Nov. 16, 1943. F. D. BRYANT 2,334,538

OPERATING MECHANISM FOR DISCHARGE LAMPS

Filed Feb. 26, 1942 2 Sheets-Sheet 1

Fig. 1.

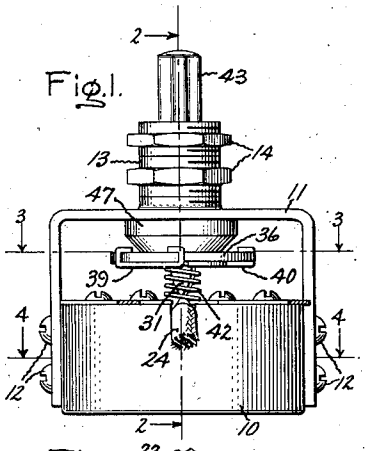
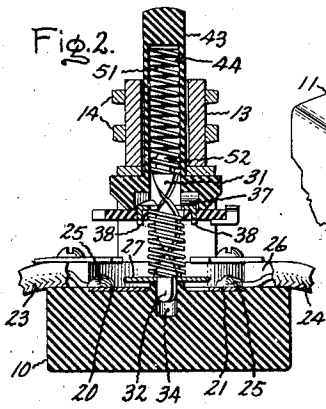


Fig. 2.



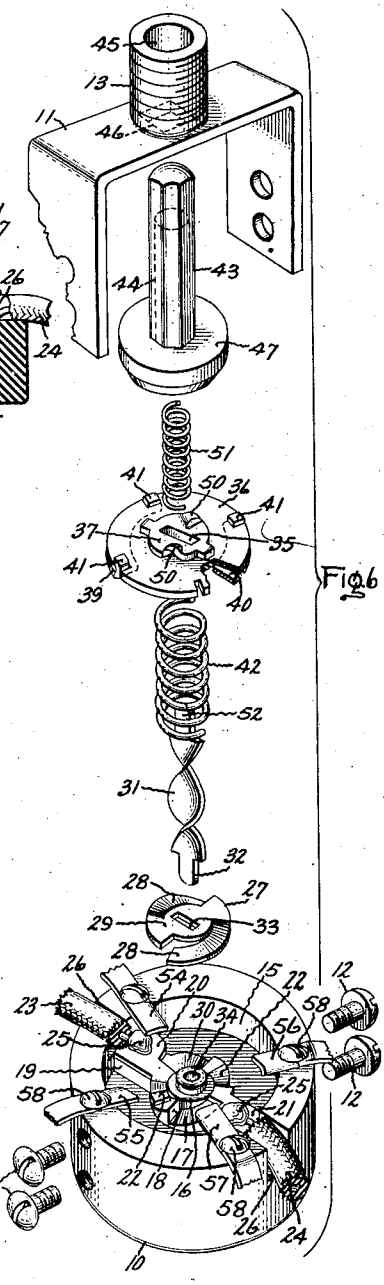


Fig. 3.

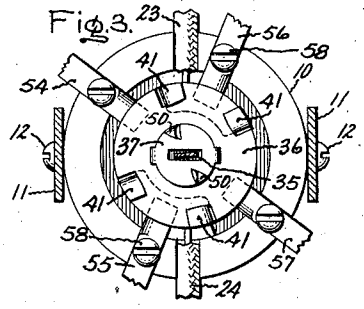


Fig. 5.

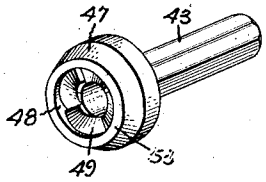


Fig. 4.

