March 21, 1967 J. J. OPALENIK ETAL 3,310,768

ELECTRIC CIRCUIT CONTROL

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FIG. 2

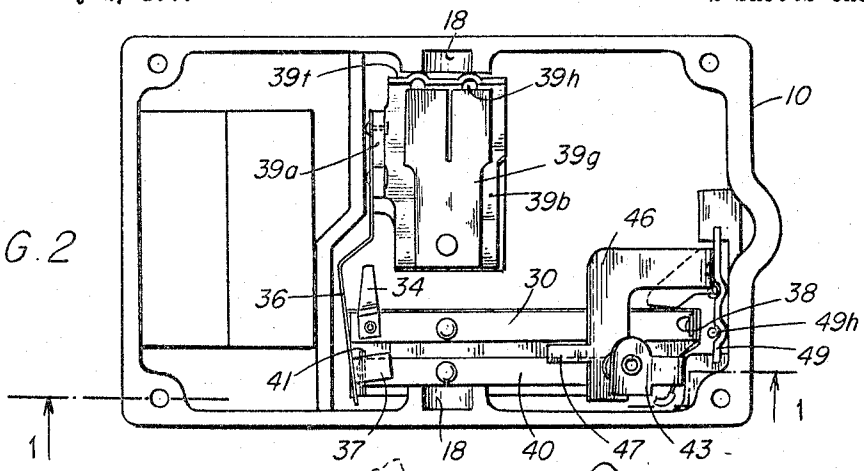


FIG. 1

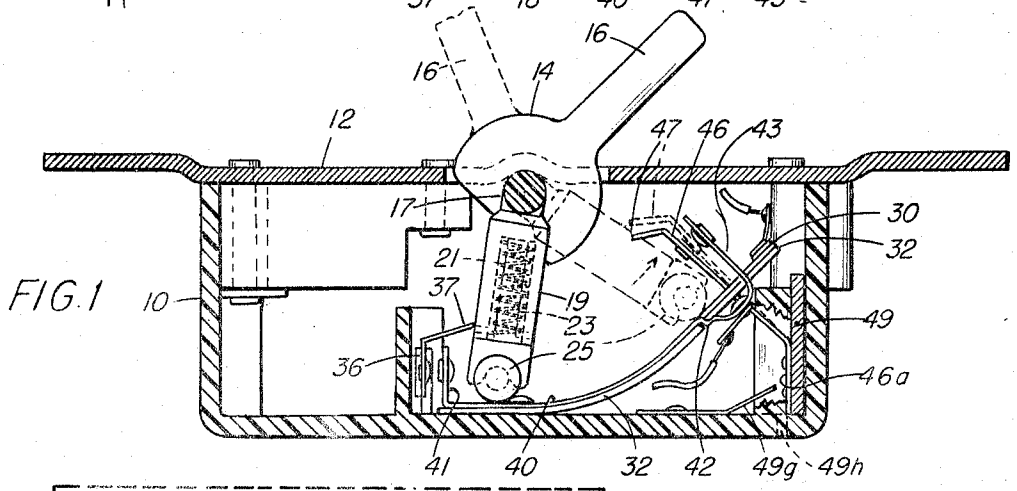
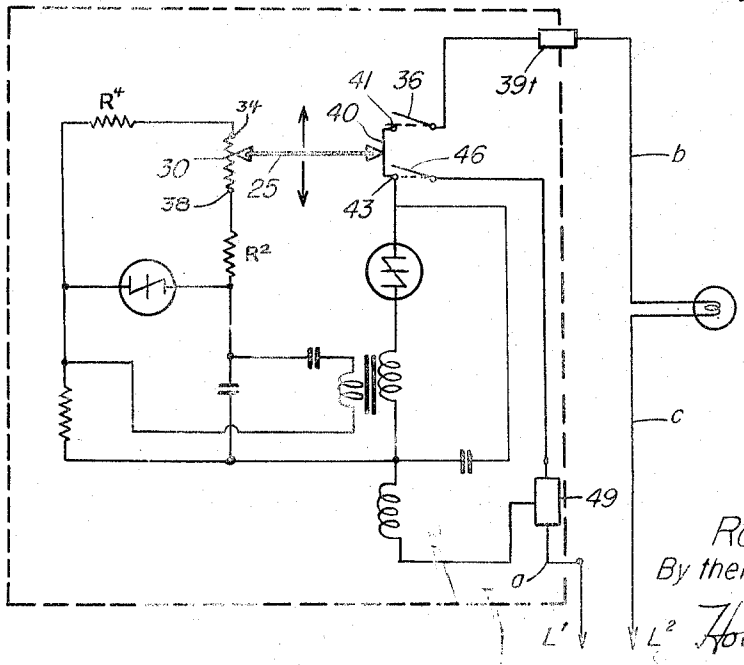


