April 29, 1952 G. O. PUERNER 2,594,493

CIRCUIT CONTROLLING DEVICE

Filed July 28, 1948

Fig. 1.

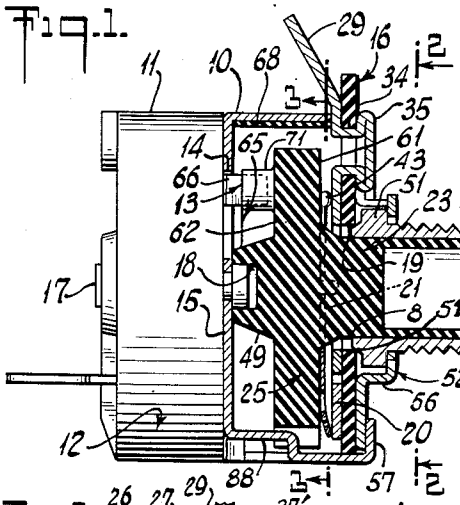
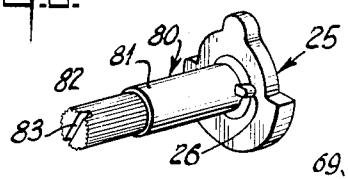


Fig. 8.



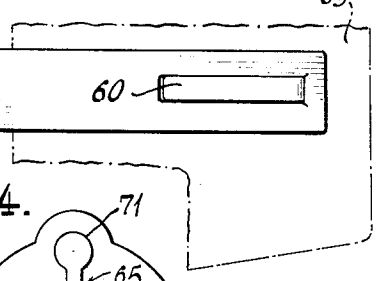


Fig. 4.

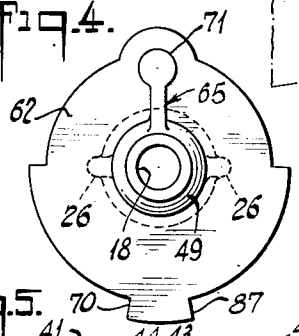


Fig. 2.

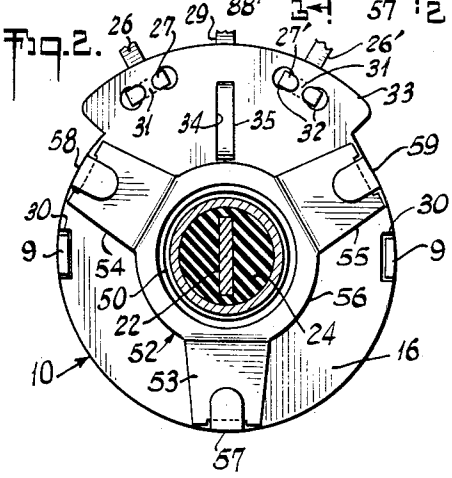


Fig. 5.

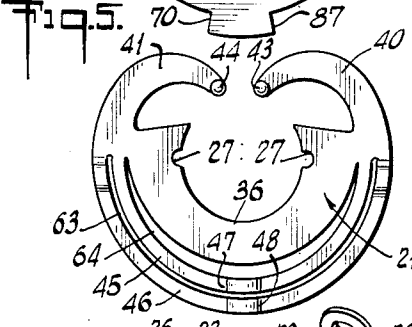


Fig. 6.

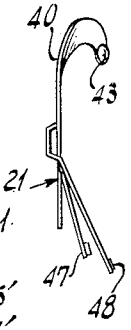
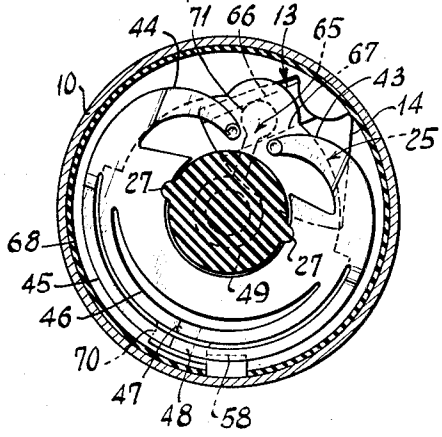


Fig. 3.



