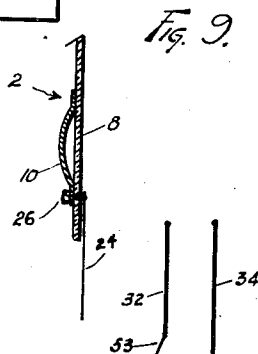
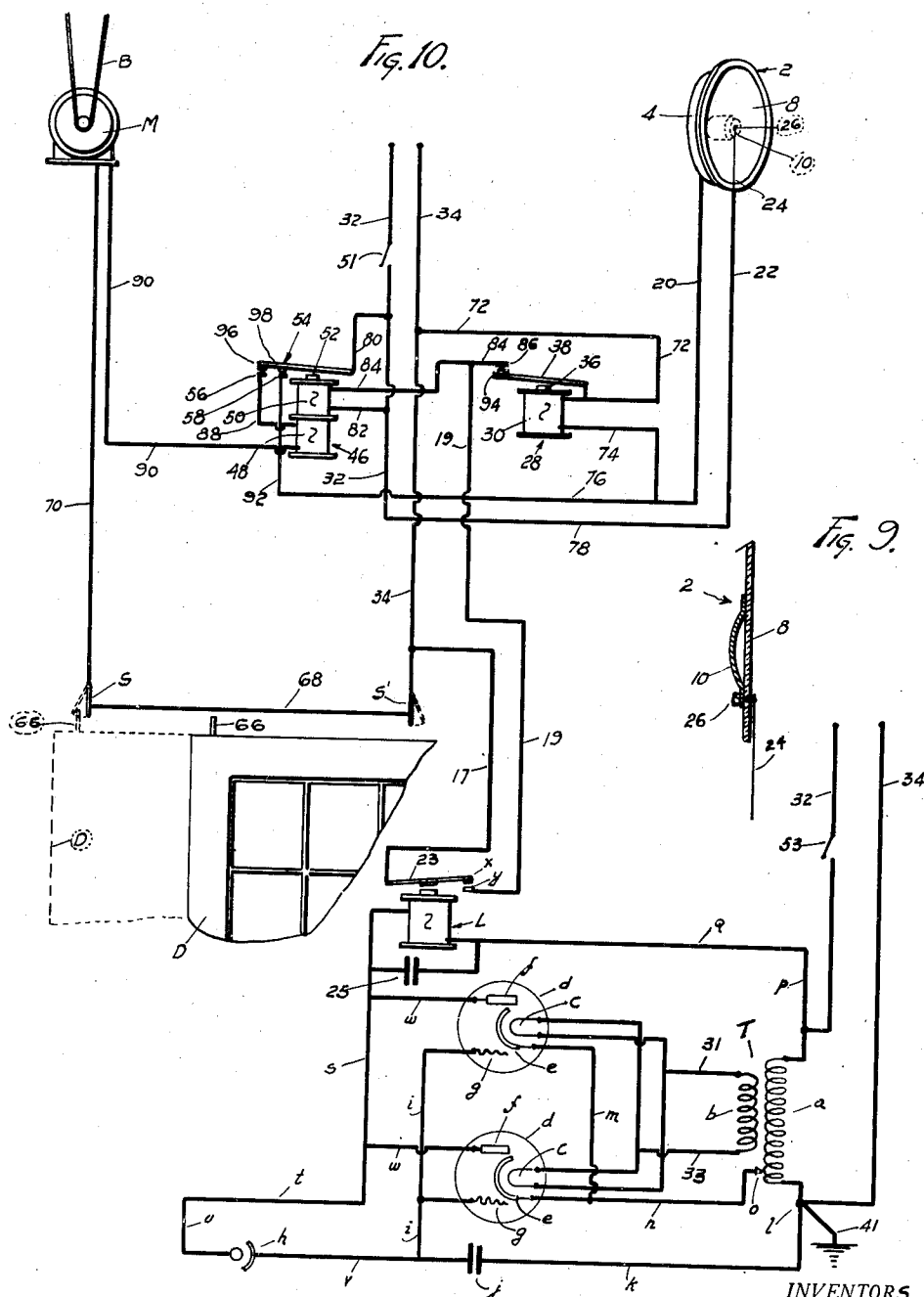
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SOUND AND LIGHT WAVE APPARATUS

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2 Sheets-Sheet 2



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SOUND AND LIGHT WAVE APPARATUS

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Serial No. 504,620

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Our invention relates to an apparatus, adapted to be operated at a suitable distance therefrom, either by sound or light waves, for actuating movable machinery or other equipment at will, and more particularly closures for garages, railroad gates, doors, fence gates, and the like.