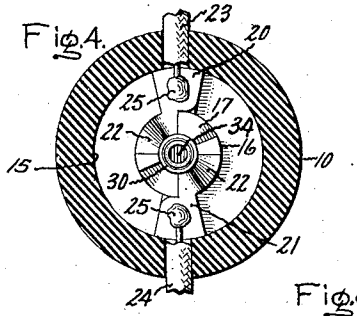
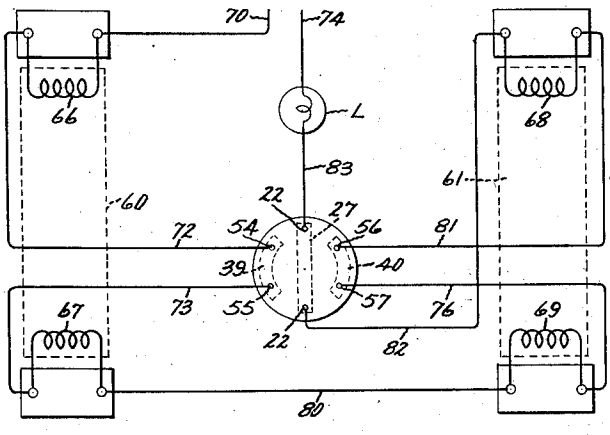


Fig. 8.



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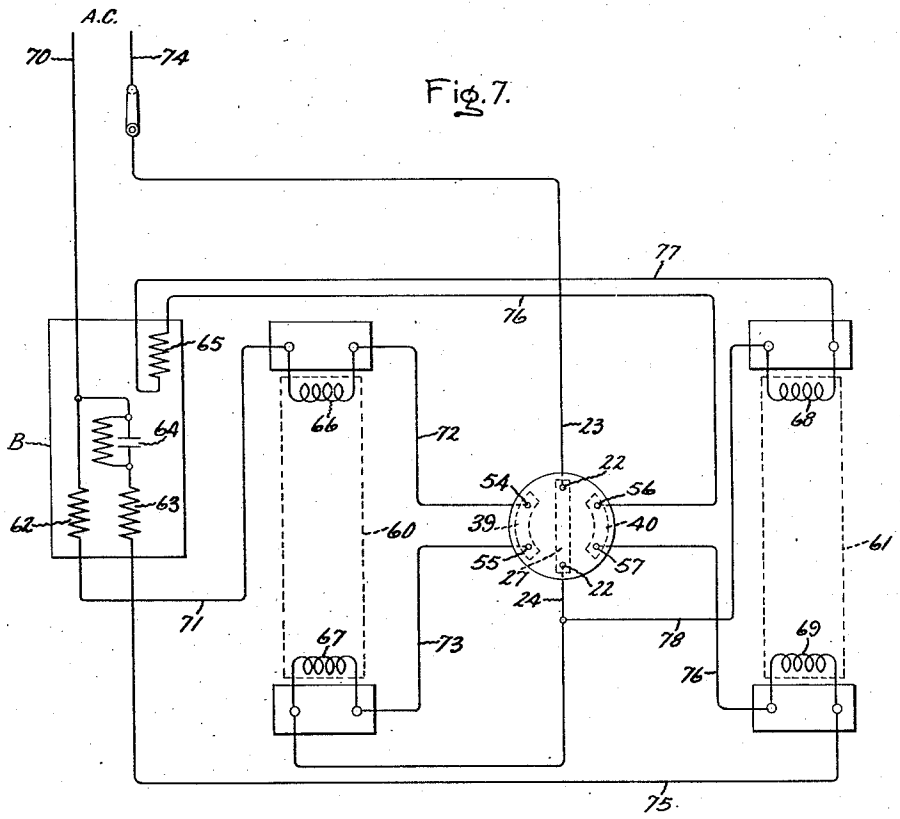
Filed Feb. 26, 1942 2 Sheets-Sheet 2

Fig. 7.



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UNITED STATES PATENT OFFICE

2,334,538

OPERATING MECHANISM FOR DISCHARGE LAMPS

Frank D. Bryant, Stratford, Conn., assignor to General Electric Company, a corporation of New York

Application February 26, 1942, Serial No. 432,382

11 Claims. (Cl. 200—4)

My invention relates to an operating mechanism for discharge lamps more particularly fluorescent lamps of the type now in commercial use.

It is an object of my invention to provide a new and improved operating mechanism for fluorescent lamps in which manually operable switch means is employed to start the lamp.

It is another object of my invention to provide an improved operating mechanism more particularly adapted for use with a plurality of fluorescent lamps connected together in circuit.

A further object of my invention is the provision of a new and improved switch mechanism for use with a plurality of fluorescent lamps which comprises relatively few parts and which may be manufactured at low cost.