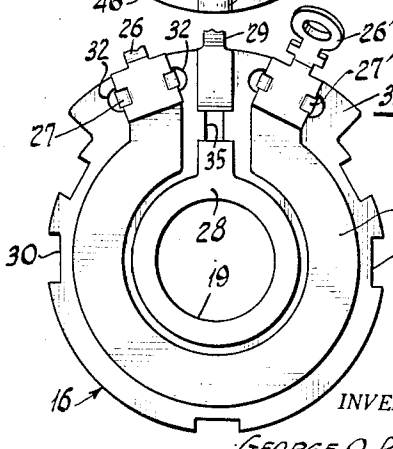


Fig. 7.

INVENTOR.
GEORGE O. PUERNER.
BY
Nicholas Lamp
ATTORNEY

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CIRCUIT CONTROLLING DEVICE

George O. Puerner, Indianapolis, Ind., assignor to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

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21 Claims. (Cl. 201—55)

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This invention relates to electrical control devices and, more particularly, to variable resistance devices, volume controls, and switches wherein balanced operation is attained with a minimum number of parts.

Volume controls incorporating switch means therein heretofore have required a comparatively large number of parts to build up the several known sub-assemblies such as the rotary control head containing the contactor and the sub-assemblies in turn were organized in an operative unit by using other elements. Such construction was relatively expensive because the cost of material, fabrication of individual elements, and assembling of the latter was high. Further, the previous control devices utilizing switch elements were not dynamically balanced as well as it was desired because the function of electrical contacting in volume control work was carried out in two distinct levels or arcuate steps, one contact of the contactor being on one step and another contact opposite the first making contact on a lower resistive path or current transfer surface. In accordance with the present invention, the above difficulties in the construction and operation of an electrical control device of the volume control type have been completely overcome.

It is an object of the invention to improve the construction and operation of electrical control devices.

It is a further object of the invention to provide a novel volume control device having comparatively few parts.

It is another object of the invention to provide an electrical control device incorporating both a variable resistance and a switch which are easily assembled in a minimum period by relatively unskilled workers.

It is a still further object to provide a variable resistance device with switch means having a balanced mode of operation.

It is still another object of the invention to provide a balanced rotary combined switch and variable resistance which is reliable in operation even though it is manufactured at a low cost.

Other objects of the invention will be apparent from the following description and accompanying drawing taken in connection with the appended claims.

For a fuller understanding of the nature and objects of the invention as well as for specific fulfillment thereof, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

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Figure 1 is a partial longitudinal section having parts in elevation of an electrical control device embodying the present invention;

Figure 2 is a plan view taken on the lines 2—2 of Figure 1;

Figure 3 is a section on the lines 3—3 of Figure 1;

Figure 4 is a top view of the insulating body on which a contactor is held;

Figure 5 is a bottom view of a contactor for use with the structure of Figure 1;

Figure 6 is a side elevational view of the contactor;

Figure 7 is a bottom view of the base member showing an arcuate resistive path and a combined collector ring and terminal; and

Figure 8 is a perspective view of another embodiment of the present invention.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring now to the drawings in detail and particularly to Figure 1, the rotary electrical control device may comprise an open-ended shell 10 mounted on a housing 11 of a rotary switch 12 having a movable switch actuator 13 extending freely through an aperture 14 in a bottom portion 15 of the housing 10. The mounting for the housing 10, which is open at one end to receive a base member 16, is conventional except for the fact that a central elongated element 17 within the switch 12 extends through an opening in the bottom portion 15 of the shell so as to act as a sort of rivet holding first the switch parts of switch 12 within the housing 11 and then the switch 12 to the shell 10. The rivet 17 has an inner enlarged portion acting as a bearing 18 for a purpose to be described hereinafter.