It accordingly is an object of our invention to provide a novel form of apparatus whereby a suitable motor functioning to actuate a movable means, such as a garage door, gate or other closure or apparatus, in which a vibratory means, sensitive to sound waves, and preferably in diaphragm form, and/or a vibratory means, sensitive to light waves, and preferably in photo-tube and electron tube form, is adapted to operate said motor, preferably by means of one or more relays in circuit with said vibratory means, said motor and a source of electrical energy.

Another object of our invention is to provide a novel form of switch mechanism or circuit interrupting means comprising a vibratory diaphragm, of suitable material, such, for example as mica, associated in any preferred way with a casing of any preferred construction, in which casing may be positioned a non-arcing fluid, such as kerosene or other suitable oil, with which diaphragm is associated in any preferred way an electrode responsive to and adapted to multiply the vibrations, or the amplitude of said vibrations, of said diaphragm, said casing having associated therewith, a movable electrode, which may be either a spring, gravity or otherwise actuated ball, provision being made in said casing for guiding said electrode in its movement, and at the same time permitting the free movement of said fluid.

The above, and further objects and advantages of our invention, as will hereinafter more fully appear, we attain by the construction described in the specification, and illustrated in its preferred form on the drawings, forming a part of our application.

Reference is had to the accompanying drawings, in which similar reference characters denote similar parts. In the drawings,

Fig. 1 is a fragmentary, more or less diagrammatic perspective view of our invention shown applied to a movable door, which may be that of a garage,

Fig. 2 is an enlarged front elevational view of one form of vibratory switch mechanism or device,

Fig. 3 is a cross-sectional view, taken on the line 3—3, Fig. 2,

Figs. 4, 5 and 6 are views similar to Fig. 3, but showing modifications thereof,

Fig. 7 is a side elevational view of one of the relays for the sound wave circuits,

Fig. 8 is a perspective view of the motor relay for said circuit,

Fig. 9 is an enlarged, and very much exaggerated cross-sectional fragmentary detail view of the convex diaphragm electrode associated with the vibratory diaphragm, and

Fig. 10 is a diagrammatic view of the electrical circuits for both sound sensitive and light sensitive devices.

Describing our invention more in detail, in its broader aspects said invention comprises an apparatus including a novel form of switch mechanism in which a vibratory diaphragm, sensitive to sound waves, upon being vibrated by any sound, such, for example as the horn of a motor vehicle, and/or a light sensitive device upon being acted upon by the rays of light from say the headlights or other source of light, is adapted through a suitable relay mechanism to energize an electric motor to operate a closure or other part of movable machinery, as may be desired.

More specifically our invention comprises an apparatus consisting of a special form of switch 2 having a suitable casing 4 with which is associated in any preferred way, as by the fasteners 6, a vibratory diaphragm 8 of suitable material, such as mica, which may be so associated with said casing as to render the same fluid tight, said casing, as seen more particularly in Fig. 3, being adapted to house to any preferred depth, a suitable non-arcing fluid, such as kerosene, or any other oil 18.

Associated with the vibratory diaphragm 8, in any manner in practice preferred, as by a suitable glue, is a preferably convex diaphragm 10 constructed of a material of electrical conductivity, thus forming an electrode, the space within said convex diaphragm being filled with air and sealed against leakage by said glue. It will thus be seen that any movement of the diaphragm 8 will be conveyed to and greatly multiplied by the convex diaphragm 10, causing an effective movement of a movable electrode 12, which may take the form of a ball constructed of material of electrical conductivity and hence is adapted to establish and disestablish an electric circuit with the electrode 10.

