United States Patent [19]

Rozema et al.

[11] **3,735,327**

[45] **May 22, 1973**

[54] VARIABLE RESISTANCE CONTROL

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[22] Filed: **Jan. 7, 1972**

[21] Appl. No.: **216,136**

[52] **U.S. Cl.** **338/183,** 338/176

[51] **Int. Cl.** **H01c 1/02**

[58] **Field of Search** 338/176–183

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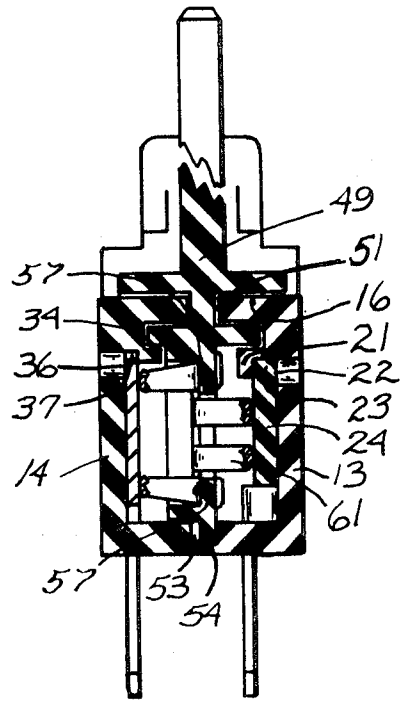
[57] **ABSTRACT**

A variable resistance control employs a contactor wipably engaging a resistance element and a collector supported by a pair of split housing sections. Positioning tabs extend from the resistance element and collector into undercut portions in the housing section. Control operating means for moving the contactor relative to the resistance element is positioned in a slot in the housing and provided with parallel longitudinal grooves receiving the side walls of the slot. A contactor having a pair of spaced bars has a continuous strip connecting the spaced bars and extending through an opening in the control operating means for engaging the resistance element. The contactor resiliently biases the control operating means against one side wall of a channel formed in the bottom wall of the housing. End walls of the housing are provided with a groove extending therearound such that a U-shaped mounting bracket having a pair of spaced legs and a connecting portion is disposed in each of the grooves. The legs have ends bent toward each other to firmly engage the housing and maintain the housing section in assembled relationships.