The base member 16 has an arcuate resistive path 20 on the inner surface thereof and is secured in the open end portion of the shell 10 by conventional lugs.

The control device also includes an elongated rotatable element 22, preferably a flat member, extending through an opening 19 in the base member 16 and this rotatable element has a body 23 of insulating material such as a suitable plastic molded to the inner end thereof.

The plastic body 23 includes a cylindrical bearing portion 24 inserted through the opening 19

of the base member 16 and has a head portion generally indicated as 25 with two spaced surfaces 61 and 62 within the shell 10. A transversely flexible and rotatable contactor is interposed between one of the surfaces 61 and 62 such as surface 61 of the head portion 25 and the resistive path 20 in sliding relation therewith upon being properly flexed by the confining head portion and surface 61.

The contactor 21 is held on head portion 25 for joint rotation with the elongated element 22 by key means such as the diametrically opposite protuberances 26 on the head portion 25 cooperating with complementary key means 27 on the contactor 21. The head portion 25 and contactor 21 are provided with interengaging portions 26, 27 respectively locking them together effectively only after the contactor is compliantly positioned by flexing it downwardly against the retaining surface 61 which is prevented from moving inwardly by having the bottom of the insulating molding 23 contact the bearing 18 within the shell 10 and/or the bottom of the shell 10, whereby the head portion and contactor are prepared for joint rotation with the elongated element 22.

The base member 16, shown more clearly in Figures 2 and 7, is initially held in the open end portion of the shell 10 by crimping securing lugs 9 over the outside surface of the base member 16 after the lugs 9 have been inserted through lateral notches 30 in the periphery of the base member in a manner known to the art. The base member 16 substantially closes the shell 10 except for the central opening 19 which is occupied by a portion 8 of the molded body 23 connecting the head 25 to the cylindrical bearing portion 24. The resistive path 20, which may comprise carbonaceous material adhered to an arcuate insulative strip, is placed on the underside of the base member 16. The ends of the path 20 are stapled to the enlarged portion 33 of the base member 16 through holes 32 by the ears 27' of the terminals 26'. A contactor ring or electrical contactor surface 28 is concentric with the arcuate and flat resistive path 20 and in the same plane therewith. The contactor surface 28 and a connector 29 are formed as one unit by stamping from flat sheets of metal and the unit is held to the base member 16 by depressing a reduced portion 35 substantially midway of the connector 29 through a hole 34 in the enlarged portion 33 of the base member 16 and then crimping over a part of the portion 35 on the outside surface of the base member 16.

The contactor 21 having a central opening 39 therein is held between the base member 16 and the head portion 25 of the molded body 23 only after the elongated element 22 is inserted through the aperture 19 in the base member 16 which is then rigidly fixed to the shell 10 in the manner described heretofore.

The contactor 21 is stamped or pressed from a sheet of resilient material such as Phosphor bronze to form oppositely extending arcuate-shaped spring contacting arms 40 and 41 having on the inner end thereof contacts 43 and 44 respectively on one side of the bearing 24 or elongated element 22 at slightly different distances from the longitudinal axis thereof. Opposite to contacts 43 and 44 on the other side of the bearing 24, there are found brush contacts 47 and 48 on arc-like arms 45 and 46 respectively formed by arcuate slots 63, 64 terminating with ends within the main body of the contactor 21. The arms 45 and 46 are continuous as contrasted with the arms 40 and 41

which are separated at the region adjacent the contacts 43 and 44. The contact arms 40, 41, 45 and 46 are bent into the position shown in Figure 6 at the same time that the contactor 21 is stamped from a thin sheet of metal. Since the contactor 21 is interposed between a retaining surface 61 on the head portion 25 and the combined arcuate resistive path 20 and the contact surface 28 which combination are in the same plane, and since the path 20 and surface 28 are concentric with each other, the distance between the center of the contactor 21 and the contacts 43, 44 is only slightly less than the distance between the same center and the contacts 47, 48 so as to provide a substantially balanced thrust upon the bearing 24 for the elongated member 22 when it is rotated.