Associated with the casing 4 in any manner in practice preferred, is a suitable housing 14, preferably of tubular form, and of electrical conductivity, which housing is provided with perfora-

tions 16 to allow free movement of the kerosene oil 18 within the casing 4, so that the electrode 12 may be easily moved to break circuit with the electrode 10 as the diaphragm 8 is vibrated, the housing 14 extending within close proximity with the electrode 10, but entirely free therefrom.

To any suitable point on the casing 4 is connected the electrical lead wire 20, which, of course, is electrically connected at all times to the movable electrode 12 through the metal casing 4 and metallic housing 14, another lead wire 22 being connected to a wire of preferably smaller gauge 24, which is secured by a suitable construction 26 to the electrode 10.

The fluid 18 permits the electrode 12 to break the circuit with the electrode 10 an indefinite number of times without any arcing or roughening between the surfaces of the two, thus increasing the life thereof. Further, a slight dash pot effect is attained so that the electrode 12 will have a positive movement.

As seen more particularly in Fig. 5, the casing 4, and hence the diaphragm 8 is inclined from the vertical, shown exaggerated in said figure, so that when said diaphragm is at rest, and thus unaffected by external influences, the electrode 12, by gravity, will be in direct contact with the electrode 10.

If described, the diaphragm 8 may be in strictly vertical position, as seen in the modification depicted in Fig. 3, in which the vibratory diaphragm 8 with its electrode 10 coacts with the movable electrode 12, its movement being opposed by a spring 11' of comparatively slight tension, which spring will positively hold said electrodes in contact but at the same time permitting circuit interruption, when the diaphragm 8 is vibrated.

In Figs. 4 and 6 we have illustrated two further modifications of our invention, Fig. 4 illustrating a simplified form of switch, the vibratory diaphragm 8 being mounted in a ring 5 of any preferred form and material, said diaphragm being mounted in said ring by suitable fasteners 6. The casing 4'', and indeed the entire switch, are also inclined in this form of our invention, the ring 5 having an arm 17 associated with said casing, which arm has a tubular housing 14 with the mobile electrode 12 adapted to engage by gravity the electrode 10, which may be constructed as in the other form of our invention, but has a tubular portion 7 telescoping with the tubular housing 14 as the diaphragm 8 vibrates. It will be observed that the non-arcing fluid 18 will by this construction have a free movement, and further, will always provide a wet surface for the electrode 12. If desired, the entrance to the tubular portion 7 may be provided with a suitable material 9 to exclude extraneous material, such as dust.

In the form shown in Fig. 6, the switch 2 is vertically positioned, the construction being precisely the same as in the other forms of our invention, except that a small permanent magnet 11, which may be of horse shoe form, and suitably mounted, as by the arm 15, so that said magnet 11 will at all times attract the movable electrode 12 to make contact with the electrode 10, until the vibration of the diaphragm 8 overcomes the attraction of the magnet 11 and breaks the circuit between the electrodes 10 and 12.

In circuit with the vibratory switch 2, in the manner presently to be described, is a relay 28 of suitable construction, and which may be termed the sound relay, having a coil 30 of a number of

turns and gauge suitable to conduct an electric current, either direct or alternating, such, for example, as used for household purposes, and supplied by the leads 32 and 34 (Fig. 10), said coil having a core 36 with which is associated an armature 38, connected as desired to an armature lever 40, associated as preferred with the framework 42 of the relay 28, said framework being provided with suitable adjusting means 44 of conventional or other form. See Fig. 7.

Associated with the relay 28 and the remaining elements of the invention, in the manner presently to be described, is a second relay 46 (Fig. 8), termed the motor relay, comprising coils 48 and 50, said coils varying in number of turns and wire gauge as in practice demanded and needed, said coils being preferably mounted as shown in said figure for convenience of assembly upon the framework of relay unit 46, although said arrangement is to be considered as suggestive merely.

Associated with the coils 48 and 50 is the core 52, with which in turn is associated the armature construction 54 having contact points 56 and 58, associated with the electrodes 60 and 62 of conventional or other form. The armature 54 with its plural contact points, may be pivoted to the framework 64 of the motor relay as shown in Fig. 8. Any other suitable construction may be substituted for that shown and just described, so long as the essential elements, viz, the coils, core and armature with plural contact points, are provided.