In the accompanying drawings, Fig. 1 is a side view of a switch constructed in accordance with my invention; Fig. 2 is a sectional view through the switch; Fig. 3 is another sectional view taken along the line 3—3 of Fig. 1; Fig. 4 is still another sectional view taken along the line 4—4 of Fig. 1; Fig. 5 is a perspective view of the operating handle; Fig. 6 is an exploded view of the switch; and Fig. 7 is a diagrammatic view showing one manner of connecting the switch in circuit with a plurality of fluorescent lamps. Fig. 8 is a view of another circuit arrangement.

Tubular discharge lamps, such as fluorescent lamps, of the type now on the market are provided with filaments at each end of a glass envelope which are heated to a point at which they become emissive so that an arc may be struck between the filaments lighting the lamp. Switch means must be provided for passing current through the filaments for a predetermined period of time to heat them to a point at which they become emissive after which the current is interrupted causing an arc to strike across the electrodes lighting the lamp. It is to a switch of this type that my invention relates.

Referring to the drawings, my switch comprises a base 10 of insulating material, such as a molded plastic provided with a U-shaped mounting strap 11 fastened to the base by any suitable means such as the screws 12. On the mounting strap between the arms of the U is a threaded nipple or nozzle 13 for mounting the strap in an opening in a lamp fixture, or the like. The nipple is adapted to be held in assembled position by a plurality of lock nuts 14. The base is provided with a recess 15 for housing a portion of the switch operating mechanism now to be described.

In the center of the recess 15 and preferably molded integrally with the base 10 is an upstanding boss 16. The boss is formed with a plurality of inclined cam surfaces 17 separated by abutment faces 18. In the construction shown, four of these cam surfaces are provided. Extending outwardly from the boss 16 to opposite side walls of the recess 15 are ledges 19 on which rest contact members 20 and 21. Each contact member is formed with an inclined cam or contact surface 22 which corresponds to the configurations of the cam surface 17. In seated position, the contact surfaces 22 rest on the inclined cam surfaces 17 of the boss and the contact surfaces are arranged on opposite sides of the boss so that the two contact surfaces are separated by an adjoining insulating cam surface 17. Conductors 23 and 24 are fastened to the contacts 20 and 21, respectively, in any suitable manner as by solder 25. The conductors rest in grooves 26 formed in opposite sides of the base.

Cooperating with the contact surfaces 22 is a rotatable conducting or shorting member 27 provided with downwardly extending inclined contact arms 28. A central bearing portion 29 supports the member for rotation on a bearing surface 30 forming part of the base 16. The contact arms are adapted alternately to engage the opposite insulating cam surfaces 17 or the contact surfaces 22; in the latter instance, a circuit is established between the conductors 23 and 24 across the shorting member. The member 27 is made of resilient material, for example, spring bronze, so that the arms move over the inclined surfaces 17 and drop off the abutment surfaces 18 with a snap action.

The means for rotating the shorting member 27 includes a spiral drive pin 31 which has a tang 32 seated in a slot 33 formed in the bearing portion 29 of the shorting member. The slot and tang are given any desired cross-sectional shape such that they closely interfit so that the drive pin and shorting member rotate together. A portion of the tang extends beyond the shorting member into a recess 34 in the boss 16 to form, in effect, a bearing arbor for the shorting member.

The spiral drive pin comprises a rectangular piece of metal twisted to shape and is seated in a corresponding rectangular opening 35 formed in a rotatable contact disk 36. Preferably, the opening 35 is punched in a metallic cam member 37 which, in turn, is fastened to the disk 36 by bent-over ears 38 (Fig. 2). The contact disk is formed of insulating material, preferably sheet

fiber, and carries diametrically opposed arcuate contact members 39 and 40. The members 39 and 40 are secured to the disk in any suitable manner as by bent-over ears 41. In assembled position, the contact disk 36 is maintained spaced from the shorting member 27 by a spring 42 which surrounds the drive pin 31, in the manner shown by Fig. 2.