FIG. 3



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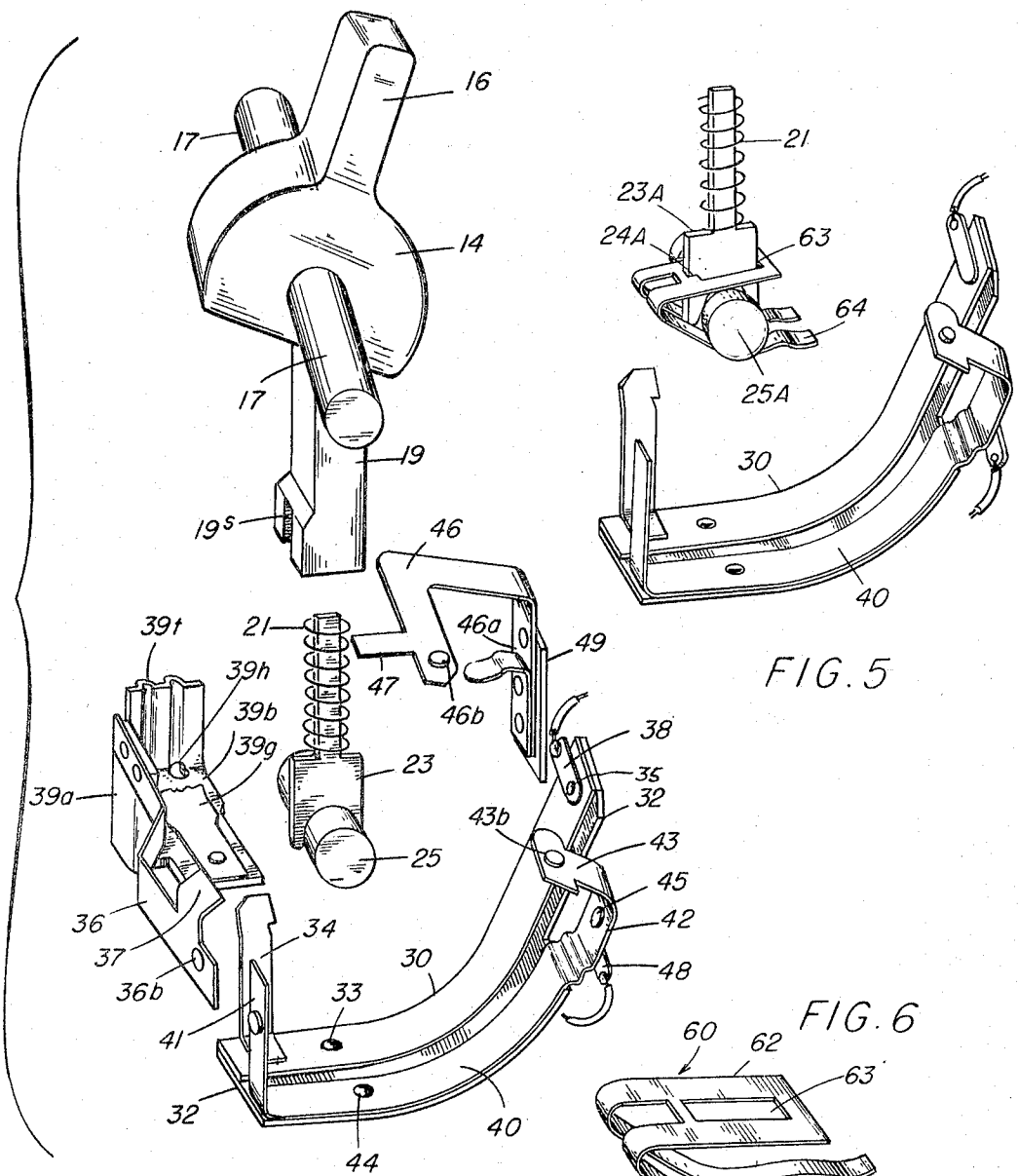