21 Claims, 3 Drawing Figures



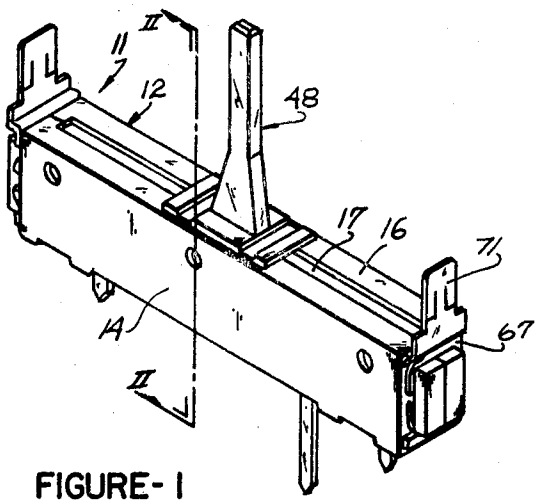


FIGURE-1

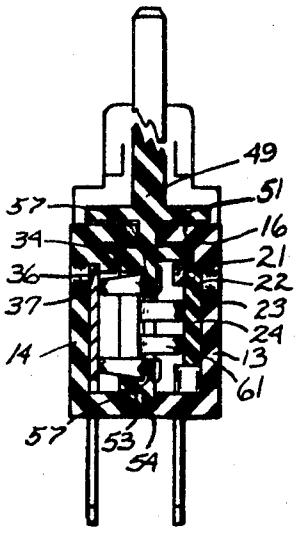


FIGURE-2

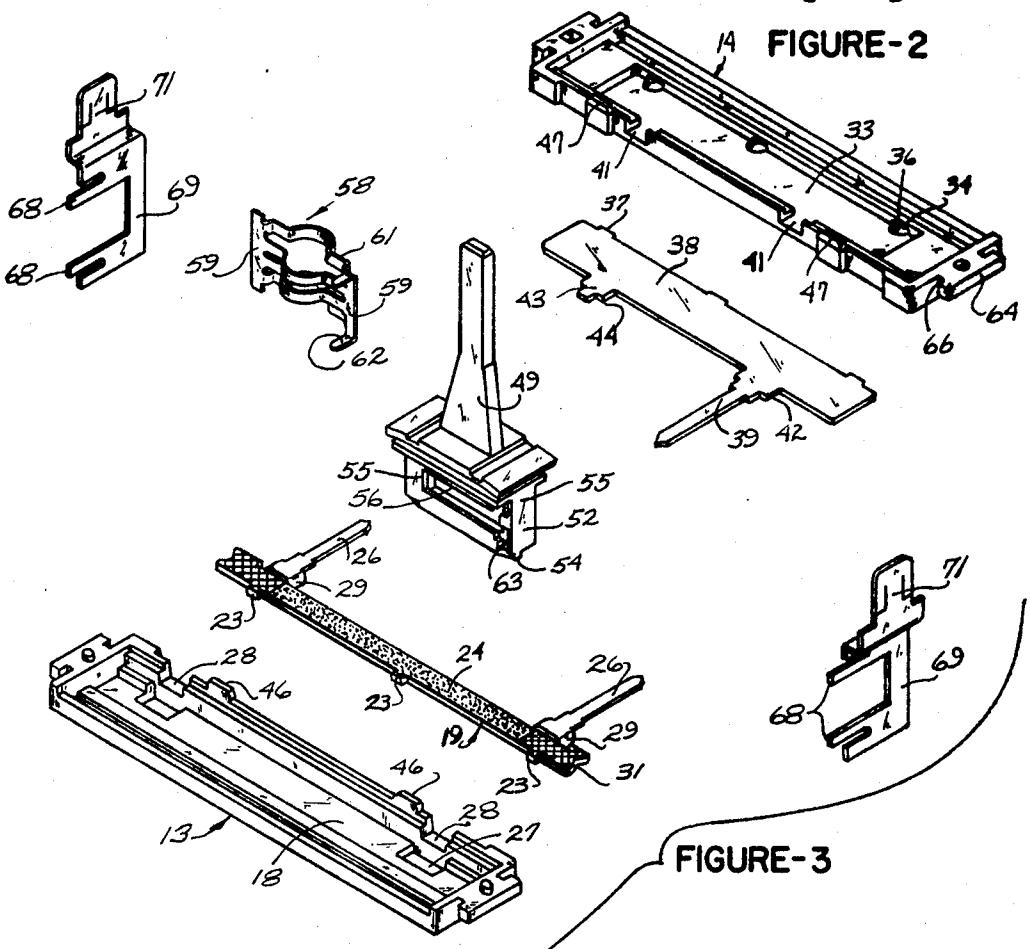


FIGURE-3

VARIABLE RESISTANCE CONTROL

The present invention relates to a variable resistance control, and more particularly, to a variable resistance slide control having a slider movable rectilinearly in the housing.

It is well-known to provide a variable resistance slide control having split housing sections supporting resistance and conductive elements and having a slider or control operating means carrying a contactor wipingly engaging the resistance and conductive elements. Such variable resistance slide controls are exemplified by Bang U.S. Pat. No. 3,362,004 issued Jan. 2, 1968. When assembling controls of this type, it is necessary to provide some means for joining the split housing sections together. In the past this has been done utilizing adhesive, ultrasonic bonding, spring clips, and various mounting brackets such as that shown in Campbell U.S. Pat. No. 3,493,914. For ease of assembly, it would be advantageous to provide a mounting bracket that maintains the split housing sections together wherein the control and mounting bracket can be assembled from the same direction thus eliminating any problems associated with changing the position of the control during assembly thereof in order to secure the mounting bracket thereto. Accordingly, it is an object of the present invention to provide a mounting bracket for securing together the split housing sections of a variable resistance slide control that can be secured to the control in the same direction of assembly as the remaining parts of the control.

In the mechanized assembly of controls of this type, it is customary to feed various elements from bowl feeders containing a large number of similar elements. In the past when a large number of contactors were placed together, a common problem was the difficulty in separating individual contactors due to the paddles of one element becoming intertwined with the contactor arms and various other parts of the other contactors. Accordingly, it is an object of the present invention to provide a contactor which eliminates the problem of separating individual contactors from a large number thereof.