The contact disk 36 is moved vertically along the spiral drive pin by a handle 43 which acts as a push button operating member for the switch. The handle is provided with a hollow extended portion 44 which projects through an opening 45 in the mounting nipple 13 to a position to be operated manually. In order to prevent rotation of the handle, the extending portion 44 is made polygonal in shape and an opening 46 in the mounting strap is similarly formed. This arrangement provides for free sliding movement of the handle in the nipple 13. The handle is also formed with an enlarged head or bearing portion 47 which cooperates with the contact disk 36.

To this end, the head is provided with a recess 48 of a size to receive the cam member 37 and the interior wall of the recess is formed with a plurality of cam surfaces 49 which cooperate with cam surfaces 50 punched out of the surface of the cam member 37. The arrangement of the cooperating cam surfaces is such that rotation of the contact disk 36 in a clockwise direction, as viewed in Fig. 6, is prevented while rotation in a counterclockwise direction is permitted. The handle is normally biased to a position at which the head 47 rests against the strap 11 by a spring 51 which rests on top of the spiral drive pin 31 and extends up into the hollow handle 44. A tongue 52 formed on the upper end of the drive pin extends up into the convolutions of the spring 51 and maintains it in seated position on the pin, as shown by Fig. 2. The head 47 is formed with a smooth bearing surface 53 at the point where it engages the contact disk 36 so that the contact disk is free to rotate relative to the handle without undue friction.

Cooperating with the contact members 39 and 40 on the rotatable disk are stationary contact members mounted on the base 10 and which extend into the recess 15. Stationary contact members 54 and 55 form a pair of contacts, adapted to be spanned by one of the arcuate contacts 39 and 40 while contact members 56 and 57 form another pair likewise adapted to be spanned by the other one of the contacts 39 and 40. The stationary contacts are secured to the base in any suitable manner as by screws 58. The movable arcuate contact members 39 and 40 are adapted to engage the respective pairs of fixed contacts alternately in a manner now to be described.

Let it be assumed that the switch is in the position shown by Fig. 2 of the drawings with the contact arms 28 of the shorting member 27 resting on the inclined cam surfaces 17 of the insulating boss 16 so that the circuit across the conductors 23 and 24 is open. When the operating handle 44 is depressed, the contact disk 36 is moved downwardly against the action of the spring 42. However, the contact disk 36 cannot rotate along the length of the spiral drive pin 31 because the cam surfaces 49 on the enlarged end of the handle engage the corresponding cam surfaces 50 on the contact disk to prevent rotation of the disk in a clockwise direction. Consequently, continued downward movement of the contact disk 36 will cause the spiral drive pin 31 to rotate in a counterclockwise direction, as viewed in Fig. 6, to move the shorting member 27 through an angle of approximately 90° so that the contact arms 28 snap off the ledges 18 into engagement with the fixed contacts 22. This closes the circuit through the conductors 23 and 24.

At the point at which the contact arms 28 snap over the abutment surfaces 18, the contact disk 36 is depressed to a position such that the arcuate contact members 39 and 40 span the pairs of fixed contacts 54—55 and 56—57, respectively, so that a circuit is completed between the individual contacts of each pair. This circuit is maintained as long as the handle 44 is held in a depressed position. As will be described more fully hereafter, the length of time during which the circuit through the fixed contacts is closed determines the time during which a heating current is applied to the electrodes of the associated fluorescent lamps.

Upon release of the operating member 44, the spring 42 will urge the contact disk 36 upwardly, thereby moving the contacts 39 and 40 out of engagement with the corresponding pairs of fixed contacts and opening the circuit through these contacts. During upward movement of the contact disk, the drive pin 31 cannot rotate in a clockwise direction, as viewed in Fig. 6, because the contact arms 28 of the shorting member engage the abutment faces 18; this means that the drive pin 31 is held in fixed position so that as the contact disk 36 is moved upwardly by action of the spring 42, it will be rotated in a counterclockwise direction along the length of the spiral drive pin through an angle of approximately 90° to move the arcuate contacts 39 and 40 out of alignment with the fixed contacts 54—55 and 56—57. Accordingly, the next time the operating member 44 is depressed the arcuate contact members 39 and 40 which have been moved out of alignment with the fixed contacts will not make contact therewith as the disk 36 is depressed so that only the insulating portion of the disk 36 will span the pairs of contacts 54—55 and 56—57. The switch will be moved to "off" position because the ensuing rotation of the shorting member 27 in a counterclockwise direction will move the contact arms 28 out of engagement with the fixed contacts 22 into seated position on the insulating cam surfaces 17, thereby opening the circuit between conductors 23 and 24. The manner in which my switch is connected in circuit for operating a plurality of fluorescent lamps will now be described.

