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English

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[54] VARIABLE RESISTANCE CONTROL WITH END COLLECTOR

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[51] Int. Cl. H01c 9/02

[58] Field of Search 338/162, 163, 170, 171, 174,
338/175, 202, 332

[56] References Cited

UNITED STATES PATENTS

2,867,705	1/1959	Beckwith	338/175 X
2,943,288	6/1960	Budd	338/175 X
2,810,809	10/1957	Barden	338/202 X
2,871,324	1/1959	Budd	338/166 X
2,925,575	2/1960	Barden	338/166
3,230,491	1/1966	Drefus	338/123

3,366,911	1/1968	Wilson	174/48 X
3,389,364	6/1968	Budd	338/174
3,412,360	11/1968	Colburn	338/162
3,522,572	8/1970	Michik	338/162 X

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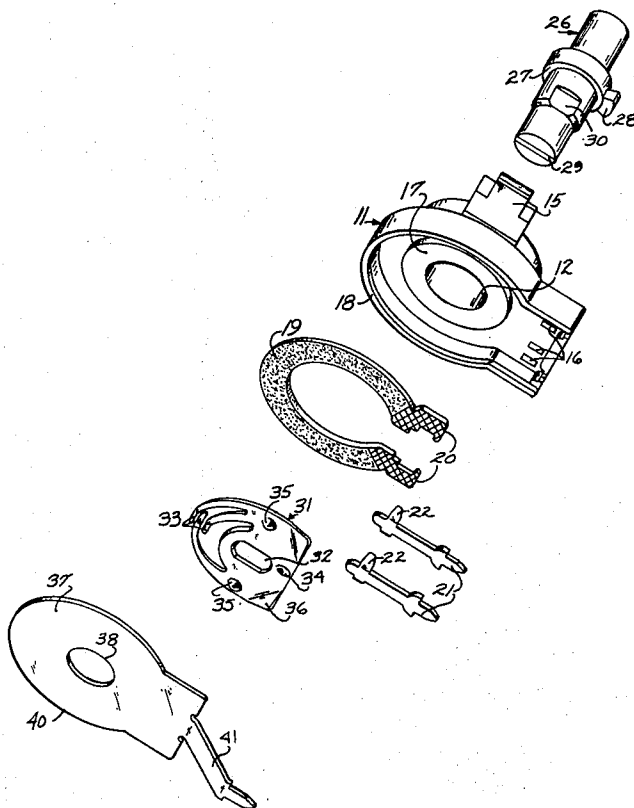
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ABSTRACT

A variable resistance control is provided wherein a contactor is pinched between a resistance element and a collector. The resistance element and collector lie substantially flatwise thereby providing uniform pressure on the contactor pinched therebetween. The contactor is constrained to rotate upon rotation of a driver rotatably supported in a housing. To minimize cost of the control a portion of the collector is utilized to close the housing. The driver has axially opposed shoulders bearing against the outer faces of the housing and collector to hold the same in place. The housing is formed of a one piece flexible, creep resistant material with integral resilient legs for mounting the control to a panel.