In the past, variable resistance controls have been assembled by fabricating a resistance elements, securing the resistance element to a base and then securing the base to the housing. This has presented problems with warpage of the resistance element due to the difficulties involved in matching coefficients of expansion of the dielectric material used for the resistance element and that used for the base. It would, therefore, be desirable to provide a resistance element that could be accurately positioned within the control and yet float, i.e., not be constrained along its entire length with regard to a base, thus eliminating warpage problems. Accordingly, it is an object of the present invention to provide a floating resistance element having means to accurately position the element within the control.

In order to stabilize the movement of the control operating means relative to the housing, slide controls of the past have utilized a control operating means having parallel longitudinal grooves that receive the side wall of the slot in the top wall of the housing whereby the control operating means is locked in the housing but can be moved back and forth along the slot. Such control operating means have tended to jump and skip as adjustment of the control is made. Due to the long slider arm extending from the control required for moving the control operating means and, since the control operating means is fabricated from a somewhat resilient material, movement of the arm laterally of the longitudinal slot has resulted in movement of the contactor secured to the control operating means laterally of the control, thus resulting in jumping or skipping of the contactor as the control operating means is moved longitudinally of the housing. It would, therefore, be desirable to fabricate a slide control eliminating problems associated with jumping and skipping. Accordingly, it is an object of the present invention to provide control operating means wherein a portion of the control operating means disposed adjacent the housing opposite the slot is engaged in a channel thereby constraining movement of the contactor in a longitudinal path and eliminating jumping or skipping.

Accordingly, it is an object of the present invention to provide an improved variable resistance slide control. Another object of the present invention is to provide a variable resistance slide control capable of being finely adjusted without having the control operating means jump or skip. An additional object of the present invention is to provide a contactor that will not intermesh with other contactors when placed together with a plurality of other contactors. A further object of the present invention is to provide a variable resistance slide control having brackets securing two housing sections together such that the brackets can be assembled from the same direction as the remaining structure of the variable resistance control. Yet another object of the present invention is to provide a variable resistance slide control wherein the control operating means is constrained within the housing and lateral movement thereof is eliminated. Yet a further object of the present invention is to provide a channel in the housing spaced from the slot through which the slider arm extends for engaging a portion of the control operating means. Yet, an additional object of the present invention is to provide a floating resistance element that can be accurately positioned within the control. 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 slide control employing a contactor wipably engaging a resistance element and a collector element supported by a pair of split housing sections. Each of the pair of split housing sections has a cavity formed therein for receiving a resistance or collector element. Positioning tabs extend from the resistance element and collector element into undercut portions in their respective housing sections to position the elements relative thereto. When the two sections are assembled together, a longitudinal slot is provided therebetween on the top surface of the housing. A slide arm is positioned in the slot with opposite sides being provided with parallel longitudinal grooves receiving the side walls of the slot whereby the slide arm is locked in the housing but can be moved back and forth along the slot. A channel provided in the bottom wall of the housing receives a portion of the slide arm and prevents lateral movement of the slide arm relative to the longitudinal slot. The slide arm is provided with a frame having an opening therethrough with a pair of seats disposed adjacent to the opening such that a contactor

having ends positioned on the seats has a continuous strip connecting the ends and extending through the opening slidably engaging the resistance element and a continuous strip slidably engaging the collector. End walls of the housing are provided with a groove extending therearound such that a U-shaped mounting bracket having a pair of spaced legs and a connecting portion is disposed in each groove. The legs have ends bent toward each other to firmly engage the housing and maintain the housing sections in assembled relationship.

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 a variable resistance slide control made in accord with the present invention.

FIG. 2 is a sectional view taken along Line II—II of FIG. 1, and

FIG. 3 is an exploded view of the control shown in FIG. 1, with the resistance element and its corresponding housing section and the collector element and its corresponding housing section being rotated 90° to provide a full view of the interior of the control.