Referring to Fig. 7, I have shown two fluorescent lamps 60 and 61 operatively connected in circuit with my switch and with a ballast B of a type commercially available. The ballast is provided with a reactor 62 having a lagging power factor connected to lamp 61 while a second reactor 63, having a leading power factor, by reason of the capacitor 64 is connected to the other lamp 61; a compensator 65 in the form of a reactor adds inductance to the heating circuit of the second lamp to insure quick starting. As mentioned above, this is an example of a ballast of the type available on the market and forms no part of my invention. Fluorescent lamp 60 is provided with heating filaments 66 and 67 at opposite ends while the lamp 61 is likewise provided with filaments 68 and 69. One manner in which the switch operates to start the lamps will now be described it being noted that in the diagrammatic showing of Fig. 7 the switch is in "on"

position with the arcuate contacts 39 and 40 in engagement with the fixed contacts.

When the switch handle 44 has been depressed to a starting position, the circuit through the shorting member 27 across the contacts 22 will be closed. Current thus flows from one side 70 of an alternating current supply line to the reactors 62 and 63 of the ballast. Current from the reactor 62 flows through conductor 71 to filament 66 at one end of the lamp 60, then through conductor 72 to fixed contact 54 through arcuate contact 39 to fixed contact 55, then by conductor 73 to the filament 67 of the lamp 60, conductor 24 to fixed contact 22 through the shorting member 27 to the other contact 22 and then by the conductor 23 to the other side 74 of the alternating current supply. Simultaneously, current flows from the reactor 63 through a conductor 75 to the filament 69 of the other fluorescent lamp 61, then by conductor 76 to the fixed contact 57 of the other pair of contacts through arcuate contact 40 to fixed contact 56, then by line 76 to the compensating reactor 65 by the conductor 77 to the other filament 68 and then through conductor 78, conductor 24, fixed contact 22, shorting member 27, the other contact 22, conductor 23 to the other side 74 of the line.

It will be apparent that the arrangement is such that as long as the switch is held in depressed position, current will flow through the electrodes of both fluorescent lamps to preheat them. Usually, this preheating time is of the order of one to five seconds. After that time the operating handle 44 is released so that the arcuate contacts 39 and 40 are moved out of engagement with the fixed contacts 54—55 and 56—57. This opens the circuit across the filaments of the lamps so that the reactors 62 and 63 provide an inductive kick causing a glow discharge to strike between the electrodes of each lamp, lighting the lamps. When this occurs, the circuit through the operating mechanism is as follows.

Current flows from reactor 63 through line 71 to filament 66 across the glow discharge through the lamp 60 to filament 67, line 24, shorting member 27 to the other side of the supply line. Simultaneously, current flows from reactor 63 by line 75 to filament 69, then across the glow discharge in lamp 61 to the other filament 68 through conductor 78 to shorting member 27 to the other side of the line.

When it is desired to turn off the lamps, the plunger 44 is again depressed, thereby moving the shorting member 27 out of engagement with the fixed contacts 22, interrupting the circuit through the lamps. This time, however, the arcuate contacts 39 and 40 do not mate with the fixed contacts because they have been rotated out of alignment with the contacts through an arc of 90° when the plunger was released to start the lamps. After the lamps have been turned off, they may again be turned on simply by depressing the plunger 44 so that the arcuate contacts 39 and 40 again engage the fixed contacts and the shorting member spans the contacts 22.