22 Claims, 4 Drawing Figures



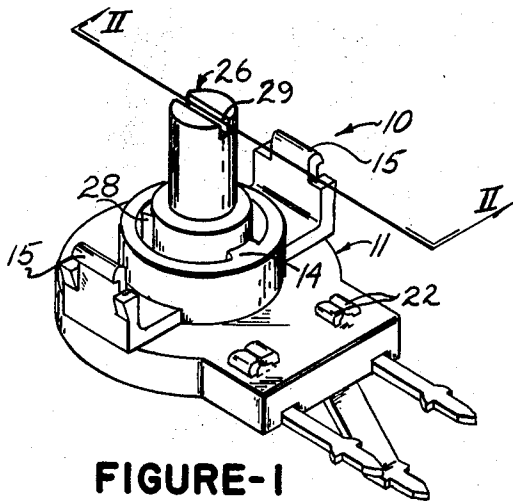


FIGURE-1

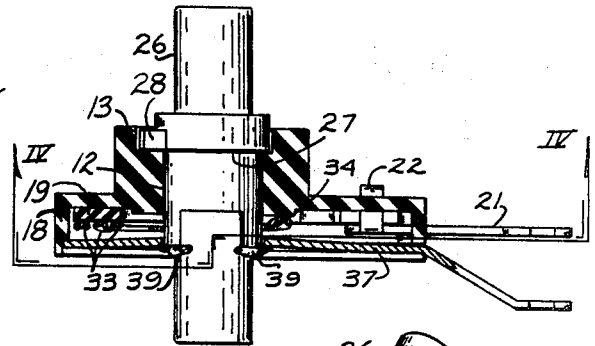


FIGURE-2

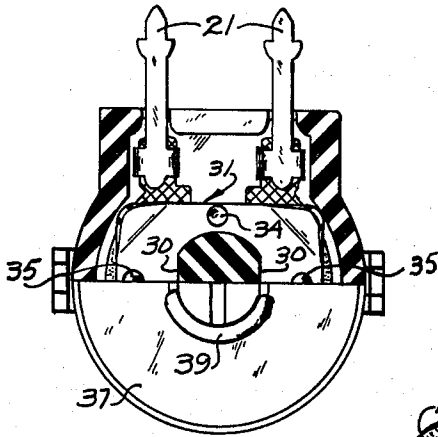


FIGURE-4

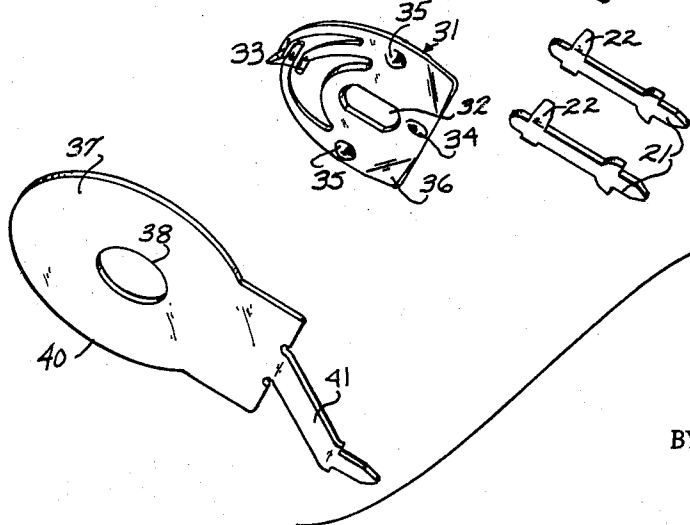
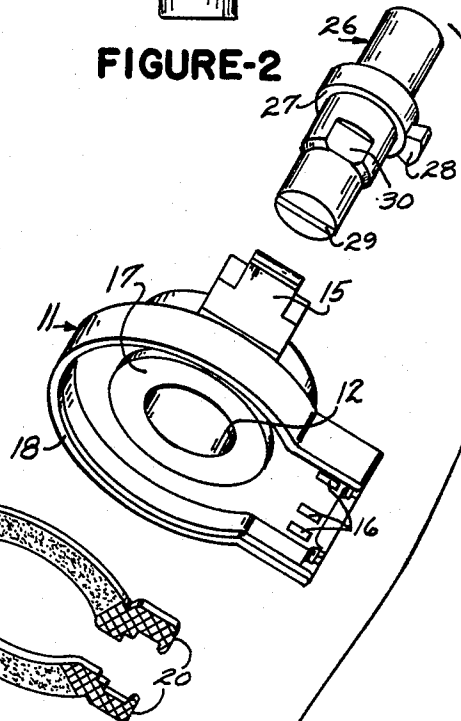


FIGURE-3

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VARIABLE RESISTANCE CONTROL WITH END COLLECTOR

The present invention relates to electrical controls and, more particularly, to a variable resistance control.

In the production of variable resistance controls it is highly desirable to minimize cost while maintaining quality. The cost of the control is directly proportional to the number of parts employed since each additional part necessitates additional expenses of fabricating the part and assembling the part into the finished product. Therefore, it would be desirable to fabricate a variable resistance controlling utilizing a minimum number of parts.

