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Rozema et al.

[11] **3,887,892**

[45] **June 3, 1975**

[54] **VARIABLE RESISTANCE SLIDE CONTROL**

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[73] Assignee: **CTS Corporation,** Elkhart, Ind.

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[52] **U.S. Cl.** **338/183;** 338/322

[51] **Int. Cl.** **H01c 9/02**

[58] **Field of Search** ..... 338/183, 176, 174, 162, 338/322, 313, 312, 332; 339/95 R, 17 R

[56] **References Cited**

UNITED STATES PATENTS

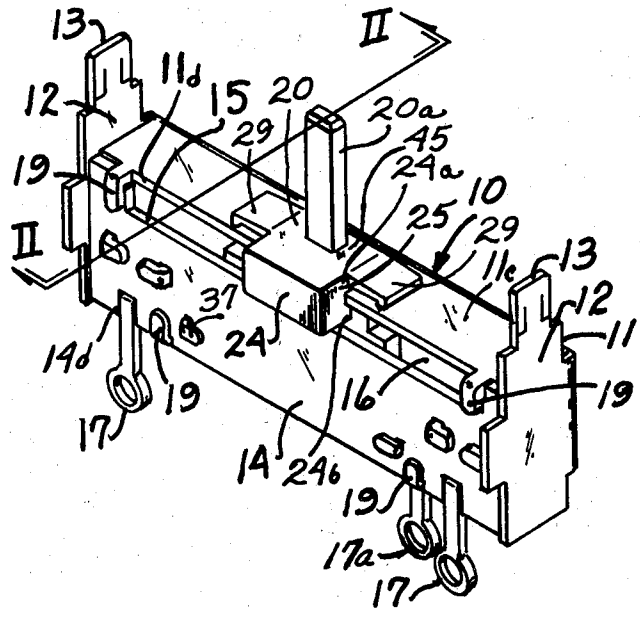
3,412,361	11/1968	Lovejoy et al.	338/183 X
3,550,059	12/1970	Barden et al.	338/183 X
3,588,779	6/1971	Goerg	338/183
3,735,327	5/1973	Rozema et al.	338/176 X

Primary Examiner—J. V. Truhe
Assistant Examiner—David A. Tone
Attorney, Agent, or Firm—John J. Gaydos

[57] **ABSTRACT**

A variable resistance slide control employs a housing having a front wall and a side wall integral therewith. A dielectric base having a resistance element and a collector element mounted thereon is secured to the housing in spaced parallel relationship to the side wall. A contactor engaging the resistance and collector element is constrained to move with a slider projecting outwardly of the housing through an elongated slot defined by the front wall and the base. The slider comprises a U-shaped section bearing against and interfitting with the front wall, a contactor frame provided with a pair of runners engaging the side wall, and a tolerance compensator limiting lateral movement of the slider. A pair of terminals secure the resistance element to the base and a bowed portion integral with each of the terminals electrically engages the resistance element at the innermost portion of the terminals.