A feature of the present invention as described above resides in the manner in which the contactor 21 is held in position on the rotatable element 22 for sliding contact with the resistive surface 20 and the brush collector surface 28. The construction of the volume control device is such that no rivets or similar fastening means are required to hold the contactor 21 in an operative position. Viewed in another light, this feature is accomplished by providing a one piece molded body 23 capable of having several functions on the inner end of the flat element 22, the body 23 having a plate-shaped head portion 25 with at least one planar retaining surface 61 with protruding integral key means 26 cooperating with the slotted contactor 21 for mutual engagement when the base member 16 is assembled with the shell 10 after the contactor 21 is interposed, is properly aligned and is flexed between the head portion 25 and the respective contacted surfaces 20 and 28. Thus, the complexity of previous control devices is entirely eliminated. The inward movement of the enlarged head portion 25 is prevented by an inner central protruding bearing 49 therein engaging the complementary central bearing 18 in the base of the housing 10 and thereby avoiding other previously necessary parts. The latter structural feature serves not only as a bearing but as a means for biasing the flexible contactor 21 against the fixed contacted surfaces 20 and 28 in a well balanced manner.

The described rotatable assembly including the contactor 21 is further centralized for rotation by placing an externally-threaded shaft-supporting bushing 50 around the cylindrical bearing 24. The bushing 50 has an inner enlarged generally hexagon-shaped portion 51 with an inwardly protruding tapered collar 51' seated within the aperture 19 of the base member 16, and is retained against the top or outside of the base member 16 by a spider-like metallic element 52. The spider 52 has three symmetrically arranged and radially extending arms, 53, 54 and 55 struck out from an outwardly protruding and centrally bored portion 56.

The arms 53, 54 and 55 are held in place by the lugs 57, 58 and 59 respectively which are integral with the open-end portion of the shell 10 in a manner similar to that described for the initial holding of the base member 16 to the open end of the shell 10 by using the lugs 9. The spider 52 not only retains the externally threaded bushing 50 against the base member 16 but also holds the base member 16 more firmly against the shell 10 than would otherwise be provided by the two lugs 9. However, it is within the purview of this invention to omit both the spider 52 and bushing 50 since a bushing cooperating with the bearing

24 of the shaft 22 may be formed integral with the base member 16. It can also be seen that the lugs 9 can be used to prevent the electrical control device from turning as a whole by having holes in the chassis through which the lugs 9 are inserted when the device is mounted on the chassis in a conventional manner.

The bottom or innermost side of the enlarged plate-shaped head portion 25 is formed as a substantially flat surface 62 which carries switch operating means such as a single web-like or radially extending protuberance 65 which engages the movable switch actuator 13 during either clockwise or counterclockwise movement of the elongated element 22 holding the parts heretofore described because the protuberance 65 is originally placed between two spaced vertical sides 66 and 67 of the movable switch actuator 13 positioned within the eccentrically located sector-like aperture 14.

A peripherally located stop means such as the radial extension 87 integral with the head portion 25 engages an inwardly depressed and eccentrically located stop portion 88 on the inner circular wall side of the shell 10 so as to limit the rotational movement of the contacts 47 and 48 over the arcuate resistive path 20 to an angle less than 360° after the switch 12 is turned on by the actuating element 65 moving the actuator 13 of the switch 12.

A thin strip of insulating material 63 is inserted within the shell 10 for engaging with the uninterrupted major portion of the side walls thereof and the underside of the base member 16 to provide substantial sealing of the inner rotatable electrical contacts away from the atmosphere and to give more positive insulation between the shell and the parts which are touched by the operator. Under certain conditions this strip can be left out.