FIG. 4

FIG. 5

FIG. 6

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ELECTRIC CIRCUIT CONTROL

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16 Claims. (Cl. 338—198)

This application is a continuation-in-part of our copending application Ser. No. 341,368, filed Jan. 30, 1964, and entitled, "Electric Circuit Control," now abandoned.

This invention relates to alternating current electric power control, more particularly to controlling the power to loads of low voltage consumption, such for example as electric circuit controller particularly adapted for devices of low voltage consumption such as in homes, offices and business as well as other uses.

In devices heretofore on the market for manually controlling electric lighting circuits to dim lights and to turn them off, the operating member has been a rotary knob or, if a lever, has not possessed the ability of full range dimming, together with complete circuit interruption and complete by-passing of the voltage and current reducing elements of the device.

It is an object of this invention to provide an improved electric circuit controller particularly adapted for devices of low voltage consumption such as in homes, offices and business as well as other uses.

Another object is to provide such a controller having a lever-type operating member.

Another object is to provide a controller as aforesaid and a circuit combination which provides full range of control from complete circuit interruption to direct connection to the power lines for maximum rated power consumption of the device controlled. A related object is to interrupt the circuit completely in one extreme position of the operating lever and to by-pass the power limiting elements in the opposite extreme position of the operating lever.

Another object is to provide for operation of a controller having the foregoing characteristics which has minimum frictional opposition to its manual operation. A related object is to provide an anti-friction roller as a bridging contact in such device to minimize friction.

Another object is to provide positive engagement at all times and in all positions of the movable contact along the tracks, and at the same time to provide for keeping the tracks clean and bright. A related object is to provide a movable contact having elements which are separately adjustable and adapted to their responsive tracks so that there will be positive engagement of each, separately.

Other objects and advantages will appear as the invention is described in connection with the accompanying drawings.

In describing a preferred embodiment of the invention, a device is illustrated and described in which all the components and elements are housed within a casing no larger than may be received within a conventional house wiring outlet or wall box.

In the drawings:

FIG. 1 is a side elevational section view taken along line 1—1 of FIG. 2 of a device embodying the invention.

FIG. 2 is a top plan view with the cover and operating lever removed of the device illustrated in FIG. 1.

FIG. 3 is a circuit diagram of a circuit in which the device is adapted to be used.

FIG. 4 is an exploded perspective view of the movable parts.

FIG. 5 is a perspective view of another form of movable contact assembly having sliding individually self-adjusting contact elements.

FIG. 6 is a perspecttive view of the movable contact element of FIG. 5.

Referring to FIGS. 1, 2 and 4 of the drawings illustrating one embodiment of the invention, an insulating casing **10** of generally rectangular shape is molded from insulating material with a hollow interior to house the fixed and movable parts. A supporting plate or cover **12**, preferably of metal, extends across the open top of a conventional outlet or switch box and for mounting the device in such box, and overlies the top of the casing and has a rectangular recess centrally located therein through which a conventionally shaped handle portion **16** of an operating lever **14** extends.

The operating lever is preferably molded from insulating material with trunnions **17** extending from the body portion **14** and adapted to be seated in trunnion seats or bearings **18** formed in the upper edges of the opposite side walls of the casing.

Extending oppositely from the lever **16** is a contact operating leg **19** which moves within the casing with the lever as it is tilted to and fro, during operation of the device. The leg **19** is hollowed out lengthwise forming a bore or recess to receive a coiled compression spring **21**. The spring surrounds the leg of a molded or stamped sheet insulation strut **23** whose lower end is enlarged and extends out of and beyond the lower end of the leg **19** and is bifurcated by an arcuate recess to embrace a reduced and narrow central portion of an anti-friction roller-contact **25**. This roller-contact is of generally dumb-bell shape with enlarged cylindrical ends which its reduced central portion connects.