Another consideration in reducing the cost of the finished control is the adaptability for automation. Variable resistors are commonly assembled in a plurality of equally spaced nests. As a nest moves past a certain station an operator or machine performs a certain function such as placing one of the parts of the component into the nest. Before the components are removed from the nests the parts must be secured together with fastening equipment. In such an operation it is desirable to have a construction wherein the parts can be assembled from one direction.

Whenever the driver rotatably supporting the contactor is loosely fitted in the bearing of a variable resistance control many problems, for example wobbling of the driver occur. It would, therefore, be desirable to provide a driver bearing relationship which eliminates wobbling of the driver.

Another problem associated with the manufacture of variable resistance controls is the fabrication of a control which will maintain the proper rotational restraining force. The rotational torque required to overcome this force must be such that accidental rotation of the driver is prevented while maintaining ease of adjustment. Thrust washers and O-rings have commonly been used to obtain the proper rotational restraining force, however, these become ineffective because of standard manufacturing tolerances and the possibility of springback occurring due to the use of resilient materials in their fabrication. It would, therefore, be desirable to provide means for maintaining the proper rotational restraining force while eliminating the need for O-rings or thrust washers.

The conventional variable resistance control generally employs a rotatable contactor secured to a driver for engaging the resistance element and collector. Ordinarily the contactor is stamped from a piece of flat conductive spring like material. The portions that are to engage the resistance element and collector are formed by bending these portions out of the plane of the body of the contactor until they are spaced the desired distance from the body. There is a tendency for these portions to spring back due to the use of spring like material. Because of variations in the material used, the precise degree of springback is difficult to reliably predict. Thus it is quite difficult to space these portions the desired distance from the body of the contactor and maintain equal contact pressure on both the resistance element and collector. It would therefore be desirable to provide a flat contactor of spring like material eliminating variations due to springback of formed parts and thus maintain predetermined contact pressures on the resistance element and collector.

In the past when it was desired to secure the electrical control to a panel, a separately fabricated fastener was secured to the base of the electrical control. Such a construction is shown in Wilson et al., U.S. Pat. No. 3,366,911, assigned to the assignee of this application. It was necessary to employ this type of construction in order to have resilient legs on the fastener while having a relatively rigid base to enable terminals to be secured thereto. It would be desirable to have a one piece housing with integral fasteners to eliminate the expense associated with fabrication of two separate pieces and assembly thereof.

Accordingly it is an object of the present invention to provide a new and improved variable resistance control having the various desirable features set forth above. Another object of the present invention is to provide a variable resistance control utilizing a minimum number of parts by using the collector

as a cover for the housing. An additional object of the present invention is to provide a variable resistance control of simple and compact structure which can be assembled from one direction and is thus adaptable for automation. A further object of the present invention is to provide a variable resistance control wherein the driver is in both radial and axial bearing engagement with the housing to thereby eliminate wobbling of the driver. Still another object of the present invention is to provide a variable resistance control with a driver of an electrically nonconductive heat deformable material, a portion thereof being swaged to maintain the control assembled and provide the proper rotational restraining force on the driver. Yet another object of the present invention is to provide a variable resistance control with the contactor pinched between the resistance element and the collector to thereby maintain equalized contact pressures on the resistance element and collector. Yet an additional object of the present invention is to provide a variable resistance control wherein the resistance element and collector lie substantially flatwise and spaced from one another in substantially parallel planes thereby permitting greater electrical clearances and flexibility of design. Yet a further object of the present invention is to provide an electrical control with a one piece molded housing having integral resilient means for mounting the control to a panel. Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty characterizing the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly the present invention is concerned with a variable resistance control wherein a contactor is pinched between a resistance element and a collector. The contactor is constrained to rotate upon rotation of a driver rotatably supported by a housing. The resistance element and collector lie substantially flatwise and in spaced relationship. In a preferred embodiment the collector closes the housing and is provided with an aperture in which the driver is rotatably supported. Axially opposed shoulders on the driver bear against the outer faces of the housing and collector plate to hold the same in place with the contactor pinched therebetween. The housing is formed of a one piece flexible, creep resistant material having integral resilient legs for mounting the control to a panel.