Reference is had more particularly to Fig. 10 in which is found a diagram of the electrical circuits. As seen in said figure, the leads 32 and 34 are connected to some source of electrical energy, which may be the usual household circuit, the lead 34 being in circuit with a suitable switch S', adapted to be opened or the circuit broken by a projection 66 upon the closure D, as presently to be explained, which switch is in circuit with a second switch S by means of the wire 68, which switch is identical in construction and operation as the switch S', said switch S being in circuit by the wire 70 with the motor M which is adapted to actuate said closure or door D. As the projection 66 is moved with the closure D to the end of its stroke or movement, said projection, by contacting the switch S or S' selectively the motor circuit is automatically interrupted through the deenergizing of the motor relay coil 48 and consequent opening of the contact points 96 and 56, and the closure in either direction of its movement brought to a standstill. The switches S and S' are of such construction that they are always normally in the closed position, and upon being momentarily opened by projection 66 they immediately regain their closed position automatically.

The lead 34 is connected by means of the wire 72 to both the armature 38 of the relay 28 and to one end of the coil 30, while the other end of the coil 30 is connected by the wire 74 to the wire 76, which in turn is in circuit with the wire 20 leading to the casing 4.

The other lead 32 from the source of electrical energy hereinbefore described is in circuit by means of the wire 78 with the wire 22 leading to the wire 24 connecting with the connection 26 to the convex electrode 10. (See also Fig. 9).

The lead 32 is also in circuit with the armature 54 of the motor relay 46 by means of the wire 80, and also with one end of the coil 50 by the wire 82.

The relays 28 and 46 are inter-connected with

each other and with the switch 2 and motor M in the following manner:

The other end of the coil 50 is connected by means of the wire 84 to the contact point 86 of the sound relay 28. One end of the coil 48 is connected by the wire 88 to the contact 56 of the motor relay 46, while the other end of said coil is connected by the wire 90 to the motor M. The other contact point 58 of the motor relay 46 is connected by the wire 92 leading to the wire 76, which connects with the wire 74 to the coil 30 of the sound relay 28, and also with the wire 20 leading to the casing 4 of the switch 2.

The circuit of the sound relay 28 is normally closed, and so long as the coil 30 thereof is energized, the circuit through the contact point 94 of the armature 38 will maintain the circuit of the motor relay coil 50 open through the points 86 and 94.

Referring again to Fig. 10, the movable electrode 12 being in contact position with the electrode 10, a circuit is established through the wires 20 and 22, the wire 20 establishing a circuit by the wire 74, coil 30, wire 72, lead 34. The wire 22 establishes the circuit through the wire 78, and lead 32. This energizes the coil 30, attracting the armature 38 and its contact 94 away from the contact 86, maintaining the circuit through the motor relay coil 50 open.

The winding, electrical resistance, etc., of the sound relay 28 is in practice determined by particular conditions, such, for example, as the character of the electric current used, its voltage etc. Said relay functions to operate the motor relay 46, which in turn operates the motor M, when the circuit of the sound relay 28 is interrupted by means of the vibratory diaphragm of the switch 2.

As just stated, the motor relay 46, when energized by the sound relay 28, functions to start the motor M. The coils 48 and 50 vary in turns and wire gauge, depending upon the size of said motor. Any preferred number of contact points 96 and 98 on the armature 54 coacting with contact points 56 and 58 on said relay may be used.

Assuming that the circuit is broken between the movable electrode 12 and the electrode 10 on the diaphragm 8, caused by the vibration thereof, due to sound, as previously explained, the closed circuit, hereinbefore described, will be interrupted, de-energizing the coil 30, and thus permitting the armature 38 to have its contact point 94 placed in engagement with the contact point 86. This establishes a circuit for the lead 34, wire 72, armature 38, contact points 94 and 86, wire 84, coil 50, wire 82 and the other lead 32 leading to the source of electrical energy.