Referring again to the rotatable elongated element 22, it should be noted that it is an elongated flat metallic member having at an outer end thereof a protruding portion 60 stamped therefrom fixedly to retain a knob 69. Therefore, another feature of this invention is the use of a flat shaft extension which may be also stamped out or produced in a similar manner on a mass production basis so as to lower the cost thereof.

In order to accommodate another usage of the subject electrical control devices and/or to further simplify the above-mentioned rotatable assembly including the molded head portion 25 and flat metallic shaft-extension 22, the latter is omitted and a stub shaft 80 with a bearing portion 81 and knurled end 82 containing a transverse slot 83 is substituted as shown in Figure 8. This arrangement is particularly advantageous when the subject volume control shown in Figure 1 is used as a trimmer control in television receivers. The knurled end 82 may fit within a recess of a panel (not shown) for easy manipulation either by the fingers of an operator or by a screw driver engaging the outside of the knurled end 82 and/or the slot 83. Thus, the shaft extension 22 is molded in a shorter form as an integral part of the molded head portion 25 so as to further reduce the cost of the subject rotatable assembly and to prevent unauthorized persons from misaligning a signal wave receiver in which the volume control is used.

Referring to Figure 3, the assembling of the contactor 21 with the protruding head portion 25 is further demonstrated for the purpose of showing how the number of parts of the previous

rotatable head and contactor assembly have been reduced and the resultant assembly very much simplified.

In the operation of the electric control device the knob 69 is turned in a clockwise direction so as to first rotatably move the switch actuator 13 to a closed position through the sliding action of an enlarged curved portion or eccentric pin 71 of the radial lug 65 within a slot formed by the spaced sides 66 and 67 of the actuator 13. Thus, the resistive path 20 is placed in connection with an electrical circuit (not shown) and after the above operation the knob 69 may be turned in the same direction by degrees depending upon the percentage of the resistive path 20 it is desired to have in a controlled circuit (not shown also) through the electrical bridge contactor 21 as one versed in the art can realize.

The rotation of the knob 69 and shaft 22 with the retaining surface 61 and the coupled contactor 21 in a reverse or counterclockwise direction and ultimately to a switch-off position of the actuator 13 is limited to a predetermined small angle after the switch 12 is turned off.

The clockwise rotation of the head portion 25 and contactor 21 includes a relatively large angle because of the substantial arc distance between the side 70 of the stop 87 in the off-position of the switch actuator 13 shown in Figure 3 and the side of the inwardly protruding lug 88 of the shell 10. Since the contacts 43 and 44 are on slightly different radii proper contact will be made upon the inner contacted surface 28 and the same holds true of the contacts 47 and 48 making contact to the resistive path 20. It should be further noted that since the brush or contact surface 28 is in the same plane occupied by the resistive path 20, the rotation of the contactor 21 by moving the knob 69 will be very smooth.

From the above disclosure, it can be seen that a new and novel electric control device is presented having the features of a flat shaft 22 so as to minimize the cost thereof and of a simplified sub-assembly including an insulating multifunction molded body 23 having the contactor retaining surface 61 of the head portion 25 and a contactor 21 without the use of rivets. Additional simplification is produced because the head portion 25 and the cylindrical bearing 24 connected thereto is molded on an inexpensive flat shaft extension. Since contactor 21 is interposed between the surface 61 and the various contacted surfaces found on the underside of the base member 16 which is, in turn, held rigidly to the outer portion of the shell 10 by means not requiring rivets, etc., and since the inward movement of the head portion 25 is prevented by the protruding bearing element 49 contacting the inside bottom of the shell 10, a simplified electric control device is produced. It will be noted that the contactor 21, after it is coupled to the outer side of the head portion 25 through the alignable means 26, 27, is really held in an operative position on the head portion 25 by the resilient action of the contacting arms 40, 41, 45 and 46 respectively responding to the opposing action of the fixed base member 16 and is associated contacted surfaces after the base member 16 is assembled with the shell 10 is a manner already discussed.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is in-

tended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A rotor for a circuit controlling device integrally molded from plastic insulating material, said rotor comprising an enlarged body portion having a flat surface generally perpendicular to the rotor axis, said surface having a plurality of lugs formed thereon, a reduced bearing portion of circular cross section protruding from one end of said body and centrally coupled thereto, and a boss protruding from the other end of said body, said boss being recessed to form a bearing support for the other end of said rotor.