18 Claims, 7 Drawing Figures



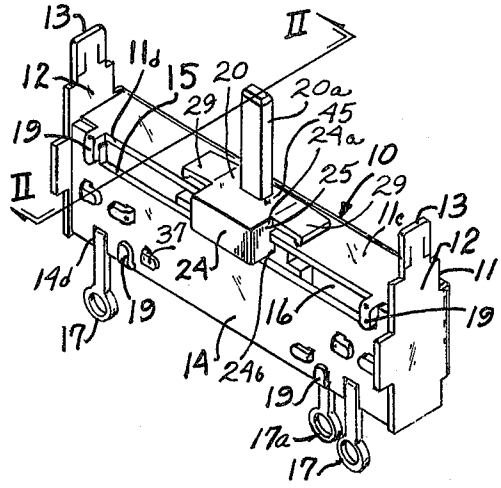


FIG. 1

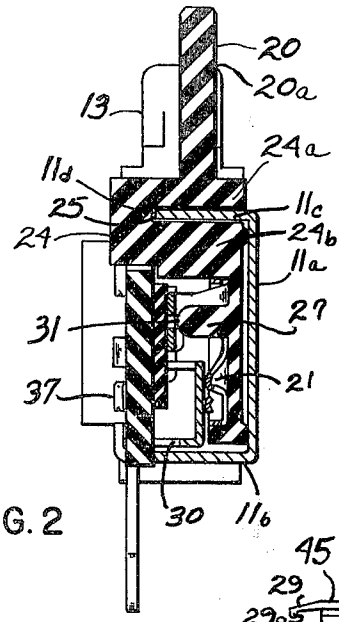


FIG. 2

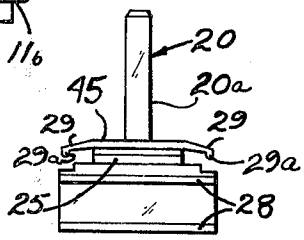
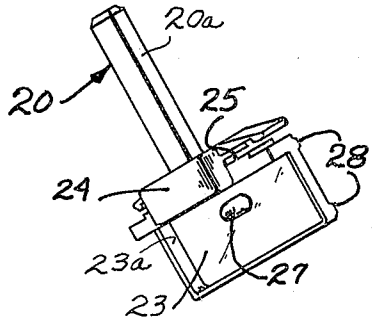


FIG. 3



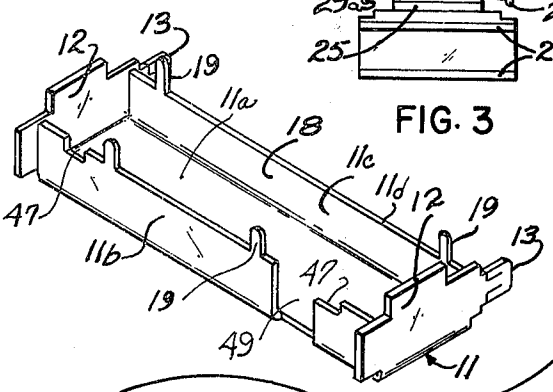
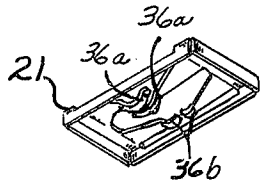


FIG. 4



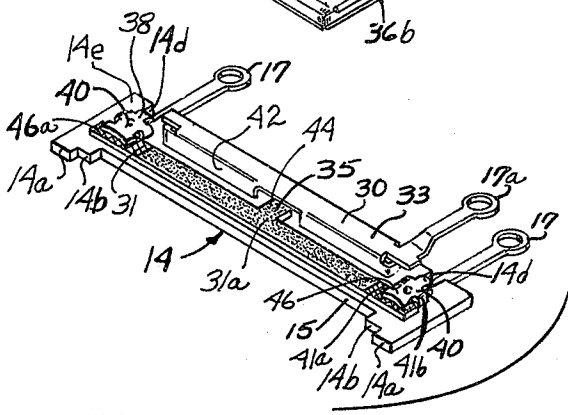


FIG. 5

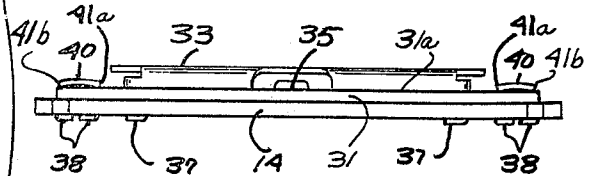


FIG. 6

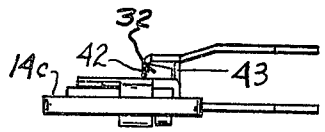
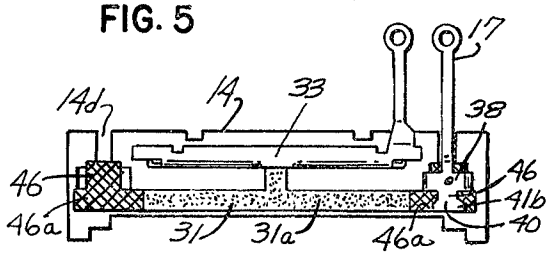


FIG. 7



VARIABLE RESISTANCE SLIDE 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.