The coil 50 being thus energized, the armature 54 is attracted, placing the contact points 96 and 98 respectively in contact with the contact points 56 and 58 of the relay 46. The current from the lead 32 then passes to wire 80, armature 54, contact points 96 and 56, wire 88, coil 48, and wire 90 to motor M, the circuit being completed through lead 34, switch S', wire 68, switch S, wire 70 to motor M, operating said motor to move the door D through a conventional or other form of belt mechanism B (Fig. 1) associated in any preferred manner with said motor.

At the same time that the coil 50 is energized, a circuit will be established from the electrical lead 32, wire 80, armature 54, contact points 98 and 58, wire 92, wire 76, wire 74, coil 30 of relay 28, wire 72, to lead 34 re-establishing the circuit

through said coil 30 which attracts its armature 38, interrupting the circuit through the contact points 94 and 86, de-energizing coil 50 ready for the next start, and permitting the electrode 12 to assume its original position with respect to the electrode 10 on the diaphragm 8, ready for the next start. Coil 48 functions to maintain relay 46 in closed position thus supplying current through contact points 96 and 56 to motor M for one cycle of closing or opening closure D until switches S or S' are opened by the projection 66.

It will be noted that this operation of re-energizing the coil 30 is independent of the sound sensitive device 2, to insure constancy of operation of said motor, since it might be possible that the vibratory diaphragm 8 would be affected by the vibration of the door or motor vehicle in operation. Coil 48 functions to maintain the relay 46 in closed position for the period of one cycle of opening or closing the closure D, after coil 50 has been opened by relay 28.

The motor M, after being once started, moves the door or closure D until the projection 66 strikes selectively the switches S and S', which breaks the motor circuit and de-energizes coil 48 which allows relay 46 to regain its open position and stops the motor and closure in the selected position. The sequence of operations of all parts in the foregoing description is repeated in identical manner during each cycle of opening or closing of the closure D.

The mechanism for actuating the motor M by light rays is depicted in diagrammatic form in the lower part of Fig. 10, and, of course, may be placed in circuit with the motor relay 46, as presently to be described, but it is to be distinctly understood that in practice the light circuit may be operated independently, it, however, being preferred to place the mechanism together in a single container so the apparatus will not be interfered with and at the same time be readily assembled for adjustment and repairs.

As seen in Fig. 10, a suitable relay L, conveniently termed the light relay, is in circuit with the motor relay 46 as is the sound relay 28 and the operation and function are identical, except that the operation of the mechanism is caused by light waves rather than sound waves.

The circuit of the light relay L is established and disestablished with the source of electrical energy, to which are connected the leads 32 and 34, the motor relay 46 and the motor M by the leads 17 and 19, the former connecting with the armature 23 of said light relay, which armature has a contact point x adapted to make and break the circuit through the contact y to which the lead 19 is connected.

The instant the coil of the relay L is energized, as hereinafter explained, its core attracts the armature 23, closing the circuit through x and y. This causes a circuit to be established between the leads 32, 34, 17, 19, wire 84, coil 50, wire 82, said coil attracting the armature 54, to close the circuit through the contacts 96 and 56, establishing a circuit through the coil 48, wire 90, motor M, wire 70, switch S, wire 68 and switch S', wire 34, until interrupted by the selective opening of said switches. Since the operation is identical with that previously described in reference to the sound wave circuit, further detailed description is not believed needed.

To actuate, or cause the light relay to be energized, a device sensitive to light rays must be provided. To this end any suitable device, such as a

novel or other form of photo-electric tube or cell *h* is provided, and is positioned at any convenient point such as the door jamb of the garage where the light rays of say, one of the automobile head lamps, may reach the same.

As is known, a photo-electric tube or cell is a device which, when connected to a source of electrical energy, and maintained in a dark condition, possesses a very high internal resistance, and permits no electric current to flow therethrough. As soon, however, as a beam of light is allowed to fall upon said tube or cell, its condition is instantly changed so that a very minute current may pass therethrough, depending upon the intensity of the light falling thereon.

To provide for said minute current, the leads 32 and 34 may be tapped at any convenient point, or separate leads may be used, and the ends of said leads are placed in circuit with the primary coil *a* of a suitable transformer T, having a secondary coil or winding *b*.

If desired said transformer may be of the adjustable type, as indicated on Fig. 10, although this is not essential.

