

Dec. 14, 1954

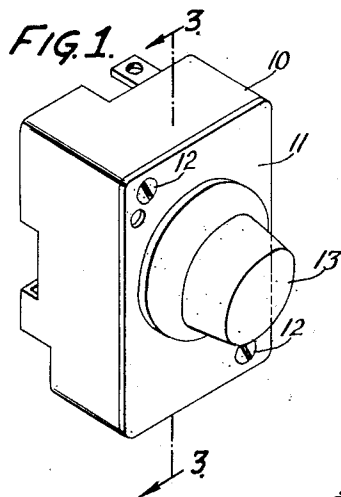
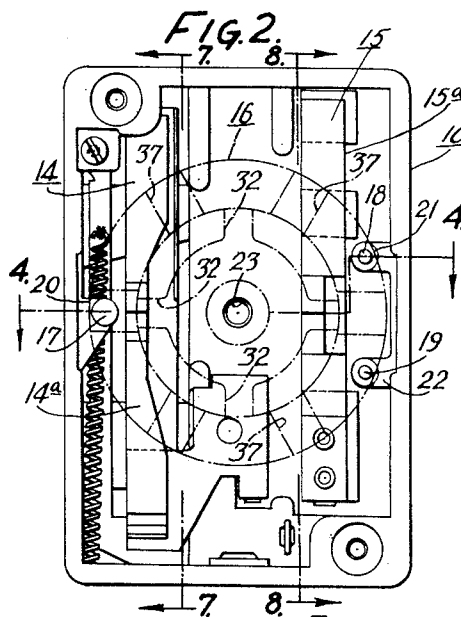
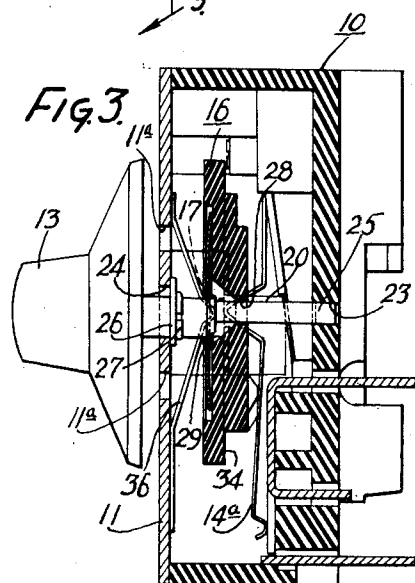
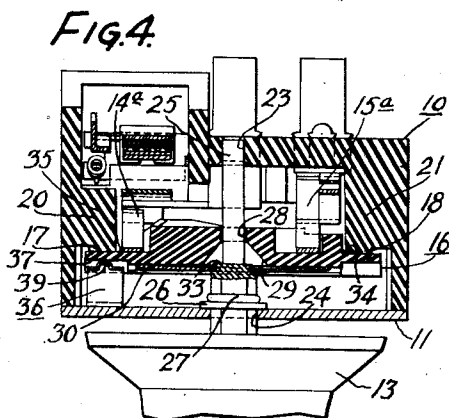
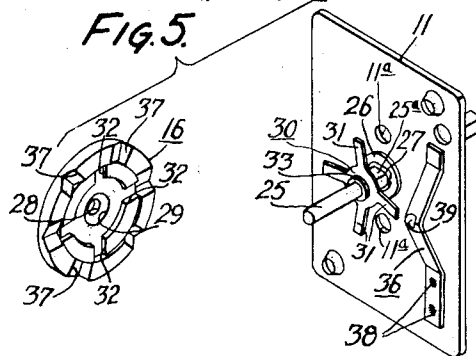
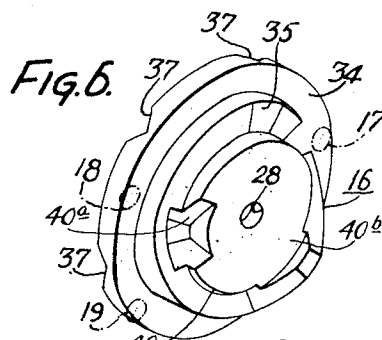
H. E. HORTMAN, JR., ET AL

2,697,156

ELECTRIC SWITCH DEVICE

Filed Feb. 2, 1953

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 9.