My switch may be used in other operating circuits, for example, an arrangement such as that shown by Patent 2,266,619, issued to John H. Campbell on December 16, 1941, and assigned to the same assignee as the instant application. This arrangement is shown by Fig. 8 of the drawings. In this operating circuit, the reactor ballast B, used in the circuit of Fig. 7, is replaced with a lamp ballast L and the lamps are connected in series with each other and with the ballast. In those cases where the fluorescent lamps 60 and 61 are of the 15 inch, 14 watt type, the ballast L is a lamp rated at 60 volts, .5 ampere. Assuming that the switch mechanism has been depressed to starting position, the starting circuit for the lamps shown in Fig. 8 operates as follows:

Current from supply line 70 flows to filament 66, through conductor 72 to fixed contact 54, arcuate contact 39, fixed contact 55, conductor 73 to the filament 67 at the other end of the lamp, then through a conductor 80 to filament 69 of the other lamp, conductor 76, fixed contact 57, arcuate contact 40, fixed contact 56, conductor 81, to the filament 68 at the other end of the lamp, thence through conductor 82, fixed contact 22, shorting member 27, conductor 23, lamp ballast L to the other side 74 of the supply line. It will thus be apparent that current flows through all the filaments of both lamps in series and likewise through the ballast lamp L.

The switch mechanism is held in depressed position for a suitable time interval, on the order of one to five seconds, until the lamp filaments are sufficiently heated. Upon release of the switch mechanism, the circuit through the pairs of fixed contacts 54—55 and 56—57 is interrupted causing a glow discharge to strike between the filaments lighting the lamps. When this occurs, current flows from one side 70 of the supply line to the filament 66 across the glow discharge in lamp 60 to the other filament 67, then through the conductor 80 to filament 69 of the other lamp across the glow discharge of this lamp to the filament 68, then through conductor 82, shorting member 27, lamp ballast L to the other side 74 of the supply line. In lighted position, the lamps 60 and 61 are still electrically connected in series with the lamp ballast L. The circuit arrangement of Fig. 8 is particularly adapted for use with direct current although it will operate as well with alternating current.

As pointed out in the aforementioned Campbell patent, it is desirable to have the switches across the electrodes of the lamps open in succession in those cases where the lamps are connected in series with a ballast, as in the arrangement of Fig. 8. With such an arrangement the operation of the circuit is such that when the first switch is opened, full line voltage is applied to one of the lamps, causing a glow discharge to take place which, due to the negative resistance coefficient of the lamp, permits a surge of current thereby raising the temperature of the filaments of the other lamp, effectively reducing its starting voltage so that when the switch of the other lamp opens, the lamp will light. It is only necessary that the switches open in succession a fraction of a second apart.

In my switch construction, the successive operation of the switches formed by the arcuate contacts 39 and 40 is attained by virtue of manufacturing tolerances. These normally are such that it would be almost impossible to secure an absolute simultaneous opening of the circuits through the arcuate contacts 39 and 40. One of the contacts will always open slightly ahead of the other so that the circuit across the filaments of the various lamps will be opened in succession in the manner described in the Campbell patent.

While I have illustrated my switch as being used with two fluorescent lamps in various operating circuits, it should be manifest that the

switch will operate equally as well with only a single fluorescent lamp simply by omitting the connections to one of the pairs of contacts 54—55 or 56—57. Similarly, it would be possible to control the operation of more than two fluorescent lamps by providing an additional pair of contacts and by so designing the spiral drive pin that the contact carrying disk 36 would be rotated through an angle sufficient to move the contacts out of alignment with the fixed contacts on the base when the switch is operated to turn off the lamps.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a switch mechanism, a base of insulating material, spaced fixed contacts mounted on said base, a shorting member rotatably mounted on said base for closing the circuit between said contacts, a spiral drive pin for rotating said shorting member, a disk mounted for movement along the length of said drive pin, said disk carrying spaced contact bars, a plurality of pairs of contact members carried by said base, each contact bar cooperating with a respective pair of contact members to close the circuit between individual contacts of each pair, a spring surrounding said drive pin and normally maintaining said contact disk spaced from said pairs of contact members, and a depressible plunger engaging said contact disk to move it downwardly into engagement with the pairs of contact members and simultaneously rotate said shorting member.