To detect and amplify the minute current flowing through the tube or cell *h*, any suitable rectifiers *d* may be employed, such as a pair of modified radio tubes, arranged in parallel, to provide for safety and capacity, so that if one should for any reason become inactive, the other will still be available for use. Any preferred number of such rectifiers or radio tubes may be used.

As seen in Fig. 10, a transformer T is provided, which transformer has a primary coil *a* of a suitable number of wire turns, and which coil is always in circuit with a source of electrical energy, supplied by means of the leads 32 and 34. Said transformer is also provided with a secondary coil of a suitable number of turns, so that the voltage in the coil *a* will be stepped down to a proper value in the coil *b*. The coil *b* is connected to the filaments *c* of the devices *d* by means of the wires 31 and 33, the current in said coil heating said filaments so they become electron emissive in said devices *d*.

Positioned within each of the tubes or rectifiers *d*, is a suitable oxide coated cathode *e*, which cathode becomes electron emitting when heated by the filament *c*, said cathodes being in circuit with the primary winding *a* of the transformer T through the wires *m* and *n*, either at a predetermined tap point *o*, or one found by adjustment, as previously stated, to provide the voltage needed.

The electron stream, thus emitted from the cathodes *e*, migrates therefrom to the plates *f* in the device *d*, and furnishes a conducting charge on the grids *g* in the devices *d*.

When the photo-electric tube *h* is in darkened condition, there is continuously maintained on the grids *g* a negative bias or electric charge of suitable voltage, by means of the wire *i* connecting the wire *k* through a suitable fixed condenser *j*, wire *k* to the end *l* of the primary winding *a* of the transformer T, the function of said condenser being to provide a high resistance electro-static capacity leak to the ground 41 for the grids *g* and *g*, thus enabling the devices *d* and *d* to give valvular or relay control of the current through the light relay L.

Another suitable fixed condenser 25 of much greater capacity than the condenser *j* is connected across the wires *q* and *s* of the light relay L, and for smoothing out the ripple of the pulsating direct current rectified by devices *d* and

d, so that said relay will be able with more positiveness to attract its armature 23. The wire *q* connects the coil of the relay L, through the wire *p* to one end of the primary winding *a*, to which, also is connected the lead 32, as seen in Fig. 10.

The plates *f* in the devices *d* are connected by the wires *w* to the wire *s*, which, in turn, is connected by the wires *t* and *u* to the photoelectric tube *h*. In order to insure stable and steady operation of the devices *d*, by reason of the static charge on the grids *g*, a ground wire 41 is provided.

In operation, when the photo-electric cell *h* is rendered active by means of light rays falling thereon, as, for example, by the automobile head lamp, a minute positive current in magnitude of a few microamperes flows from the lead 32, through wires *p* and *q*, the coil of the relay L, wires *s*, *t*, and *u* to the photo-electric cell *h*, through wires *v* and *i*, and onto the grids *g*. This minute current, of course, is insufficient in every way to operate the relay L.

As previously explained, when said photo-electric cell is in darkened condition there is continuously maintained on the grids *g* a negative charge of predetermined voltage by reason of the transformer T. The minute positive charge flowing onto the grids *g* diminishes said negative charge in an amount proportional to the light falling onto the photo-electric tube *h*. This destroys the electrical balance of the devices *d*, causing a relatively heavy current to flow from the plates *f* to the cathodes *e*, the circuit of which is provided by the lead 32, wires *p* and *q*, coil of the relay L, wires *s* and *w*, plates *f*, the electronic spaces within the devices *d* to cathodes *e*, wires *m* and *n*, and through that portion of the primary winding *a* between the points *o* and *l*, connecting with the other lead 34.

The electric current thus established is ample to energize the coil of the relay L, which attracts the armature 23 to close the contact points *x* and *y*, causing the motor relay 46 to function identically as previously described in connection with the sound sensitive device 2, and its relay 28.