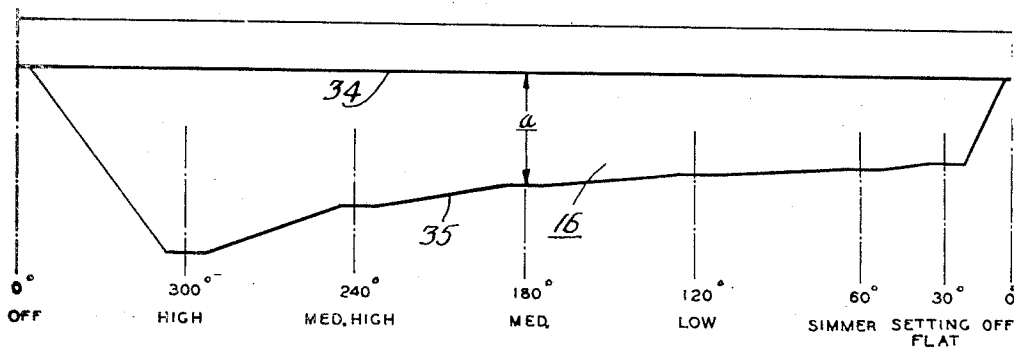


Fig. 7

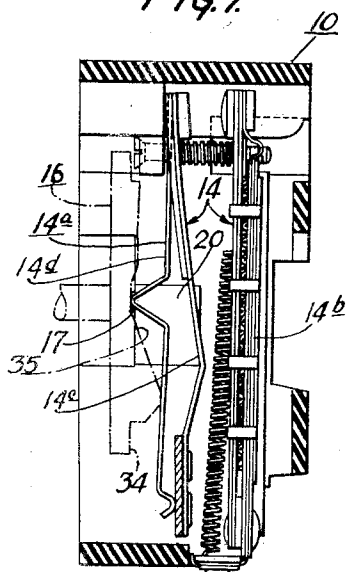
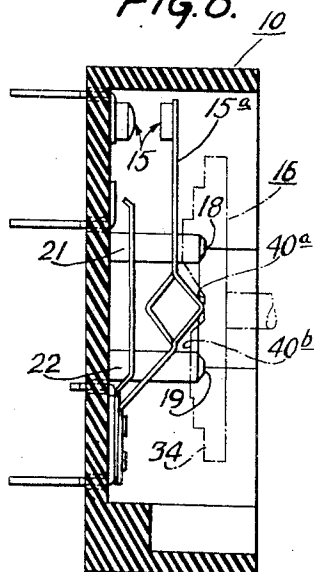


Fig. 8.



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2,697,156

ELECTRIC SWITCH DEVICE

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Application February 2, 1953, Serial No. 334,696

9 Claims. (Cl. 200—153)

This invention relates to electric switch devices, and more particularly to operating mechanisms in manually adjustable switch devices employing a circular cam which gives different adjustments of the device and also serves to turn it on and off.

One object of the present invention is to provide a simple and inexpensive structure for use in such a device which permits considerable tolerance in manufacture of the parts.

Another object of the invention is to provide a structure which is efficient in operation.

A further object of the invention is to provide a structure in which the effective portion of the adjustment cam is maintained in exact relation to the parts operated thereby.

In some control switch devices it is very important that an exact relation be maintained between the effective portion of the adjustment cam and the parts operated thereby. An example of such a device is a wattage controller for controlling the average wattage input to a load such as a heating unit on an electric range. In such a controller, the different adjustments of the cam should accurately give different "heats" or temperature levels of the controlled heating unit. A further object of this invention is to provide the desired accuracy in such a device.

Other objects and features of the invention will be apparent from the following detailed description with reference to the accompanying drawing, in which

Fig. 1 is a perspective view of a switch device embodying the invention;

Fig. 2 is a front view of the device, with the front cover removed and with the adjustment cam shown in dot-and-dash line;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 2;

Fig. 5 is an exploded perspective view of the cam, cover plate and shaft;

Fig. 6 is a larger-scale perspective view of the cam taken from the opposite side thereof;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 2;

Fig. 8 is a sectional view taken on line 8—8 of Fig. 2; and

Fig. 9 is a development view of the adjusting cam.

For the purpose of disclosure the invention is illustrated as embodied in a wattage input controller of the general type disclosed in U. S. Patent No. 2,623,137, issued December 23, 1952, to W. H. Vogelsberg, and in the copending application of D. E. Clapp, Serial No. 246,098, filed September 11, 1951. The present invention is not concerned with the details of the switch mechanism and, therefore, reference will be made thereto only to the extent necessary for a complete understanding of the present invention as embodied in the device.