For a better understanding of the present invention reference may be had to the accompanying drawings wherein the same reference numerals have been applied to like parts and wherein:

FIG. 1 is an isometric view of an improved variable resistance control built in accord with the present invention;

FIG. 2 is a cross sectional view of the variable resistance control taken along lines II—II of FIG. 1;

FIG. 3 is an exploded view of the variable resistance control shown in FIG. 1; and

FIG. 4 is a cross sectional view of the variable resistance control taken along lines IV—IV of FIG. 2, assuming FIG. 2 is shown in full.

Referring now to the drawings there is illustrated a variable resistance control generally indicated at 10 comprising a housing 11, an electrically nonconductive heat deformable rotatable shaft or driver 26, and a collector 37 sealing the housing 11.

Considering first the housing 11, it consists of a one piece molded electrically nonconductive material. As best shown in FIG. 2, the housing 11 is provided with an aperture 12 having an enlarged portion 13 into which stop means 14 (shown in FIG. 1) projects. Diametrically and peripherally disposed legs 15 extend from the housing 11 for mounting the assembled control in a panel as disclosed in Wilson et al., U.S. Pat. No. 3,366,911 assigned to the assignee of this application and incorporated herein by reference. As best shown in FIG. 3 a plurality of slotted openings 16 extend through the base of the housing 11. Internally of the housing 11 a raised annular trackway 17 extends around the aperture 12. A skirt 18 extends outwardly from the base of the housing 11 and around

the periphery of the base of the housing 11. The skirt 18 terminates in a shouldered portion. An arcuate shaped resistance element 19 is disposed radially of the raised annular trackway 17 and provided with a pair of depending legs 20. Where improved electrical connections are desired the legs 20 are coated with a suitable conductive material. In order to secure the element 19 to the base of the housing 11 a pair of terminals 21 having a pair of depending tabs 22 is positioned over the legs 20 of the resistance element 19 and secured to the base of the housing 11 by means of placing the tabs 22 in the slotted openings 16 and bending them over on the opposite side of the housing 11. The element 19 could be alternatively secured by extending the tabs 22 through from the opposite side of the housing 11 and bending them over the top of the legs 20. Since the legs 15 are integral with the housing 11 it is necessary to use a material that will permit flexibility of the legs 15 while insuring rigidity of the portion supporting the resistance element 19 and eliminating creep of the material surrounding the slotted openings 16 to enable the terminals 21 to be securely fastened to the housing 11. Polysulfone has been found to be satisfactory for this purpose.

In order to provide adjustability of the control 10, the electrically nonconductive heat deformable driver 26 is rotatably positioned in the aperture 12. The housing wall surrounding the aperture 12 provides supporting means for rotatably supporting the driver 26. An annular flange 27 on the driver 26 is positioned in the enlarged portion 13 of the aperture 12 and engages the housing 11 to prevent further insertion of the driver 26 and form a radial bearing between the driver 26 and housing 11. A stop member 28 extends radially of the flange 27 and is positioned for movement in an interference path with the stop means 14 projecting into the enlarged portion 13. Adjustability of the control 10 is enhanced by providing a slot 29 in each end of the driver 26, thereby insuring adjustability of the control 10 from either the front or rear. Diametrically opposed flats 30 are spaced on the driver 26 axially of the annular flange 27 to provide the driver 26 with a non-circular cross section. A contactor 31 having an opening 32 corresponding to the non-circular cross section of driver 26 is positioned on the driver 26 and constrained to rotate therewith due to mating engagement of the non-circular cross section of the driver 26 and the opening 32. A plurality of paddles 33 integral with the contactor 31 are positioned to wipingly engage the resistance element 19. In order to insure balance of the contactor 31 and equalize contact pressure on the resistance element 19, a pressure equalizing protuberance 34 extends from the contactor 31 and engages the raised annular trackway 17. Means for spacing the contactor 31 in the form of additional pressure equalizing protuberances 35 are positioned on opposite sides of the contactor 31. In the manufacture of the contactor 31, the general shape is first cut from a piece of flat spring like material. The paddles 33 are coined to permanently deform them the desired distance from the plane of the contactor 31 and maintain a curved surface for making point contact with the resistance element 19. In order to provide the paddles 33 with a spring bias they are connected to the body of the contactor 31 by resilient arms lying in the same plane as the contactor. The pressure equalizing protuberances 34, 35 are also permanently deformed with the use of dies to a desired height. A predetermined contact pressure is thus obtained by varying the height of the pressure equalizing protuberances 34, 35 thereby eliminating problems associated with springback of formed parts and development of form dies associated with contactors having portions bent from the body of the contactor. The corners 36 of the contactor 31 may be bent away from the plane of the resistance element 19 to eliminate the possibility of engagement therewith.