It will be observed that we do not desire to be limited to the exact structure of the devices *d*, hereinbefore described in detail, since other types of radio or electron tubes may be used, and more particularly a novel or conventional form of gas-filled electron tube, provided such devices have the proper and needed characteristics for proper association with the cell *h*, transformer T and relay L. Further, the devices *d* and *h* are rectifiers, and permit an alternating current to pass through them in only one direction. The fixed condensers *j* and 25 are used merely for insuring the proper operation of the devices *d*, and may be used or not, or other suitable devices substituted therefor, depending upon the character and operation of the devices *d*.

It may also be noted, that while we intend our invention to be used in connection with an alternating current by suitable changes a direct current may be employed.

In case it should be desired to render the entire apparatus inactive, suitable switches 51 and 53, positioned at any preferred point in the circuits, may be provided.

Another important feature of our invention is that it may function as a safety device, when an automobile is positioned in a garage with its doors closed, and the engine running. As is well known, the poisonous qualities of the exhaust

gases, due largely to the carbon monoxid gases, soon overcomes any individual present in the garage under such conditions.

The sound sensitive device 2 being in circuit as previously described, the air pulsations caused by the explosions of the internal combustion engine cause the diaphragm 8 to vibrate, and, as previously explained, instantly causes the motor M to be actuated to open the garage doors admitting pure air into the garage.

Still another important feature of our invention is that without the slightest change to any already installed door opening equipment, our special apparatus may be placed in circuit with the motor of said equipment, and the door may be operated to open and close, either by light or sound waves. The apparatus disclosed on Fig. 10 may be conveniently stored within a small space, such as a suitable iron box, insuring safety and preventing any tampering thereof by unauthorized persons.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

We claim as our invention:

1. In an apparatus of the class described, including a conventional closure, an electric motor for actuating said closure, and a source of electrical energy for operating said motor, the combination of a switch mechanism, a first relay in circuit with said source of electrical energy, a motor relay in circuit with said first relay, said source of electrical energy, and said switch, said switch being adapted to maintain a closed circuit with said first relay, so said first relay will be energized by said source of electrical energy, but when said switch is operated by a motor vehicle accessory when placed in direct alignment therewith, the circuit of said switch is opened, to close the circuit of said motor relay, said source of electrical energy and said motor to operate said closure.

2. In an apparatus of the class described, including a conventional closure, an electric motor for actuating said closure, and a source of electrical energy for operating said motor, the combination of a set of switches in circuit with said motor and said source of electrical energy, means on said closure for selectively operating said switches when said closure is operated, a switch mechanism, sensitive to the effect produced by

the operation of a motor vehicle accessory, when positioned in direct alignment therewith and at a distance therefrom, a set of relays in circuit with said motor, said source of electrical energy, said switch mechanism and with each other, whereby, when said switch mechanism is operated by said motor vehicle accessory, said motor will operate said closure, said means on said closure being adapted to break said circuit through said set of switches, selectively to stop said motor, and an emergency switch for controlling said circuits.

3. In an apparatus of the class described, including a conventional closure, an electric motor for actuating said closure, and a source of electrical energy for operating said motor, the combination of at least two switches, responsive to vibrations caused by the operation of two different motor vehicle accessories, when said accessories are selectively placed in direct alignment with at least one of said switches, and electrical means in circuit with said switches, said motor and said source of electrical energy, whereby said motor vehicle accessories may selectively be caused to operate at least one of said switches when placed in direct alignment therewith and operated at a distance from said closure.

4. In an apparatus of the class described, including a conventional closure, an electric motor for actuating said closure, and a source of electrical energy for operating said motor, the combination of at least two switches, responsive to vibrations caused by the operation of two different motor vehicle accessories, when said accessories are selectively positioned in direct alignment with at least one of said switches, and a set of interconnected relays in circuit with said switches and said source of electrical energy, whereby said switches may selectively cause said source of electrical energy to actuate said motor to operate said closure.

5. In an apparatus of the class described including a conventional closure, an electric motor for actuating said closure, and a source of electric energy for operating said motor, the combination of at least two switches responsive to vibrations caused by the operation of two different motor vehicle accessories, when said accessories are selectively positioned in direct alignment with at least one of said switches, and a set of interconnected relays in circuit with said switches and said source of electrical energy whereby said switches may selectively cause said source of electrical energy to actuate said motor to operate said closure.

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