2. In a circuit controlling device having a contractor, and a bushing; a rotor integrally molded from plastic insulating material, said rotor comprising an enlarged body portion defining a pair of facing semicircular segments of unequal area having a flat surface perpendicular to the rotor axis, said surface having a plurality of lugs formed thereon for supporting said contactor, a stop projection extending horizontally from the periphery of said larger segment of body, a reduced bearing portion of circular cross section protruding from one end of said body and adapted to fit within said bushing to support one end of the rotor, said reduced portion having a slot at its outer end, and a boss protruding from the other end of said body, said boss being recessed to form a bearing support for the other end of said rotor.

3. In a circuit controlling device having a contactor, and a bushing; a rotor integrally molded from plastic insulating material, said rotor comprising an enlarged body portion defining a pair of facing semicircular segments of unequal area having a flat surface perpendicular to the rotor axis, said surface having a plurality of lugs formed thereon for supporting a contactor, a stop projection extending outwardly from the periphery of said larger segment of said body, a reduced bearing portion of circular cross section protruding from one end of said body and adapted to fit within a bushing to support one end of the rotor, said reduced portion having a slot at its outer end, a boss protruding from the other end of said body, said boss being recessed to form a bearing support for the other end of said rotor, and a switch actuating member projecting outwardly from the other end of said body, said member being spaced from the rotor axis.

4. A variable resistance comprising, in combination, a casing having a bushing extending therefrom, a rotor formed from molded insulating material having an enlarged body portion disposed within said casing, a reduced bearing portion protruding from one end of said body portion and journalled in said bushing to form a bearing for one end of said rotor, a boss protruding from the other end of said body portion, said boss having a recess formed therein, a pin mounted on said casing and extending into said recess to form a bias adjustable bearing support for the other end of said rotor, said body portion having a flat surface facing and closely spaced to one wall of said casing, an arcuate resistance element mounted on said casing wall, a plurality of lugs formed on said surface, and a contactor formed from spring material mounted between said resistance element and said surface, said contactor having cut out portions cooperating with said lugs to prevent rotation of the contactor with respect to said rotor, and said contactor being maintained in engagement with said surface solely by the resilience of said spring material, the thrust imparted to the rotor by said contactor being taken up by said bias adjustable bearing support.

5. A variable resistance comprising, in combination, a casing having a bushing extending therefrom, a rotor formed from molded insulating material having an enlarged body portion disposed within said casing, a reduced bearing portion protruding from one end of said body portion and journalled in said bushing to form a bearing for one end of said rotor, a boss protruding from the other end of said body portion, said boss having a recess formed therein, a pin mounted on said casing and extending into said recess to form a bias adjustable bearing support for the other end of said rotor, said body portion having a flat surface facing and closely spaced to one wall of said casing, an arcuate resistance element mounted on said casing wall, an arcuate metal strip of smaller radius than said resistance element mounted on said casing wall in concentric relation with said resistance element, whereby said strip and said element lie in a common plane, a plurality of lugs formed on said surface, and a resilient contactor having a portion engaging said surface and a plurality of contact arms engaging said strip and said resistance element, said contactor having recessed portions cooperating with said lugs to prevent rotation of the contactor relative to the rotor, said contactor being maintained in engagement with said surface solely by the resilience of said contactor.