The lower end of the lever-leg **19** has a transverse slot **19***s* running upward from its lower end into which the enlarged end **23** of the strut slides. This keeps the strut from turning within the leg **19** and keeps the roller from skewing as it travels along tracks **30** and **40**, as will now be described.

The roller **25** acts as a bridging contact member and is adapted to roll along arcuate parallel tracks **30** and **40**. The track **30** consists of a trip of resistance material which is attached by rivets **33** and **35** adjacent its upper and lower ends to a curved insulation mounting plate **32**.

Affixed to the lower end of the resistance track **30**, by another rivet or otherwise, is a terminal lug **34** which is adapted to be connected to other components of the circuit such as a resistor R^4. At the upper end of the resistance track **30**, an upper terminal lug **38** is likewise secured, to which is adapted to be soldered or otherwise connected, a conductor wire for connecting the upper end of the resistance strip in the circuit.

For improved contact between the strip **30** and lug **38**, the upper end of the strip may be coated to a few thousandths thickness with a low resistance film adjacent the lug. If the silver film is closely restricted and the strip is of sufficient resistance and length so that the roller does not reach the end of the strip, the resistor R^2 may be eliminated. Likewise, by increasing the length and resistance of strip **30** at its lower end, the resistor R^4 may be eliminated.

Also mounted on the curved insulating mounting plate **32** parallel to the resistance track **30**, but spaced alongside thereof is a curved conductive track **40** which is stamped from sheet metal of high conductivity such as copper, brass or equivalent alloy in the form of a strip having its lower end bent upwardly at right angles to form a fixed lower contact member **41**. A portion **42** of upper end of track **40** is offset outwardly and its extremity **43** is bent radially inward toward the trunnion axis, forming a fixed upper contact member **43**. The conductive strip is riveted adjacent its lower end by a

rivet 44 to the insulating mounting strip 32 while the opposite upper portion 42 has a terminal lug 48 riveted to its back side by a rivet 45.

A movable contact member 46 for engagement with the upper fixed contact member 43 is stamped from sheet metal in generally L-shape with one-half of the long leg bent downwardly at right angles to provide a mounting portion 46*a* adapted to be riveted or otherwise secured to a terminal plate 49 to which a conductor wire may be conventionally connected. This plate may be mounted by sliding its opposite longitudinal edges into slots formed in the wall of the casing 10 and running from front to rear in conventional fashion. Holes 49*h* are formed in the floor of the casing in alignment with terminal 49 for insertion of the bared end of a conductor wire which will, thereupon, be gripped by a flat spring metal gripping member 49*g* riveted or otherwise affixed upon the floor of the casing, with its end overlying the holes 49*h*.

When the upper movable contact 46 is mounted as described, a contact button 46*b*, which is mounted on the short leg of said upper movable contact, is positioned to lie beneath a similar contact button 43*b* on the upper fixed contact 43. This upper movable contact 46*b* is normally biased by its own resilience out of engagement with the upper fixed contact 43, but may be flexed to engage that contact. For that purpose, an operating finger 47 extends laterally from the edge of the short leg of the upper movable contact 46 inwardly in alignment with the plane of movement of the leg 19 of the operating lever, so that when the leg 19 reaches its uppermost point of travel (as shown in broken lines), it will engage the finger 47 and move contact button 46*b* into engagement with the button of upper fixed contact 43.

For engagement with the lower fixed contact 41, a lower movable contact member 36 is stamped in strip form from sheet metal and is located to extend laterally with respect to the fixed contact 41 toward the interior of the casing. The inner end of the lower fixed contact 36 is adapted to be riveted or otherwise secured to an arm 39*a* of a stamped metal wire terminal member of shape as illustrated in FIGS. 2 and 4 having a base portion 39*b* affixed to the floor of the casing and having an upwardly bent terminal plate portion 39*t* adjacent a side wall of the casing. Holes 39*h* in the base portion are over holes in the casing floor for insertion of the bared ends of conductor wires as usual to be gripped by a spring finger 39*g* parallel to the casing floor and on top of the terminal base 39*b*.