2. In a switch mechanism, a base of insulating material, spaced contacts mounted on said base, a conducting member rotatably mounted on said base for closing the circuit between said contacts, a spiral drive pin for rotating said conducting member, a disk mounted for movement along the length of said drive pin, said disk carrying a contact bar, a pair of contact members carried by said base, the contact bar cooperating with the pair of contact members to close the circuit between the individual contacts of the said pair, spring means normally maintaining said contact disk spaced from said pair of contact members, and a plunger engaging said contact disk to move it downwardly into engagement with the pairs of contact members and simultaneously rotate said conducting member.

3. In a switch mechanism, a base of insulating material, spaced contacts mounted on said base, a conducting member rotatably mounted on said base for controlling the circuit between said contacts, a spiral drive pin for rotating said conducting member, a disk mounted for movement along the length of said drive pin, said disk carrying a contact bar, a pair of contact members carried by said base for cooperation with said contact bar, spring means normally maintaining said contact disk out of engagement with said pair of contact members, a depressible plunger, and interengaging cam means on said contact disk and plunger to prevent rotation of said disk as the disk is moved downwardly into engagement with the pair of contact members whereby said drive pin is rotated to operate said conducting member.

4. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, additional switch mechanism carried by said base operable by said member, and manually operable means engaging said member to move it along the length of said drive pin to operate said last-mentioned additional switch mechanism, movement of said member along said drive pin causing the latter to rotate to operate said rotatable circuit controller.

5. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, additional switch mechanism carried by said base and being operable by said member, manually operable means, interengaging cam means on said manually operable means and said member to prevent rotation of said member as it is moved along the length of said drive pin to operate said last-mentioned additional switch mechanism whereby said drive pin rotates said circuit controller and spring means biasing said member to initial position by moving it rotatably along the length of said spiral drive pin.

6. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, additional switch mechanism carried by said base and being operable by movement of said member along said drive pin, a nonrotatably mounted movable plunger, and interengaging cam means on said plunger and member to prevent rotation of said member as it is moved along the length of said drive pin by movement of said plunger to operate said last-mentioned additional switch mechanism whereby said drive pin is rotated to operate said circuit controller.

7. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, said member carrying a conducting element, contacts carried by said base cooperating with said conducting element as said member is moved along said drive pin, a nonrotatably mounted movable plunger and interengaging cam means on said plunger and member to prevent rotation of said member as it is moved along the length of said drive pin by movement of said plunger to place said conducting element in contact with the contacts on said base whereby said drive pin is rotated to operate said circuit controller.

8. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, spaced contacts carried by said base, said member carrying a conducting element normally in alignment with said contacts, a nonrotatably mounted plunger, interengaging cam means on said plunger and member to prevent rotation of said member as it is moved along the length of said drive pin by movement of said plunger to place said conducting element in contact with said spaced contacts whereby said drive pin is rotated to operate said circuit controller and spring means biasing said member to initial position by moving it rotatably along the length of said spiral drive pin

to position said conducting element out of alignment with said spaced contacts.

9. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, separate spaced contacts carried by said base, a member having a conducting element normally spaced from said contacts, manually operable means for moving said member to place the conducting element in engagement with said spaced contacts, and means operative upon movement of said member for rotating said circuit controller.

10. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, separate spaced contacts carried by said base, a member having a conducting element, means normally biasing said member to maintain said conducting element out of electrical engagement with said contacts, a plunger for moving said member against the action of said biasing means to place the conducting element in electrical engagement with said spaced contacts, and means operated by movement of said member for rotating said circuit controller.

11. In a device of the class described, a base of insulating material, switch mechanism carried by said base including a rotatable circuit controller, a spiral drive pin for rotating said circuit controller, a member movable along the length of said drive pin, separate spaced contacts carried by said base, said member carrying a conducting element normally in alignment with said spaced contacts, spring means normally maintaining said conducting element out of engagement with said spaced contacts, a non-rotatably mounted plunger and interengaging cam means on said member and plunger to prevent rotation of said member as the latter is moved along the length of said drive pin to place said conducting element in engagement with said spaced contacts whereby said drive pin is rotated to operate said circuit controller, said biasing means being adapted to return said member to initial position by rotation along the length of said spiral drive pin.

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