As shown in Fig. 1, the switch device illustrated comprises a casing 10 formed of insulating material such as Bakelite, and a front cover plate 11 which is formed of metal and which is removably secured to the casing 10, as by means of screws 12. The casing and cover form a housing for the component parts of the device. The device is manually adjustable by means of the rotatable knob 13 having suitable indicia corresponding to an "off" position and various "heat" positions. Further the device can be supported, as on the back-splasher of an electric range, with two screws threadingly engaging the tapped holes 11a in cover plate 11. (see Fig. 5).

In the particular switch device shown, there is an adjustable thermostatic switch 14 (Figs. 2 and 7) located

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at the left-hand side of the casing as viewed from the front, said switch having an adjustable blade 14a and a thermomotive member 14b, and there is an on-off switch 15 located at the right-hand side of the casing and having a movable blade 15a. The two blades 14a and 15a are actuated by a circular rotatable cam 16 formed of insulating material such as Bakelite and hereinafter particularly described. Adjustable blade 14a comprises a flexible current-carrying portion 14c secured at its lower end relative to the switch structure 10, and a strut 14d secured at the top of the flexible portion 14c. The strut 14d bears at its center on race 35 of cam 16 while bearing against the support for portion 14c at its lower end. The base of the thermomotive member 14b is fixedly secured relative to the switch case by suitable means. As may be seen in Fig. 2, there are three small-surfaced bearing elements 17, 18 and 19 which are formed integrally with the casing 10. Bearing element 17 is in the form of a raised circular portion of an internal projection 20 on the left-hand wall of casing 10, and bearing elements 18 and 19 similarly are raised circular portions of internal projections 21 and 22 on the right-hand wall of casing 10. These three bearing elements serve to fix the position of the rotatable cam as hereinafter described. It will be noted that bearing element 17 is immediately adjacent to adjustable blade 14a and is somewhat larger than the bearing elements 18 and 19. The latter elements are immediately adjacent to the adjustable blade 15. The three bearing elements are disposed so as to be engaged by the peripheral portion of the inner face of the cam.

Referring now to Fig. 3, the rear wall of the casing 10 is provided with a centrally located opening 23, and the front cover plate is provided with a centrally located opening 24 which is aligned with the opening 23. These two openings serve to rotatably support a shaft 25 which carries both the adjustment knob 13 and the cam 16, the control knob 13 being indexed to the shaft 25 through a milled flat 25a. Axial movement of the shaft in the direction of the switch front (to the left as viewed in Fig. 3) is prevented by means of a split ring 26 which is seated in a recess in the shaft and the thrust washer 27 which bears against the inside surface of the cover plate 11.

The mounting of the cam on the shaft, and the manner in which it is keyed thereto, are of particular importance and will now be described. The shaft is reduced in diameter over a greater portion of its length within the casing 10, and the cam is loosely mounted on the smaller portion of the shaft. To this end, the cam is provided with a central opening 28, and the portion of the cam adjacent the opening and forwardly thereof is beveled, as shown at 29, so that there is relatively small wall area of the opening 28 engaging the shaft 25. The cam is indexed to the shaft by means of a spider 30 secured to the shaft and having radial resilient fingers 31 which seat in recesses 32 on the outer face of the cam. The spider 30 is secured to the shoulder of the shaft in any suitable manner, as by riveting over a portion of the shoulder at 33. By the arrangement just described the cam is fixed to the shaft as regards rotation but is permitted non-rotative universal movement relative to the shaft. It may be said that the cam is floatingly mounted on the shaft while being keyed thereto. Further it is possible to index the cam in any one of four positions, in other words, in each quadrant with respect to the milled flat 25a on the shaft. Thus if the switch 10 is mounted with its longer axis horizontal instead of vertical and it is desired to maintain the dial indicia in the same relative position as with the switch mounted vertically, the shaft can be reindexed by lifting the index spider 30 from its seating recesses 32, rotating the spider through 90°, and reseating it while maintaining the cam in its original position.