Variable resistance slide controls provided with a slider carrying a contactor wipingly engaging a resistance element and a collector element are well known in the art. In certain prior art slide controls, the housing is generally made from two substantially identical molded half sections joined to leave a slot in the front wall of the housing, and a slider having a gripping portion extending through the slot wipingly engages the resistance and collector elements mounted in the housing. The slider bears on the front wall of the housing of the joined half sections defining the slot and, during movement rectilinearly along the slot, the slider frequently jumps, skips or rocks. This eratic motion of the slider is caused in part by misalignment of the two spaced surfaces of the front wall formed upon joining together the two half sections of the housing, thus causing the slider to bear unevenly on the surfaces supporting the slider. Eratic motion of the slider is also partially caused by the large tolerances required in the manufacture and assembly of the half sections of the housing and slider. It would therefore be desirable to provide a variable resistance slide control having a smoother and more uniform slider movement.

Prior art slide controls are provided with an elongated longitudinal slot in the front wall of a housing and the gripping portion of a slider projects through such slot. In many applications, such slide control is mounted with the slot in the front wall visible to the operator. This is objectionable not only because the inside of the control is visible but also because it encourages insertion of foreign objects into the slot in contact with the resistance and collector elements presenting potential electrical shock hazards. Various means have been suggested for closing the slot in order to prevent exposure. Generally such closing means increases the cost and complexity of manufacture and assembly of the control, such as the use of a shield as shown in U.S. Pat. No. 3,676,826 or the use of a special slider drive and additional carrier block assembly as shown in U.S. Pat. No. 3,588,779. It would, therefore, be desirable to provide a variable resistance slide control that can be assembled and manufactured in a simple and facile manner and yet is protected against the ingress of foreign objects into the housing in possible contact with the resistance and conductive elements from the front or operator's side of the slide control as well as providing a control that eliminates from the front view visible exposure of the inside of the control.

Various types of terminal structures have been devised for variable resistance controls for securing electrical terminals to the resistance element and for securing the terminals and the resistance element to a base as well as providing good electrical contact between the terminals and the end of the resistance path of the resistance element. It is desirable that the hop-off resistance, defined as the residual resistance between the end of the resistance path on the resistance element and that portion of the resistance element spaced apart from the end of the path that makes positive electrical contact with the terminal, be at a minimum. Prior art termination means, such as disclosed in U.S. Pat. No. 2,632,832, secure the resistance element to a base with

a U-shaped terminal embracing the resistance element tabs extending radially from the resistance element. The legs of the U-shaped terminal passing through holes in the base are staked to the base to secure the resistance element and the terminal to the base, resulting in a portion of the terminal making positive electrical contact with the resistance element. The difficulty with this prior art construction is the inability to maintain a flat surface to surface engagement between the resistance tab and the U-shaped terminal to assure a positive electrical connection unless the staking pressure is held closely within rather critical limits. Other prior art U.S. Pat. Nos. 2,736,783 and 2,958,839 also show termination structures having a protuberance engaging the resistance end tab to assure a positive electrical connection. Although such terminal constructions with the protuberances centered on the end tabs are satisfactory for certain control applications, other applications require an electrical connection as close as possible, preferably at the innermost end of the resistance path on the resistance element. Such connection between the terminal and the resistance path greatly minimizes the hop-off resistance. On the other hand if the terminal engages the resistance path, then the contactor on the slider will abut against the terminal before the contact engages the end of the resistance path. In preferred design practice, the contactor should not abut against the terminal which results in a finite amount of resistance left in the circuit. Therefore, it would be desirable to provide a termination means having a positive electrical connection as close to the end of the resistance path as possible, a minimum residual resistance between the end of the resistance path and its end terminal, and means securely attaching such terminal and the resistance element to the base.