In order to seal the control 10 the collector 37 is disposed over the opening in the end of the housing 11. Outer edge 40 of the collector 37 is supported by the shoulder of the skirt 18 to properly space the collector 37 from the resistance element 19 and terminals 21. By supporting the resistance element 19 and collector 37 substantially flatwise and in spaced relation-

ship, a uniform distance is established between the resistance element 19 and collector 37 whereby a uniform pressure is maintained on the contactor 31 as it rotates. The collector 37 is provided with an aperture 38 through which one end of the driver 26 extends. Ordinarily controls of this type are provided with both the collector and resistance element spaced concentrically about an aperture in the housing. In such a control it is necessary to space the collector a sufficient distance from the resistance element to provide electrical clearance. The specific distance is determined by the desired current carrying capability of the element. Thus where a particular width limitation is desired, the current carrying capability of the control must be limited. The present invention overcomes this problem by spacing the collector 37 in a different plane than the resistance element 19 thereby permitting greater electrical clearance. Also in prior controls, where the collector and resistance element are spaced concentrically about an aperture in the housing, the housing is in two pieces to enable assembly while providing a sealed construction. During assembly the collector must be securely positioned before the two pieces of the cover are fastened. The present invention avoids the use of a two piece housing by utilizing the collector to seal the housing. Thus an extra part and an additional assembly step are eliminated thereby greatly reducing the cost of the control.

In order to fasten the collector 37 to the housing 11 and provide the proper rotational restraining force for the driver 36, portions 39 of the driver 26 are heat swaged outwardly over the outer portion of the collector 37. As shown in FIG. 2 when the portions 39 of the driver 26 are swaged over the collector 37, the collector 37 is slightly dished whereby the resiliency of the collector 37 provides the desired rotational restraining force between flange 27 and housing 11 and between portions 39 and collector 37. This slight dishing does not affect the uniform distance between the collector 37 and resistance element 19 wherein the contactor 31 travels since the protuberances 35 are spaced concentrically about the axis of the driver 26 and the amount of dishing will be uniform at any fixed distance from the axis of the driver 26. Thus the portions 39 and flange 27 form axially opposed shoulders bearing against the outer faces of the collector and housing to hold the same in place. It is to be understood that the collector can be secured to the housing in a different fashion such as by deforming the housing over the outer edge 40 of the collector 37. In doing this it would be necessary to have flanges on the driver spaced internally of the collector and housing to maintain proper rotational torque.

The pressure equalizing protuberances 35 engage the collector 37 on opposite sides of the driver 26 to cooperate with paddles 33 and pressure equalizing protuberance 34 for maintaining the contactor 31 pinched between the resistance element 19 and collector 37 to insure equalized contact pressures. In addition to maintaining the contactor 31 pinched between the resistance element 19 and collector 37, the paddles 33 and the pressure equalizing protuberances 35 electrically connect the resistance element 19 and collector 37. It is desirable to utilize point contacts between the collector 37 and contactor 31 such as done in using pressure equalizing protuberances 35 since this insures low contact resistance. Since the force urging the contactor 31 toward the collector 37 is transferred through the small unit area of the pressure equalizing protuberances 35, the pressure equalizing protuberances 35 are urged into close contact with the collector 37. In wipingly engaging the collector 37 the pressure equalizing protuberances 35 will push aside any particles that may be present on the collector 37, thereby maintaining close contact and correspondingly low contact resistance. The terminal 41 is integrally connected to the collector 37 for cooperating with terminals 21 to electrically connect the control 10 to an external circuit.