When the lower movable contact is mounted as described, it is positioned so that its contact button 36*b* will be normally pressed by its own resilience into engagement with a similar fixed contact button 41*b* on the lower fixed contact 41 of the conductive strip 40.

The parts are so proportioned that when the operating handle 16 is tilted, the bridging-contact roller 25 will roll along the tracks 30 and 40. When the roller reaches uppermost position, one end will drop into the offset portion 42 of the conductive strip and will thereby be maintained there. In such uppermost position, the surface of the contact-operating leg 19 of the operating lever engages the finger 47 of the upper movable contact and moves the contact button 46*b* into engagement with the upper fixed contact button 43*b*. This permits smooth uninterrupted operation from electronic dimming to across-the-line brightness.

When the handle is moved in the opposite direction and the bridging-contact roller reaches its lowermost position, it will ride completely over the lower rivets 33 and 44 and will remain on the opposite side thereof so as to be maintained in such lowermost position. In the lowermost position, the surface of the contact-operating leg 19 will engage and move the finger 37 of lower movable contact 36 to separate its button 36*b* from the fixed contact button.

Referring to FIG. 1 and the diagram of FIG. 3, when the operating lever is in uppermost position of FIG. 1, the movable switch contacts 36 and 46 will be in the dotted position of FIG. 3, because the movable contact 36 will be biased closed and the movable contact 46 will be moved closed by operating lever leg 19. The power from line L' will pass through wire *a*, terminal plate 49, movable and fixed contacts 46 and 43, conductive track 40, fixed and movable contacts 41 and 36, terminal plate 39, wire *b* lamp E, wire *c* to line L^2. The electronic portion of the circuit will, thus, be shorted out.

When the operating lever is in lowermost position, the movable switch contacts 36 and 46 will be in the full-line position of FIG. 3 because movable contact 46 is biased open and movable contact 36 will be moved open by operating lever leg 19. The positive movement of the lower movable contact 36 open thus ensures that the circuit will be interrupted through all parts of the circuit and its components.

When the operating lever is in any intermediate position, the movable contact 36 will be biased closed, connecting line L' and lamp E to conductive track 40. Also the roller contact 25 bridges over to the resistance track 30 encircuiting variable portions of it in the electronic circuit while switch contacts 46 and 43 remain open. The brilliance of the light will depend on the position of the bridging roller along the resistance track.

A roller contact is preferred particularly in cases where the resistance strip is of the sort whose resistance is achieved by a coating on the strip that may be subject to wear and variation upon oft-repeated operations. In such cases, the anti-friction character of the roller prolongs the life of the device in addition to giving good contact pressure and ease of movement. In some circumstances, however, a sliding contact may be used in lieu of a roller.

The device above described functions as a potentiometer in the circuit illustrated in FIG. 3 wherein like reference numerals refer to like parts of FIGS. 1, 2 and 4. The circuit, per se, with the resistors, condensers, coils and transistors connected as diagrammatically shown, is not claimed as new; but the potentiometer and its structure as used in the circuit is claimed as a novel and valuable improvement. Heretofore only rotary control devices in the nature of rheostats were available, without the advantage of cutting the electronic components in or out completely in the full "on" positions or the "off" positions. Moreover, the advantage of lever-operation similar to snap-switches and quiet-action A.C. switches has not heretofore been available in full-scale dimming circuit controllers.

All of the components are of small size and may be connected together and fitted into a casing no larger than may be received in a conventional house wiring switch or wall box, a miniature printed circuit board (not shown) being used, if desired.

In large production procedures, manufacturing inaccuracies and variations in curvature of the tracks may occur. These tracks are separate pieces and of different materials and are not identical in shape. Thus, to avoid the roller not making positive contact at all times and in all positions in all devices embodying the invention, a sliding type of movable contact member, designated generally by numeral 60, may be employed. A roller 25A similar to roller 25 (except as hereinafter noted) is used as before, to positively locate the parts when in full "Off" and full "On" positions, including on one hand moving the flexible contact 36–37 to open the circuit in "Off" position and, on the other hand, moving the flexible contact 46–47 into engagement with fixed contact 43 in full "On" position.