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 slider jump or skip. A further object of the present invention is to provide a variable resistance slide control that can be assembled and manufactured in a simple and facile manner. Still another object of the present invention is to provide a control housing with a slot in the corner of the housing defined by a front wall and a side wall having an indented base thereby preventing the ingress of harmful objects into the resistance and collector element from the front side of the housing. Another object of the present invention is to provide a variable resistance slide control with a slider having a U-shaped section slidably engaging the inner and outer surfaces of the front wall of the housing. Yet another object of the present invention is to provide a resistance element termination that minimizes the residual resistance between the resistance path and the end terminal and securely attaches the end terminal and the resistance element to the base. Still another object of the present invention is to provide a terminal with a bowed portion having an edge making electrical contact with the resistance element. 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 dielectric base secured to a metal L-shaped housing. The legs of the L-shaped housing are integral and define the front wall and the side wall and, in a preferred embodiment, a rear wall and a pair of end walls are also formed integrally with the side wall. Integral mounting brackets extending forwardly, rearwardly or sidewardly from the two end walls are employed for fastening the control to a mounting panel. A control operating means or slider comprising a U-shaped section having an integral resilient bearing engages the inner and outer surfaces of the front wall of the housing. The contactor is constrained to move with the slider. The dielectric base secured to the housing in spaced parallel relationship to the side wall is provided with an elongated indentation defining a slot adjacent to the front wall through which a portion of the slider projects externally of the housing for operating the slider. A pair of terminals secure the resistance element to the base. Each of the terminals has a bowed portion making electrical engagement with the resistance element at the innermost portion of the terminals.

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 preferred embodiment of a variable resistance slide control made in accord with the present invention;

FIG. 2 is a sectional view of FIG. 1 taken along lines II—II of FIG. 1;

FIG. 3 is a side view of the slider shown in FIGS. 1 and 2;

FIG. 4 is an exploded view of the control shown in FIG. 1, with the dielectric base and housing partially rotated to provide a better view of the interior of the control;

FIG. 5 is a top view of the dielectric base shown in FIG. 4 with one of the terminals removed;

FIG. 6 is a side view of the dielectric base shown in FIG. 5; and

FIG. 7 is an end view of the dielectric base shown in FIG. 5.

Referring now to FIGS. 1 through 4 of the drawings, there is illustrated a variable resistance slide control generally indicated at **10**, comprising an elongated channel shaped housing **11** formed and stamped from a single piece of metal and defined by a side wall **11***a*, a rear wall **11***b*, and a front wall **11***c* having an elongated edge **11***d*. A pair of end walls **12** integral with the side walls have mounting tabs **13** extending therefrom. Depending upon the mounting requirements, the mounting tabs **13** can extend rearwardly, sidewardly or forwardly from the end walls **12**. The rear wall **11***b* and the front wall **11***c* are integral with the side wall **11***a* and the end walls **12**. Although the rear wall **11***b* is an integral part of the housing **11**, the rear wall can be eliminated, except for spaced portions required to position the dielectric base, if the application for the control does not require a rear closure for the control, or the rear wall can be detachably secured to the housing. In accord with the present invention, it is essential that the metal portion of the housing have at least an L-shaped cross section with the legs of the L defining the front and side walls.