As best shown in FIG. 3 this construction is readily adaptable to mechanized assembly. To assemble in a plurality of equally spaced nests, the first step is the positioning of the driver 26 in a nest. Next, the housing 11 is positioned on the

driver 26 with the flange 27 engaging the housing 11. The resistance element 19 is then positioned around the annular trackway 17 and the terminals 21 are secured to the ends 20 of the resistance element 19 with the tabs 22 passing through the slotted openings 16 and being folded over on the opposite side of the housing 11. The contactor 31 is then positioned on the non-circular cross section of the driver 26. Lastly, the collector 37 is positioned on the driver 26, pinching the contactor 31 between the resistance element 19 and collector 37, and portions 39 of the driver 26 are heat swaged to increase the diameter of the driver 26 in the aperture 38 of the collector 37 and secure the collector 37 and the housing 11 together. Once the control 10 has been assembled it is seen that the driver 26 is secured against wobbling. In addition to the axially spaced bearing surfaces provided by aperture 12 and aperture 38 the flange 27 on the shaft 26 engages the housing 11 to provide a radial bearing. The portions 39 of the driver 26 having been heat swaged outwardly over the collector 37 maintain flange 27 in engagement with the housing 11. Additionally, cooperation of flange 27 with housing 11 and cooperation of portions 39 with collector 37 maintains the desired rotational restraining force on the driver 26.

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention, it will be appreciated that numerous changes and modifications are likely to occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A variable resistance control comprising a housing defined by a skirt and an end wall integral with said skirt, a resistance element lying in a plane and supported flatwise against the end wall of said housing, a collector supported by said skirt and having a diameter slightly larger than the diameter of the resistance element and closing one end of the housing, said collector being provided with an aperture, said collector being substantially flatwise and lying in a plane in spaced parallel relationship to said plane containing said resistance element, a contactor rotatable about an axis and positioned between said resistance element and said collector, and driver means for rotating said contactor whereby upon rotation of said driver means said contactor wipingly engages said resistance element and said collector, said collector rotatably supporting said driver means in said aperture.

2. The control of claim 1 wherein the skirt extends from the housing and has a shoulder formed therein, said collector being supported on said shoulder, and at least a portion of said skirt or said driver means is deformed over the collector to secure the collector to the housing.

3. The control of claim 1 wherein said housing comprises a molded substantially cup-shaped member, the end wall of the housing is the bottom thereof, the resistance element is disposed flatwise against the bottom of said cup-shaped member, the collector defines the other end wall of the housing, the bottom of said cup-shaped member is provided with a plurality of slots, and terminals having arms passing through said slots secure said resistance element to said housing.

4. The control of claim 1 wherein a stop member extends radially from the driver means, and stop means secured to the housing is disposed in an interference path with the stop member.

5. The control of claim 4 wherein said driver means is provided with a first shaft portion in said aperture and is supported solely by said collector, the end wall being provided with an opening and said driver means being provided with a second shaft portion rotatably supported in said opening.

6. The control of claim 2 wherein said housing comprises a molded substantially cup-shaped member, the end wall of the housing is the bottom thereof, the resistance element is disposed flatwise against the bottom of said cup-shaped member, the collector defines the other end wall of the hous-

ing, the bottom of said cup-shaped member is provided with a plurality of slots, and terminals having arms passing through said slots secure said resistance element to said housing.

7. The control of claim 2 wherein a stop member extends radially from the driver means, and stop means secured to the housing is disposed in an interference path with the stop member.

8. The control of claim 3 wherein a stop member extends radially from the driver means, and stop means secured to the housing is disposed in an interference path with the stop member.

9. A variable resistance control comprising a housing having supporting means in one end and an opening in the other end, a collector disposed over said opening and having an aperture therein, a driver having a shaft rotatably supported in the aperture in said collector, said supporting means and said collector rotatably supporting said driver, said driver having one end of the shaft solely supported by said collector, a resistance element supported flatwise by said housing and lying in a plane in spaced parallel relationship to said collector, said collector having a diameter about as large as the diameter of the resistance element, and a contactor positioned between said resistance element and said collector, said contactor being constrained to rotate with said driver, said contactor wipably engaging said resistance element and said collector.

10. The control of claim 9 wherein said driver has a radially extending flange in bearing engagement with the housing adjacent the supporting means in said one end.

11. The control of claim 10 wherein a stop member is connected to said driver and extends from said flange, and stop means is positioned on said housing in an interference path with said stop member.