The movable contact 60 is formed from thin flexible sheet metal into the shape illustrated in FIG. 5. It is generally U-shaped with one leg 62 (referred to for convenience as the upper leg) having a longitudinal rectangular hole 63 adapted to receive the enlarged portion of strut 23A. Contact 60 is mounted on the strut by having

the inner edge of the hole **63** engage in a slot **24A** cut into one side of the enlarged portion of the strut.

In FIG. 5, the circular heads of the roller are not as wide as in FIG. 4, thus leaving space on each side of the strut to receive the side portions of the leg **62** between the strut and the heads of the roller.

The lower leg **64** of contact **60** is bifurcated up to the bend of the contact and its two bifurcations fit, respectively, between the strut and the heads of the roller. The sliding contact is of such width that the bifurcations separately engage the two tracks **30** and **40** in paths alongside and inwardly of the paths along which the roller heads roll.

Because the sliding contact is made of thin resilient sheet metal, the bifurcations of its lower leg resiliently engage the tracks with a light firm pressure adequate for the current rating of the device. This engagement is continuous along the whole length of the tracks **30** and **40**. Moreover, the bifurcations enable individual engagement of each track by its bifurcation and individual self-adjustment to each track by each bifurcation so that firm resilient contact pressure is maintained at all times despite variations in curvature of the tracks and any manufacturing inaccuracies.

Many modifications within the scope of the invention will occur to those skilled in the art. Therefore, the invention is not limited to the specific embodiment described.

What is claimed is:

1. An electric circuit controller, comprising an insulating housing, an operating member pivotally supported for movement to and fro in said housing, a high conductivity arcuate track and high resistance arcuate track paralleling said conductive track both mounted in said housing, an electrically conductive bridging conductor carried by said operating member and positionable in any intermediate position along said tracks to provide for varying the amount of resistance encircuited as said conductor moves from one end of the resistance track to the other, a fixed contact adjacent one end of one of said tracks, a movable contact separate from said bridging contact positioned adjacent said fixed contact and engageable with and disengageable from said fixed contact, and means controlled by movement of said operating member to actuate said movable contact when said bridging conductor is at one end of said track and to open the circuit through said tracks.

2. An electric circuit controller, comprising an insulating housing, an operating member pivotally supported for movement to and fro in said housing, a high conductivity arcuate track and high resistance arcuate track paralleling said conductive track both mounted in said housing, an electrically conductive bridging conductor carried by said operating member and positionable in any intermediate position along said tracks to provide for varying the amount of resistance encircuited as said conductor moves from one end of the resistance track to the other, a fixed contact adjacent each end of one of said tracks, movable contacts separate from said bridging contact positioned adjacent said fixed contact and engageable with and disengageable from said fixed contacts, and means controlled by movement of said operating member to actuate said movable contacts when said bridging conductor reaches one end of said track or the other respectively to cause encircuiting or short circuiting respectively of said high resistance track.

3. An electric circuit controller, comprising an insulating housing, an operating member pivotally supported for movement to and fro in said housing, a high conductivity arcuate track and high resistance arcuate track paralleling said conductive track both mounted in said housing, an electrically conductive bridging conductor carried by said operating member and positionable in any intermediate position along said tracks to provide for varying the amount of resistance encircuited as said conductor moves from one end of the resistance track to the other, fixed contacts at each end of said conductive track, a movable contact adjacent each end of said conductive track, the movable contact at one end being biased into engagement with its fixed contact, the movable contact at the other end being biased out of engagement with its contact, and means on said operating member causing disengagement of the normally engaged contacts when said bridging conductor reaches said one end of said conductive track and causing engagement of the normally disengaged contacts when said bridging conductor is at the other end of said conductive track to cause encircuiting or short circuiting respectively of said high resistance track.