The open side of the housing is closed with a dielectric base **14** of suitable material such as laminated fibre engaging portions of the edges of the front and the rear walls. A plurality of folded ears **19** extending from the rear wall **11***b* and the front wall **11***c* laterally over the base **14** secure the base to the housing **11**. The dielectric base **14** has a top edge **14**a abutting against the edge of the front wall, a pair of notches **14***b* receiving the ears **19** extending from the front wall **11***c*, and, in a preferred form of the invention, an elongated indentation **15** spaced from the elongated edge **11***d* of the front wall **11***c* defines an elongated slot **16** (see FIG. 1) facing a side of the housing. The bottom edge **14***c* of the base has notches **14***d* and a pair of terminals **17** partially received in the notches **14***d* are secured to the base. An elongated resistance element **31** of suitable material, such as laminated fibre, having a striplike carbonaceous or equivalent resistance film **31***a* deposited on a surface thereof is secured to the inner surface **14** *e* of the base **14** with a pair of clinching ears **38** integral with the terminals **17**. As best seen in FIG. **5**, a pair of end tabs **46** of greater width than the resistance element **31** allow a greater clamping area for securing more rigidly the resistance element **31** to the base **14**. Conductive pads **46***a* are deposited on the end tabs **46** in overlapping relationship with the ends of the resistance film **31***a*.

In a preferred form of the invention and, as seen in FIGS. **1**, **4** and **5**, the center portions of the terminals **17** received in the notches **14***d* are flush with the base. The outer ends of the terminals extend through the notches **14***d* (see FIG. **1**) adjacent to the cut outs **47** in the rear wall **11***b* of the housing and the inner ends of the terminal are bent up over end tabs **46** and in electrical contact with the conductive pads **46***a*. Integral with each of the clinching ears **38** is a bowed portion **40** (see FIGS. **5** and **6**) having a pair of edges **41***a* and **41***b* electrically connected to the conductive pads **46***a* and to the ends of the resistance film **31***a*. The edge **41***a*, being the innermost portion of the terminal, engages the resistance element **31** nearer to the end of the resistance film **31***a* than the edge **41***b*. Clamping the terminal **17** to the base **14** causes the edges **41***a* and **41***b* of the bowed portion **40** to grip the resistance element **31** in positive electrical contact, the edge **41***a* being fixed close to the end of the resistance path **31***a* to minimize the residual resistance between the resistance film and the terminal **17**.

Also disposed on the inside surface **14***e* of the base in spaced parallel relationship to the resistance element **31** is an elongated collector element **30** clinched to the base by ears **37**. The collector element **30** has a top surface **33** spaced from the base and two legs **42** and **43** defining an elongated channel **32** (see FIG. **7**) abut the inside surface **14***e* of the base. The legs **42** and **43** contain notches **35** defining a gap extending through the legs and underneath the top surface **33** of the collector element. Extending in the gap is a resistance center tap **44** for connecting, when desired, to a not shown center tap terminal. The gap defined by notches **35** extending through the collector element need not be at the center of the collector element but could be placed anywhere along the collector element **30** for connecting a tap terminal to the resistance path **31***a* at any point between the terminals **17**. A terminal **17***a* integral with the col-

lector element 30 extends through the notch 49 in the rear wall of the housing 11*b*.

A control operating means or slider 20 generally of molded plastic comprises a gripping means or arm 20*a*, a U-shaped section 25 including a bight portion 24 and legs 24*a* and 24*b*, the leg 24*a* integrally being attached to a spring bearing 45, containing two molded spring members 29. As best seen in FIG. 3, the end of each of the spring members 29 is provided with a bearing ridge 29*a*. The channel formed by the bight portion 24 and the legs 24*a* and 24*b* receives the edge 11*d* of the front wall 11*c* as well as a portion of the front wall 11*c*.