12. The control of claim 9 wherein the contactor comprises a paddle engaging the resistance element and a protuberance projecting from the plane of the contactor engages the collector.

13. The control of claim 9 wherein a raised annular trackway extends around the supporting means in said housing and is disposed between said supporting means and said resistance element, said contactor having contact means engaging said resistance element, and a pressure equalizing protuberance is spaced from said contact means and engages said annular trackway.

14. The control of claim 13 wherein two additional pressure equalizing protuberances are permanently deformed from said contactor for stabilizing said contactor.

15. A variable resistance control comprising a housing having an aperture in one end and an opening in the other end, a collector member disposed in one of said ends of the housing and having an aperture therein, a driver having a shaft portion rotatably supported in one of the apertures, a resistance element member supported flatwise in the other of said ends of said housing and lying substantially in a plane in spaced parallel relationship to said collector member, said plane being normal to the axis of rotation of said driver, a flange extending radially from the driver in bearing engagement with one of the ends of the housing for limiting axial movement of the driver in one direction relative to said housing, and a contactor sandwiched between said members and having contact means spring biased therebetween, said contactor being constrained to rotate with said driver, said contactor wipably engaging said members, said collector member having a diameter slightly larger than the diameter of the resistance element member, said collector member closing one of said ends of the housing.

16. The control of claim 15 wherein said housing is substantially cup-shaped, the one end of the housing is the bottom thereof, the resistance element member is disposed flatwise against the bottom of said cup-shaped housing, the bottom of said cup-shaped housing is provided with a plurality of slots, and terminals having arms passing through said slots secure said resistance element member to said housing.

17. The control of claim 15 wherein at least a portion of said housing or said driver is deformed over one of the members to secure the member to the housing.

18. The control of claim 15 wherein the one end of said housing is provided with an enlarged portion, the flange is disposed in said enlarged portion, a stop member extends radially from the driver, and stop means secured to the housing is disposed in an interference path with the stop member.

19. A variable resistance control comprising a base, a resistance element supported flatwise on said base, a collector supported by said base in spaced parallel relationship to said resistance element, said collector being substantially flatwise and having a diameter slightly larger than the diameter of the resistance element, a driver supported for rotation relative to said base, said driver having first and second shaft ends, said collector forming the sole support for one of said shaft ends, and a contactor constrained to rotate with said driver for wipably engaging said resistance element and said collector, said contactor comprising a body lying in a single plane and a plurality of resilient arms lying in said plane, contact means coined from said arms and permanently deformed from said plane and engaging said resistance element with a predetermined pressure, and a pressure equalizing protuberance permanently deformed a predetermined distance from said plane and engaging said collector, said predetermined pressure being a function of said predetermined distance.

20. The variable resistance control of claim 19 wherein said contactor is positioned between said resistance element and said collector and two additional pressure equalizing protuberances are permanently deformed from said plane for stabiliz-

ing said contactor.

21. A variable resistance control comprising a housing having an aperture in one end and an opening in the other end, a collector closing said opening and having an aperture therein, a driver having first and second shaft ends rotatably supported in the aperture in said one end of said housing and in the aperture in said collector, said collector forming the sole support for one of said first and second shaft ends, a resistance element supported flatwise by said housing, and a contactor positioned between said resistance element and said collector, said contactor being constrained to rotate as said driver rotates, said contactor wipably engaging said resistance element and said collector.

22. A variable resistance control comprising a molded housing having an opening in one end, a resistance element supported flatwise by said housing, a collector supported substantially flatwise by said housing, said collector being disposed over said opening and closing said opening and spaced from a plane containing said resistance element, said housing being deformed over the collector to secure the collector to the housing, a contactor positioned between said resistance element and said collector, and driver means for rotating said contactor whereby upon rotation of said driver means said contactor wipingly engages said resistance element and said collector.

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Notice of Adverse Decision in Interference

In Interference No. 98,455, involving Patent No. 3,670,285, J. A. English, **VARIABLE RESISTANCE CONTROL WITH END COLLECTOR**, final judgment adverse to the patentee was rendered April 18, 1980, as to claim 22.
[Official Gazette February 23, 1982.]