Referring no to the drawings, there is illustrated a variable resistance slide control generally indicated at 11 comprising a housing 12 made from a pair of housing sections 13, 14 which when joined together form a top wall 16 having a slot 17 therein. The first housing section 13 is provided with a cavity 18 therein such that resistance means 19 lying substantially in a plane can be positioned in the cavity 18. As best shown in FIG. II, the cavity 18 is provided with overhangs 21 defining undercut portions 22 such that positioning tabs 23 on the resistance means 19 slip under the overhangs 21 to accurately position the resistance means 19 relative to the first housing section 13. In the preferred embodiment the housing sections 13, 14 are molded with pins being utilized during the molding process to define the undercut portions 22. In an actual construction, the pins used in the molding process have a radius of 0.040 inch with the positioning tabs 23 having a width of 0.064 inch and a height of 0.020 inch. These dimensions permit about a 0.005 inch tolerance between the positioning tabs 23 and the undercut portions 22. Such a tolerance permits the resistance means 19 freedom of movement in an end-wise direction, thus, eliminating any problems due to differing coefficients of expansion of the first housing section 13 and the resistance means 19. If desired, one of the positioning tabs 23 could be dimensioned to fit snugly in its respective undercut portion 22 whereby the resistance means 19 would be rigidly secured. Since the remaining positioning tabs 23 would be free to move in their respective undercut portions 22, relative expansion between the first housing section 13 and the resistance means 19 could take place without producing warpage of the resistance means 19.

The resistance means 19 comprises a resistance element 24 having a pair of terminals 26 clinched thereto. The terminals 26 are clinched on the resistance element 24 and positioned in a relieved area 27 in the cavity 18 of the first housing section 13. The terminals 26 extend through grooves 28 provided in the bottom wall of the first housing section 13. In order to permit end-wise movement of the resistance means 19, the grooves 28 are slightly wider than the terminals 26 thus permitting relative expansion of the first housing section 13 and the resistance element 24 without causing any warpage of the element. Shoulders 29 on the terminals 26 engage the bottom wall of the first housing section 13 adjacent the grooves 28 to securely position the positioning tabs 23 under the overhangs 21.

In the mechanized assembly of variable resistance controls of this type, the resistance element is customarily air blown up a spindle. In the past, this has caused problems in that the resistance element 24 being of small size has a tendency to flip over, thus requiring someone to manually turn the resistance element over before the mechanical process can continue. In the present embodiment, the resistance element 24 is provided with a forked end portion 31 whereby the forked end portion engages the spindle thus preventing the resistance element 24 from turning over.

A second housing section 14 is provided with a cavity 33 somewhat similar to the cavity 18 in the first housing section 13. As shown in FIGS. 2 and 3, the cavity 33 is provided with overhangs 34 defining undercut portions 36 such that a plurality of positioning tabs 37 on a collector 38 lying substantially in a plane slip under the overhangs 34 to accurately position the collector 38 relative to the second housing section 14. A collector terminal 39 extends outwardly of the second housing section 14 through a groove 41 in the bottom wall thereof. Shoulders 42 on the terminal 39 engage the bottom wall of the second housing section 14 adjacent the groove 41 to position the collector positioning tabs 37 under the overhangs 34. Since it is only necessary to have one terminal extend from the collector 38, a shortened collector terminal 43 is provided at one end having shoulders 44 engaging the bottom wall of the housing adjacent the groove 41 to maintain the positioning tabs 37 under the overhangs 34. The second housing section 14 is provided with tongues 47 which fit into the grooves 28 of the first housing section 13 and engage the terminals 26 of the resistance element 24 to secure the terminals and resistance element against lateral movement. Similarly the first housing section 13 is provided with tongues 46 which fit into the grooves 41 of the second housing section 14 and engage the collector terminals 39, 43 to restrain the collector 38 against movement laterally of the housing.

As shown in FIG. 2, control operating means 48 is slidably mounted in the slot 17 having an operable portion or slide arm 49 provided with parallel longitudinal grooves 51 that receive the side walls of the slot whereby the slide arm 49 is locked in the housing but can be moved back and forth along the slot. A drive arm or frame 52 extends from the slide arm 49 between the resistance element 24 and collector 38 to the bottom wall of the housing wherein stabilizing means in the form of a channel 53 is provided which receives channel engaging means in the form of a keel portion 54 of the frame 52 and prevents lateral movement of the keel portion 54 thereby constraining the frame 52 to move longitudinally of the housing. In order to eliminate any possibility of interference between the keel portion 54 and the terminals 26, 39, the forward ends of the keel portion 54 are tapered. The channel 53 is slightly larger than the keel portion 54 disposed therein whereby the frame 52 can move to the collector side of the housing.