4. An electric circuit controller, comprising an insulating housing, an operating member pivotally supported for movement to and fro in said housing, a high conductivity arcuate track and high resistance arcuate track paralleling said conductive track both mounted in said housing, an electrically conductive bridging roller contact carried by said operating member and positionable in any intermediate position along said tracks to provide for varying the amount of resistance encircuited as said contact moves from one end of the resistance track to the other, means to press said roller contact into engagement with said tracks, a fixed contact adjacent each end of one of said tracks, movable contacts separate from said bridging contact positioned adjacent said fixed contact and engageable with and disengageable from said fixed contacts, and means controlled by movement of said operating member to actuate said movable contacts when said bridging contact reaches one end of said track or the other respectively.

5. An electric circuit controller as claimed in claim **2** wherein siad tracks have means at each end over which said bridging conductor rides and which thereupon maintain said operating member in one or the other of opposite end positions, respectively, in movable contact actuating condition.

6. An electric circuit controller as claimed in claim **5** wherein said bridging conductor is a spring-pressed roller carried by said operating member.

7. An electric circuit controller as claimed in claim **6** wherein said operating member is a molded insulation lever having a leg extending into said housing and having a bore, a spring in said bore pressing said roller into engagement with said tracks.

8. An electric circuit-control device having a load terminal and an A.C. line terminal, power-control means for controlling the power delivered to a load connected to said load terminal and to said A.C. line, said power-control means including a potentiometer having a resistance and a movable contact, a pivotally mounted member to vary the position of said contact along said potentiometer resistance, two pairs of fixed and movable contacts, one pair being adjacent each end of said potentiometer, one movable contact being biased into engagement with its fixed contact and the other being biased out of engagement with its fixed contact, one contact of each pair being connected to said load terminal and the other being connected to said line terminal, means directly connecting the other contacts of said pairs and along which said potentiometer contact is movable, said pivotally mounted member engaging and moving said movable contacts whereby said power-control means is by-passed in one end-position of said pivotally mounted member and the power circuit is disconnected in the other end-position of said pivotally mounted member, and said power-control means is encircuited in intermediate positions of said pivotally mounted member.

9. A circuit controller as claimed in claim **2** having terminals at the end of said resistance track, at least one of said terminals being beyond the travel of said bridging contact providing resistance between said one terminal and the bridging contact when at the end of its travel.

10. A circuit control device as claimed in claim **8** wherein the potentiometer resistance is a strip which ex-

tends beyond at least one end-position of said movable potentiometer contact providing resistance connectable between the end of said potentiometer resistance strip and said movable contact when the latter is adjacent its end-position.

11. An electric circuit controller as claimed in claim **2** in which the bridging conductor comprises a resilient unitary sheet metal member having individual self-adjusting portions separately sliding along said tracks.

12. An electric circuit controller as claimed in claim **3** in which the bridging conductor comprises a resilient unitary sheet metal member having individual self-adjusting portions separately sliding along said tracks.

13. An electric circuit controller, comprising an insulating housing, an operating member supported for movement pivotally to and fro in said housing, a high conductivity arcuate track and a high resistance arcuate track paralleling said conductive track both mounted in said housing, a resilient bridging contact movable by said operating member and slidably movable along said tracks to provide for varying the amount of resistance encircuited as said contact is positioned at any position from one end of the resistance track to the other and a spring-pressed roller mounted on said operating member and bridging and rolling along said tracks.

14. An electric circuit controller as claimed in claim **2** wherein the bridging conductor comprises a U-shaped resilient sheet metal member having individual self-adjusting portions separately sliding along said tracks.

15. An electric controller as claimed in claim **13** wherein the sliding contact is U-shaped and is supported from said operating member.

16. An electric current controller as claimed in claim **13** having a spring-pressed roller mounted on said operating member and bridging and rolling along said tracks, a fixed contact at each end of said conductive track, movable contacts engageable with and disengageable from said fixed contacts, and means controlled by movement of said operating member to actuate said movable contacts when said bridging conductor reaches one end of said track or the other respectively to cause encircuiting or short-circuiting respectively of said high resistance track, and means at each end of said tracks over which said roller rides and which thereupon maintain said operating member in one or the other of opposite end positions, respectively, in movable contact-actuating position.

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