The uniqueness of the slider of the present invention can best be understood by describing general tolerances that can readily be maintained between the front wall 11*c* and the legs 24*a* and 24*b* of the slider. It is well known that sheet metal can be readily obtained with tolerances of ±0.001 inch or less. Specifically, the thickness of the sheet metal from which the housing 11 was stamped and formed has a thickness of 0.025 ± 0.001 inch. Therefore the deviation of the front wall of the housing from a single plane is 0.002 inch or less. Tolerances for molded parts generally are in the range of +0.003, −.000 inch, therefore, the maximum tolerance between the legs 24*a* and 24*b* of the U-shaped section 25 is 0.003 inch. If a dimension of +0.002 inch is added for clearance to the dimension between the legs 24*a* and 24*b*, the minimum and maximum dimensions between the legs and the front wall are 0.002 and 0.007. By providing a close bearing fit between the legs 24*a* and 24*b* of the slider and the front wall of the housing, rocking of the slider in the direction of movement of the slider is substantially reduced and maintained at less than 0.007 inch at the place of engagement of the legs of the U-shaped slider with the front wall. Preferably, the bight portion 24 of the U-shaped section 25 is spaced from the edge 11*d* of the front wall 11*c* to eliminate any ruffness in the feel of the slider while the slider is moved from one end of the housing to the other end. The edge 11*d* usually has a rough edge resulting from blanking and shearing of the housing from a piece of sheet metal. Furthermore, the spring members 29 extending longitudinally from the leg 24*a* urge the leg 24*b* against the inner surface 18 of the front wall and further decrease rocking motion of the slider 20.

For the purpose of constraining a contactor 21 to move with the slider, a frame 23 extends rearwardly from the leg 24*b* inside of the housing and the contactor is disposed within the frame. Preferably, and in accord with the present invention, the frame 23 is provided with a pair of spaced runners 28 slidably engaging the inner surface of the side wall 11*a*. Since the bearing surfaces of the runners slidably engaging the surface of the side wall and the bearing surfaces legs of the U-shaped section are normal to each other, it is unnecessary to control closely the tolerances therebetween. Any tolerances deviation in the width of the frame or in the thickness of the runners will not effect the rocking motion of the slider since such deviation merely alters the space between the frame 23 and the rear wall 11*b* and between the bight portion of the U-shaped section and the edge 11*d*.

The contactor 21 comprising a pair of contacts 36*a* and 36*b* is received in the frame 23*d* and the edges of the contactor abut the rim 23*a* in an interference fit. In the assembled control, the contacts 36*a* resiliently engage the resistance film 31*a* and contacts 36*b* resiliently engage the surface 33 of the collector element 30.

Preferably and as best shown in FIG. 2 of the drawings, a tolerance compensator 27 integral with the frame 23 limits lateral movement of the slider inside of the housing. By providing the end of the tolerance compensator 27 behind an engageable with the pair of contacts 36*a* slidably engaging the resistance film 31*a*, the tolerance compensator limits lateral movement of the slider only when the slider 20 is moved laterally in a direction away from the side wall. Lateral rocking of the slider in the opposite direction, i.e., toward the side wall, is nonexistent since the runners 28 provided on the frame of the slider are biased by the contactor 21 and in continuous engagement with the inner surface of the side wall. Longitudinal movement of the slider is limited by engagement of the U-shaped section of the slider with the tabs 19. The tabs 19 also prevent the contacts 36*a* of the contactor from engaging the terminals 17.

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 slide control comprising an elongated housing having a front wall and a side wall extending normal to the front wall, a dielectric base mounted to the housing in spaced parallel relationship to the side wall, the dielectric base having a top edge abutting against the edge of the front wall and having a bottom edge, the dielectric base being provided with notches communicating with the bottom edge, a resistance element and a collector element supported on the base, a plurality of terminals connected to the resistance element and to the collector element for connecting the control to an external electrical circuit, the terminals being partially received in the notches provided in the base, control operating means supported for movement relative to the housing, a contactor constrained to move with the control operating means, the contactor wipably engaging said resistance element and the collector element, the edge of the front wall of the housing and the top edge of the dielectric base being spaced from each other and defining an elongated slot, the control operating means having a portion extending through the slot and bearing against the front wall.

2. The control of claim 1, wherein the operating means comprises a U-shaped section interfitting with the front wall and slidably supported thereon.

3. The control of claim 2, wherein the legs of the U-shaped section of the operating means slidably engage the inner and outer surfaces of the front wall.

4. The control of claim 1, wherein the dielectric base contains an elongated indentation defining the edge thereof, and the elongated indentation and the edge of the front wall define the elongated slot facing a side of the housing.