The frame 52 as shown in FIGS. 2 and 3 is rectangular and comprises four integral members, two spaced

vertical members **55** and two spaced horizontal members **57** defining an opening **56** in the frame **52.** A contactor **58** having a pair of spaced bars **59** and four continuous strips **61** connecting said bars is secured to the frame **52** by means of a pair of tabs **62** which extend through a pair of apertures **63** included in said frame **52.** Before the instant invention contactors having resilient arms with paddles engaging the collector and resistance element were used. During assembly of controls having that type of contactor, the arms and paddles of one contactor became intertwined with the arms and paddles of another contactor thus requiring manual labor to separate the contactors prior to assembly. The present invention eliminates the problem by utilizing a contactor **58** having continuous strips **61** engaging the collector **38** and resistance element **24.** Two of the continuous strips extend through the opening **56** and slidably engage the resistance element **24.** As best shown in FIGS. **2** and **3,** the other two strips slidably engage the collector **38** and resiliently urge the spaced bars **59** of the contactor **58** into engagement with the two vertical members **55** of the frame **52.** In the event the strips **61** engaging the resistance element **24** were to encounter some foreign object, the additional resilient pressure on the contactor strips would force the frame **52** to the left in FIG. II, thereby preventing the strips **61** from gouging the resistance element **24.** Customarily the pressure on the collector **38** is greater than on the resistance element **24,** whereby the keel portion is resiliently urged against the resistance element side wall of the channel **53.** By providing the channel **53** in the bottom wall, the contactor **58** is constrained to move longitudinally of the housing thus eliminating problems of jumping and skipping associated with prior controls.

A headed portion **64** is provided at each end of each of the housing sections **13, 14** forming a groove **66** between the headed portion **64** and the remainder of the housing section. In order to maintain the housing sections **13, 14** together, a mounting bracket **67** is disposed in each of the grooves **66.** Each brackets **67** comprises a generally U-shaped member having a pair of spaced legs **68** and a connecting portion **69** with a mounting tab **71** extending from the bracket **67** for insertion in a not shown panel slot. The legs **68** are disposed on opposite sides of the headed portion **64** and are bent toward each other to firmly engage the housing and maintain the bracket **67** thereon. During the mechanized assembly of this control, it is possible to place the mounting brackets **67** in a nest, place one of the housing sections thereon and continue with the assembly until the other section is placed thereon, whereby the legs **68** of the mounting bracket **67** can be folded over to secure the housing sections together. This is a great advantage over the prior art mounting brackets which had to be placed over the ends of the housing after the control was assembled. Due to the problems associated with removing the control from its nest during assembly to position the mounting brackets thereon, it was generally necessary to utilize an additional fastener to secure the housing sections together prior to placing the mounting bracket thereon. Accordingly, the present mounting bracket **67** eliminates the need for an additional fastener and greatly simplifies the assembly of the control.

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention and an additional modification thereof, 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, an elongated resistance element and a collector disposed in said housing, said housing having a plurality of walls, one of said walls having a slot extending therethrough, control operating means supported for movement relative to said housing and having an operable portion extending outwardly through said slot, and a contactor secured to said control operating means and constrained to move therewith, said contactor wipably engaging said resistance element and said collector, said contactor having a pair of spaced vertical bars and a pair of continuous resilient horizontal strips, each end of said horizontal strips being connected to one of said spaced vertical bars, one of said horizontal strips engaging said resistance element and the other of said horizontal strips engaging said collector.

2. The control of claim **1,** wherein said control operating means is disposed between said resistance element and said collector, said control operating means comprises a frame projecting inwardly of said housing from said slot, said frame having an opening therethrough, and one of said pair of continuous strips projects through said opening.

3. The control of claim **2** wherein said frame comprises a pair of spaced vertical members, said spaced vertical bars engaging said vertical members, the other of said pair of horizontal strips resiliently urging said spaced bars against said vertical members.