6. A combined variable resistance and switch comprising, in combination, a casing having a bushing extending therefrom a switch unit secured to said casing, said switch unit having an actuating member projecting through said casing, a rotor formed from molded insulating material having an enlarged generally cylindrical body portion disposed within said casing, a stop member projecting from the periphery of said body portion, a lug formed in said casing cooperating with said stop member to limit the angular movement of said rotor, a pin protruding from and integral with said rotor, said pin being spaced from the rotor axis and being engageable with said actuating member to operate said switch unit, a reduced bearing portion formed integrally with said body portion and journalled in said bushing, said body portion having a flat surface facing and closely spaced to the casing wall having said bushing, an arcuate resistance element mounted on said casing wall, and a contactor formed from spring material mounted between said surface and said resistance element, said contactor being maintained in engagement with said surface solely by the resilience of said spring material.

7. A combined variable resistance and switch comprising, in combination, a casing having a bushing extending therefrom, a switch unit secured to said casing, said switch unit having an actuating member projecting through said casing, a rotor formed from molded insulating material having an enlarged generally cylindrical body portion disposed within said casing, a stop member projecting from the periphery of said body portion, a lug formed in said casing cooperating with said stop member to limit the angular movement of said rotor, a pin protruding from and integral with said rotor, said pin being spaced from the rotor axis and being engageable with said actuating member to operate said switch unit, a reduced bearing portion formed integrally

with said body portion and journalled in said bushing to form a bearing for one end of said rotor, a boss protruding from the other end of said body portion, said boss having a recess formed therein, a pin mounted on said casing and extending into said recess to form a bias adjustable bearing support for the other end of said rotor, said body portion having a flat surface facing and closely spaced to one wall of said casing, an arcuate resistance element mounted on said casing wall, a pluralty of lugs formed on said surface, and a contactor formed from spring material mounted between said resistance element and said surface, said contactor having cut out portions cooperating with said lugs to prevent rotation of the contactor with respect to said rotor, and said contactor being maintained in engagement with said surface solely by the resilience of said spring material, the thrust imparted to the rotor by said contactor being taken up by said bias adjustable bearing support.

8. In a circuit controlling device having a housing, a bushing, a contactor element and a resistance element; a rotor enclosed by said housing comprising a main body of insulating material, said body having a plurality of surfaces, a bearing portion integrally molded to one of said surfaces, and a boss oppositely placed with respect to said bearing portion on said other surface, said bearing portion insertable in said bushing and said boss engaging said housing of said circuit controlling device to provide a two point suspension for said rotor in the operation thereof.

9. In a circuit controlling device; a rotor as in claim 8 wherein said rotor includes projecting means substantialy medially placed on said surface opposite said surface including said boss, said projecting means connected to said bearing surface so as to retain said contactor element on said surface.

10. A circuit controlling device as in claim 8 wherein said resistance element is placed adjacent said contactor element on said surface opposite said surface including said boss.

11. A rotor integrally molded from plastic insulating material comprising two facing semicircular segments having a plurality of longitudinally spaced surfaces, one of said segments having a diameter greater than its other segment, a plurality of ledges formed by the juxtaposition of the diameters of said segments, a stop projecting from the periphery of said larger segment, a bearing portion extending along an axis substantially vertical with respect to one of said spaced surfaces, said bearing portion having a plurality of lugs extending radially therefrom along said one surface toward its periphery, and a boss molded to the other of said spaced surfaces, said boss having a rib extending longitudinally along said other surface in a direction diametrically opposite said stop formed on said larger semicircular segment.

12. A rotor as in claim 11 wherein said boss has recess formed therein for holding a second bearing means.

13. A rotor as in claim 11 wherein said bearing portion is centrally positioned on said one of said surfaces and has a flat shaft molded thereto.