5. The control of claim 1, wherein a frame extends rearwardly from one leg of the U-shaped section of the operating means, and the contactor is constrained to move with the frame of the operating means.

6. The control of claim 5, wherein a pair of runners extending from the frame of the operating means slidably engage the inner surface of the side wall.

7. The control of claim 6, wherein the runners extending from the frame of the operating means prevent lateral movement of the slider toward the side wall, and a tolerance compensator integral with the frame of the operating means and extending toward the dielectric base limits lateral movement of the slider away from the side wall.

8. The control of claim 5, wherein a tolerance compensator extends laterally from the frame of the operating means for limiting lateral movement of the frame away from the side wall, the end of the tolerance compensator being engageable with the contactor.

9. The control of claim 1, wherein the housing has a U-shaped cross section, one of the legs of the U defining the front wall, the other leg of the U defining a rear wall and the bight portion of the U defining the side wall, the housing is of sheet metal and the slider is of electrically nonconductive material.

10. In a variable resistance control, the combination comprising an elongated housing having a U-shaped cross section, a dielectric base supported by the housing and defining a first side wall of the housing, a resistance element and a collector element supported on the base, the housing being defined by a front wall, a rear wall and a second side wall integral with the front and rear walls, a slider comprising a U-shaped section having legs interfitting with the front wall and slidably supported thereon, the legs slidably engaging the inner and outer surfaces of the front wall, and a contactor disposed in the housing and wipably engaging the resistance element and the collector element, the contactor being constrained to move with the slider.

11. The control of claim 10, further comprising a pair of end walls integral with the side wall and closing the ends of the housing.

12. The control of claim 11, wherein a pair of mounting tabs are integral with the end walls for securing the control to a mounting panel.

13. The control of claim 10, wherein the front wall and the dielectric base are spaced from each other and define an elongated slot through which the slider projects outwardly of the housing.

14. In a variable resistance control, the combination comprising a housing, a dielectric base supported by the housing, a resistance element containing a resistance path and a collector element supported on the base, control operating means supported for movement relative to the housing, a contactor wipably engaging the resistance element and the collector element and constrained to move with the operating means and terminal means joined to the resistance element for connecting the ends of the resistance path to an external electrical circuit, the terminal means comprising a curved portion having a first edge and a second edge spaced apart from the first edge, the first edge being disposed on the resistance element nearer said resistance path than the second edge and making electrical contact with the resistance path.

15. The control of claim 14, wherein the terminal means comprises attaching means integral with the curved portion, the attaching means affixing the terminal means and the resistance element to said base.

16. The control of claim 15, wherein the resistance element contains an end tab and the attaching means is disposed around the end tab for securing the resistance element to the base.

17. A variable resistance control comprising an elongated housing having a plurality of walls, a dielectric base supported by the housing, a resistance element containing a resistance path and a collector element supported on the base, a pair of end tabs integral with the resistance element and of greater width than the resistance element, control operating means supported for movement relative to the housing, a contactor constrained to move with the control operator means, the contactor wipably engaging the resistance path and the collector element, and a terminal joined to the base and the resistance element, the terminal having a first portion and a second portion spaced from said first portion, the first portion clinching the end tabs of the resistance element to the base and the second portion making contact with the resistance element.

18. A variable resistance control comprising an elongated housing having a front wall and a pair of spaced side walls normal thereto, the front wall having an exterior surface and an interior surface, the front wall of the housing and one of the side walls defining an elongated slot therebetween, a resistance element and a collector element disposed in the housing, terminals connected to the resistance element and the collector element for connecting the control to an external electrical circuit, a contactor wipably engaging the resistance element and the collector element, and control operating means supported for movement relative to the housing and extending outwardly through the elongated slot, the control operating means comprising a U-shaped section interfitting with and slidably engaging the front wall, a spring bearing disposed outside the housing and engaging the exterior surface, and a frame disposed within the housing adjacent to the interior surface, the U-shaped section connecting the spring bearing to the frame, the contactor being constrained to move with the frame of the control operating means.

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