4. The control of claim **2,** wherein said frame has a pair of apertures extending therethrough and said contactor has a pair of tabs extending through said apertures, said tabs being folded over to secure said contactor to said frame.

5. The control of claim **4,** wherein said tabs extend from one of said pair of vertical spaced bars.

6. A variable resistance control comprising a housing having first and second housing sections, resistance means supported within said housing adjacent said first housing section, collector means supported within said housing adjacent said second housing section, a contactor disposed between and wipably engaging said resistance means and said collector means, an overhang on said first housing section, said resistance means lying substantially in a plane and projecting under said overhang to prevent movement of said resistance means perpendicular to said plane.

7. The variable resistance control of claim **6,** wherein said resistance means has a shoulder engaging said first housing section to maintain said resistance means positioned under such overhang.

8. The variable resistance control of claim **7,** wherein said resistance means comprises a resistance element and termination means, said resistance element having a plurality of positioning tabs projecting under said overhang.

9. The variable resistance control of claim **8,** wherein said positioning tabs are dimensioned to permit endwise movement of said resistance element relative to said first housing section.

10. The variable resistance control of claim 9, wherein one of said positioning tabs is dimensioned to snugly fit under said overhang whereby said resistance element is rigidly positioned in said housing yet free along its length except at said one of said positioning tabs to move relative to said first housing section.

11. The variable resistance control of claim 8, wherein said termination means comprises a pair of terminals clinched to said resistance element, each of said terminals having a shoulder thereon engaging said first housing section.

12. The variable resistance control of claim 11, wherein said first housing section is provided with a pair of grooves, said terminals being positioned in said grooves with said shoulders abutting the housing adjacent said grooves, said second housing section having a plurality of tongues interfitting with said grooves to securely position said terminals.

13. The variable resistance control of claim 7, wherein said collector lies substantially in a plane, said second housing section being provided with an overhang, said collector projecting under said overhang to prevent movement of said collector perpendicular to said plane, said collector having a shoulder engaging said second housing section to maintain said collector positioned under said overhang.

14. A variable resistance control comprising a housing having first and second housing sections, an elongated resistance element and a collector disposed in said housing, said resistance element and said collector being provided with terminals extending out of the housing, said housing having a pair of spaced grooves, and a mounting bracket disposed in each of said grooves maintaining said housing sections together, each of said mounting brackets comprising a generally U-shaped member having a pair of spaced legs and a connecting portion, said legs being disposed on opposite sides of said housing, said legs having ends bent toward each other to firmly engage said housing and maintain said bracket thereon, and a mounting tab extending from each bracket.

15. The variable resistance control of claim 14, wherein said ends are disposed adjacent the housing opposite said connecting portion.

16. The variable resistance control of claim 14, wherein said housing has a pair of end walls, said grooves are adjacent said end walls and extend around the housing, each of said mounting brackets having said connecting portion and said legs positioned in its respective groove.

17. A variable resistance control comprising a housing having a plurality of walls, one of said walls having a slot extending therethrough, a resistance element supported in said housing, a collector supported in said housing, control operating means supported for movement relative to said housing comprising an operable portion extending outwardly through said slot and a drive arm positioned between said resistance element and said collector, said operable portion being provided with parallel longitudinal grooves receiving the side walls of said slot, a contactor constrained to move with said drive arm wipably engaging said resistance element and said collector, and stabilizing means disposed in said housing, one of said stabilizing means and said drive arm being provided with a channel and the other being provided with channel engaging means slidably engaging said channel.

18. The variable resistance control of claim 17, wherein said stabilizing means is positioned in a wall of the housing opposite said one of said walls.

19. The variable resistance control of claim 17, wherein said wall opposite said one of said walls is provided with a channel and said drive arm is provided with channel engaging means slidably engaging said channel.

20. The variable resistance control of claim 17, wherein said channel is larger than said channel engaging means and said contactor resiliently urges said channel engaging means into engagement with one wall of said channel.

21. The variable resistance control of claim 20, wherein terminals are disposed adjacent said channel, and said channel engaging means has tapered ends to eliminate any possibility of interference.

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