14. In an electrical control device having a base provided with a resistance element and a bushing, and having a cup-shaped cover attached to the base and coacting therewith to provide a housing: a shaft journaled in the bushing and projecting into the housing; a driver fixed to the shaft at the end thereof inside the housing, said driver having an annular rearward projection concentric to the shaft with the extreme rear edge of said projection lying in a plane normal to the shaft axis and beyond the adjacent end of the shaft so as to provide a smooth uninterrupted runner adapted to ride on and receive support from the bottom wall of the cup-shaped cover, whereby said runner and the bottom wall of the cup-shaped cover constitute a thrust bearing; and a contactor carried by the driver and interposed between the base and the driver, said contactor having spring contact fingers to resiliently bear against the resistance element and by the spring tension thereof hold the circular runner against the bottom of the cup-shaped cover.

15. In an electrical control, the combination with a base having a bearing and an annular resistance element concentric therewith and exposed on the inner face of the base, and a cup-shaped cover attached to the base and coacting therewith to provide a housing enclosing said resistance element, of: a shaft journaled in the bearing and projecting into the housing; a driver fixed to the shaft at the end thereof inside the housing; a contactor carried by the driver and having a spring contact finger to ride upon and resiliently bear against the resistance element; and an annular runner integral with the driver and extending rearwardly therefrom, said runner being concentric to the control shaft and its rearmost edge lying in a plane normal to the shaft axis and beyond the adjacent end of the shaft to ride upon and be supported by the inner face of the cup-shaped cover whereby said annular runner and the wall of the cover upon which it rides constitute a thrust bearing to hold the shaft and driver against inward displacement from a position maintaining the spring contact finger under tension.

16. An electrical control of the type having cooperating rotatable and stationary elements enclosed within a housing with the rotatable element movable by means of a shaft protruding from one wall of the housing, characterized by the provision of a thrust bearing comprising, the wall of the housing opposite that through which the shaft protrudes; and a part on the shaft bearing against said rear wall, the part on the shaft which engages the rear wall being a smooth annular runner concentric to the shaft axis with its rearmost edge lying in a plane perpendicular to said shaft axis and extending beyond the rearmost portion of the shaft so as to have a smooth running bearing upon the rear wall of the housing.

17. The electrical control set forth in claim 16 further characterized by the fact that said part on the shaft is a one piece molding of insulating material.

18. In an electrical resistance device: a base having a hole therethrough for the reception of a control shaft; a resistance element on the inner face of the base; a control shaft journaled in the hole in the base; a driver fixed to the shaft and overlying the inner face of the base; a spring contactor mounted on the driver and engaging the resistance element, the tension of the spring contactor imparting a rearward thrust to the driver and shaft; a cup-shaped cover positioned over the rear face of the base and coacting with the base to define a housing for the resistance element and contactor; and a thrust bearing to oppose the rearward thrust engendered upon the shaft and driver by the tension of the spring contactor, said thrust bearing comprising, a ring in-

tegral with the driver and projecting rearwardly therefrom beyond the rearmost portion of the shaft, the rear edge of said ring lying on a plane normal to the shaft axis and having a smooth sliding engagement with the adjacent end wall of the cup-shaped cover.

19. The electrical resistance device of claim 18 further characterized by the provision of cooperating stop abutments on the driver and the cup-shaped cover to define the limits of rotation of the rotatable elements of the control.

20. In a variable resistance device of the type in which a resistance element is traversed by a contactor driven by a rotatable control shaft passing through a hole in a base of insulating material, and wherein the control shaft is biased endwise toward the rear of the device: a cover attached to the base over the rear face thereof, said cover coacting with the base to form a housing for the device and having a wall substantially normal to the shaft axis and opposite the rear end of the shaft; a driver for the contactor fixed to the shaft inside the housing; and a circular runner on the rear of the driver extending beyond the rearmost portion of the shaft and throughout its entire circumference bearing

against said wall of the cover to provide a smooth running thrust bearing for supporting the shaft against the rearward end thrust thereon.

21. The variable resistance device of claim 20 further characterized by the provision of cooperating stop abutments on the driver and the cover for limiting rotation of the driver and consequently the contactor.

GEORGE O. PUERNER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
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