As may be seen in Fig. 6, the peripheral portion 34 of the inner face of cam 16 is smooth surfaced for engagement with the previously described bearing elements 17, 18 and 19 which are represented in dotted outline in Fig. 6. This peripheral portion, as molded, lies in one plane and represents the datum surface. Due to the mounting of the cam as above-described, the cam is permitted to seat itself against these bearing elements. The resilient fingers 31 of the spider 30 serve to press the

cam against the bearing elements, while at the same time keying the cam to the shaft.

The primary purpose of the switch device is to provide the desired input or "heat" to a heating load by the cyclic opening and closing of the contacts of the thermostatic switch 14 at some predetermined rate. Different "heats" are obtained by prestressing the thermomotive member 14b of the thermostatic switch 14 in varying amounts. This prestressing is obtained by the controlled displacement of blade 14a by cam 16 acting through annular lobe section 35 (Fig. 6) which is immediately adjacent the planar reference surface 34 on the front face of said cam. In the device shown, increased displacement of blade 14a (to the right in Fig. 7) provides for higher heats. As molded, the cam lobe 35 has a program (see Fig. 9) corresponding to the indicia on the control knob 13 to which it is indexed. If for some reason, the cam structure and mounting system for the thermostatic switch do not give the the correct displacement to blade 14a corresponding to the control knob indicia, the heat input will be in error. In former devices, warpage of the molded cam and cumulative tolerances made this problem severe.

In the present switch device, the reference race 34 is maintained biased against bearing element 17. To accomplish this end, and also provide for detenting of the cam in its various positions, a leaf spring 36 (Fig. 5) is provided on the inner surface of cover plate 11, and detenting recesses 37 are provided on the outer face of the cam at the peripheral portion thereof, these recesses being annularly spaced from one another. The leaf spring 36 has one end secured to the plate 11 at 38 as by eyelet type connections, while the other end of the spring is free and bears against the cover plate. The spring is bent in the form of a side V and has a hemispherical button formed outwardly at its apex 39 to seat in the detent recesses. As may be seen in Fig. 4, the portion 39 engages the cam directly in front of the bearing element 17, so that the spring 36 always insures engagement of the cam with the bearing element 17. This bearing element is necessarily larger in area than elements 18 and 19 to take the load of spring 36 in addition to that of spider spring 30.

A development of the cam is shown in Fig. 9, from which it may be seen that the race 34 serves as a datum with respect to which the intelligence of race 35 is determined. The datum or reference race 34 is maintained by bearing element 17 in fixed relation to the blade 14a for any effective portion of the cam in any position of the latter.

The program on cam race 35 is thus faithfully imparted to blade 14a for it will be seen that no errors will result if it is assumed that the differential distance designated in Fig. 9 as *a* between the reference race 34 and the program race 35 for any angular position can easily be held during molding. Warpage of the cam from one angular position to the next will not interfere with the effective measurement by bearing element 17 of the distance between races 34 and 35 for any one angular position of the cam.

The cam 16 is provided with a third race 40 (Fig. 6) disposed inwardly radially of the cam race 35 for actuating the on-off switch 15. This race merely has an "off" detent at 40a and a continuous land 40b. It will be apparent that additional races could be formed on the cam face if desired.

While a particular embodiment of the invention has been illustrated and described, such embodiment is intended only for the purpose of disclosure and is not intended to limit the invention. It is to be understood, therefore, that the invention contemplates such other embodiments and modifications as may occur to persons skilled in the art.

I claim:

1. In a switch device, an adjustable switch element, a fixed bearing element in close proximity to said switch element, a multi-position adjustment circular cam having an annular program race on one of its faces engaging said switch element and also having an annular reference race on the same face adjacent to the program race and engaging said bearing element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, a rotatable shaft on which said cam is loosely mounted, cooperative means on said shaft and said cam to key the

cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, and means exerting pressure on the other face of said cam in proximity to said bearing element to continually maintain the portion of the cam adjacent said bearing element in firm engagement with said bearing element, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

2. In a switch device, a housing for the component parts of the device, an adjustable switch element within said housing, a shaft extending into said housing and rotatably supported thereby, a circular cam within the housing loosely mounted on said shaft, cooperative means on said shaft and said cam to key the cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, said cam having a planar annular reference race on one of its faces and also having an annular program race on the same face immediately adjacent to said reference race and engaging said switch element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, a plurality of small-surfaced bearing elements integral with said housing adjacent to said reference race for engagement thereby, one of said bearing elements being immediately adjacent to said switch element, and means exerting pressure on said cam in proximity to said one bearing element to continually maintain the portion of the cam adjacent the latter bearing element in firm engagement with the latter bearing element, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

3. A device according to claim 2, wherein said keying means comprises a plurality of radial fingers on said shaft, and a corresponding plurality of angularly spaced recesses on the cam seating said fingers.

4. A device according to claim 3, including a shoulder on said shaft and a spider secured to said shoulder to provide the radial keying fingers.

5. In a switch device, a housing for the component parts of the device, an adjustable switch element within said housing, a shaft extending into said housing and rotatably supported thereby, a circular cam loosely mounted on said shaft within said housing adjacent a wall thereof, cooperative means on said shaft and said cam to key the cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, said cam having angularly-spaced recesses on the peripheral portion of the cam face confronting said wall, and also having a planar annular reference race on the peripheral portion of its other face and an annular program race adjacent said reference race and engaging said switch element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, a plurality of small-surfaced bearing elements integral with said housing adjacent to said reference race for engagement thereby, one of said bearing elements being immediately adjacent to said switch element, and a spring on said wall engageable with said recesses to index said cam in any one of a plurality of positions and also serving to exert pressure on said cam effective to continually maintain firm engagement of the cam with the latter bearing element, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

6. In a switch device, a casing and a cover therefor providing a housing for the component parts of the device, said casing and said cover having aligned openings, an adjustable switch element within said housing, a shaft rotatably supported in said openings and extending from said cover, a circular cam loosely mounted on said shaft within said casing adjacent said cover, cooperative means on said shaft and said cam to key the cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, said cam having a planar annular reference race on the periphery of its inner face and also having an annular program race on the same face adjacent said reference race and engag-

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ing said switch element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, three small-surfaced bearing elements integral with said casing adjacent to said reference race for engagement thereby, one of said bearing elements being immediately adjacent to said switch element, and a leaf spring on the inside of said cover engaging the peripheral portion of the outer face of the cam opposite the latter bearing element so as to maintain firm engagement of the cam therewith, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

7. In a switch device, a casing and a cover therefor providing a housing for the component parts of the device, said casing and said cover having aligned openings, an adjustable switch element within said housing, a shaft rotatably supported in said openings and extending from said cover, a circular cam loosely mounted on said shaft, cooperative means on said shaft and said cam to key the cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, said cam having annularly-spaced recesses on its outer face at the peripheral portion thereof, and also having a planar annular reference race on the periphery of its inner face and an annular program race adjacent said reference race and engaging said switch element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, three small-surface bearing elements integral with said casing and disposed adjacent to said reference for engagement thereby, one of said bearing elements being immediately adjacent to said switch element, and a spring on said cover engageable with said recesses to index said cam in any one of a plurality of positions and also serving to exert pressure on said cam effective to continually maintain firm engagement of the cam with the latter bearing element, whereby said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

8. In a switch device, a housing for the component parts of the device, an adjustable switch element within said housing, a shaft extending into said housing and rotatably supported thereby, a circular cam within the housing loosely mounted on said shaft, cooperative means on said shaft and said cam to key the cam to the shaft

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while permitting non-rotative universal movement of the cam relative to the shaft, said cam having a planar annular reference race on one of its faces and also having an annular program race on the same face immediately adjacent to said reference race and engaging said switch element, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, a fixed bearing element disposed immediately adjacent said switch element for engagement by said reference race, and a spring adjacent the opposite face of said cam and arranged to exert pressure on the latter cam face at a point directly opposite said bearing element so as to continually maintain the portion of the cam adjacent said bearing element in with said bearing element, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

9. In a switch device, an adjustable switch element, a plurality of fixed bearing elements one of which is in close proximity to said switch element, a multi-position adjustment circular cam having an annular program race engaging said switch element and also having an annular reference race engaging said bearing elements, said program race having a displacement program relative to said reference race in the direction of adjustment of said switch element, said cam also having a plurality of angularly spaced recesses, a rotatable shaft on which said cam is loosely mounted, a plurality of radial fingers on said shaft seating in said recesses to key the cam to the shaft while permitting non-rotative universal movement of the cam relative to the shaft, and means exerting pressure on said cam in proximity to said bearing element to continually maintain the portion of the cam adjacent said bearing element in firm engagement with said bearing element, whereby at a particular adjustment position of the cam said switch element is positioned according to the displacement of the program race relative to the reference race in the direction of adjustment of said switch element.

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