Dec. 23, 1958 M. B. ARISMAN ET AL 2,866,055

TANDEM CONCENTRIC VARIABLE RESISTANCE DEVICE

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Fig. 1.

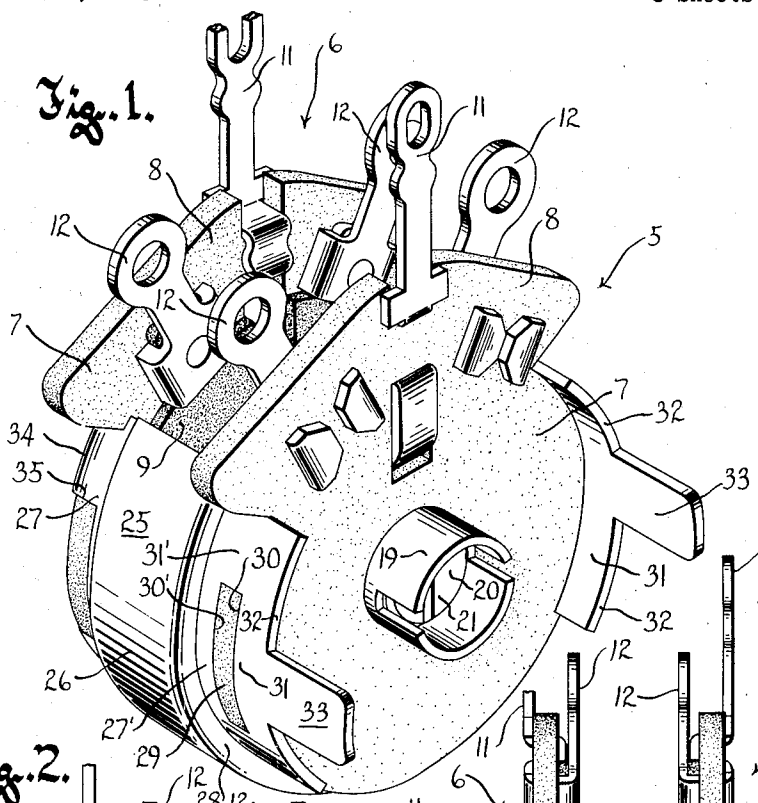


Fig. 2.

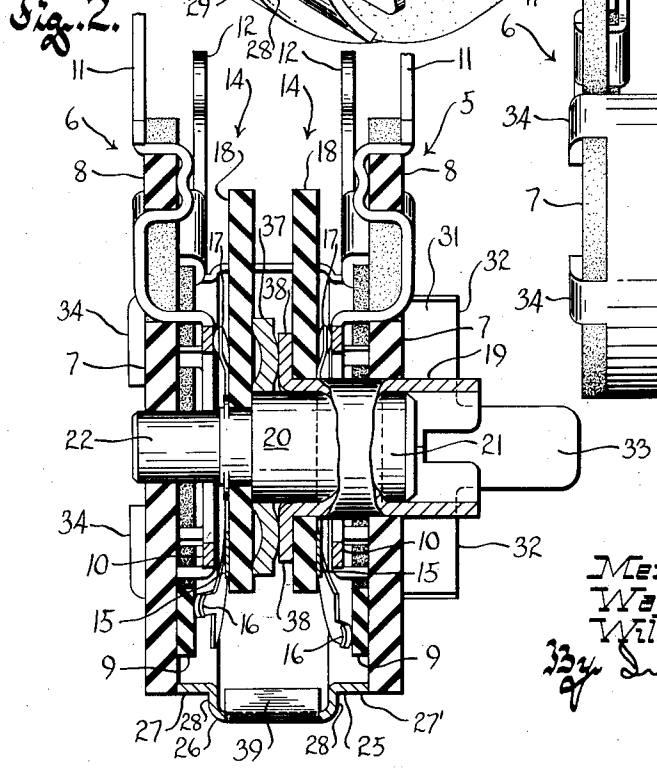
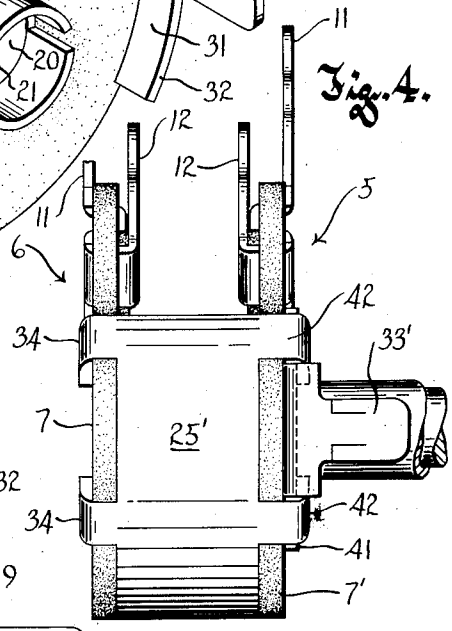


Fig. 4.



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Fig. 5.

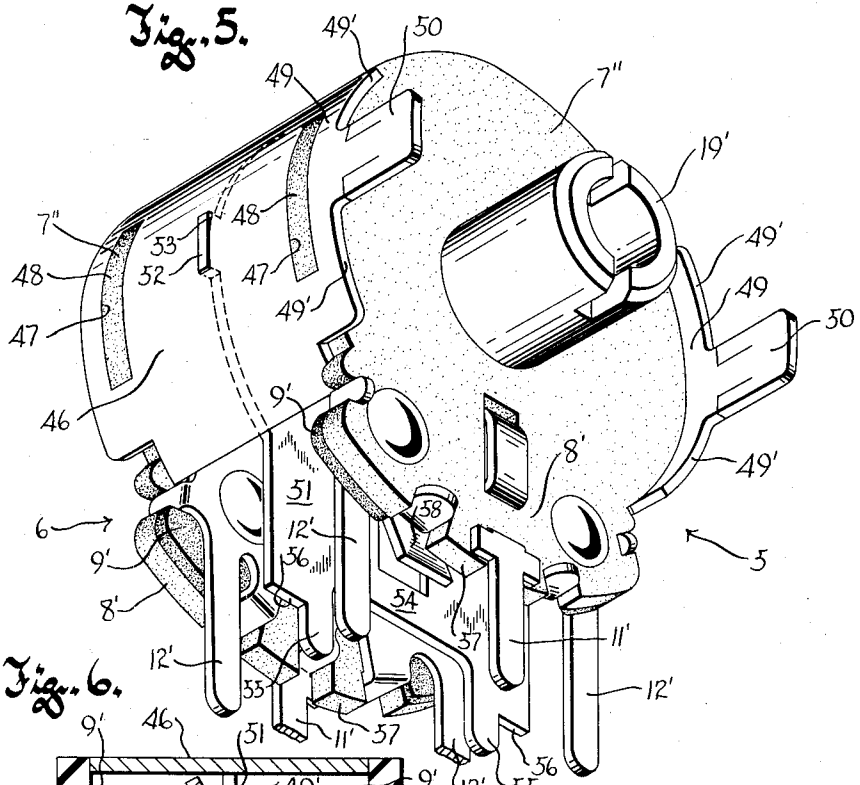
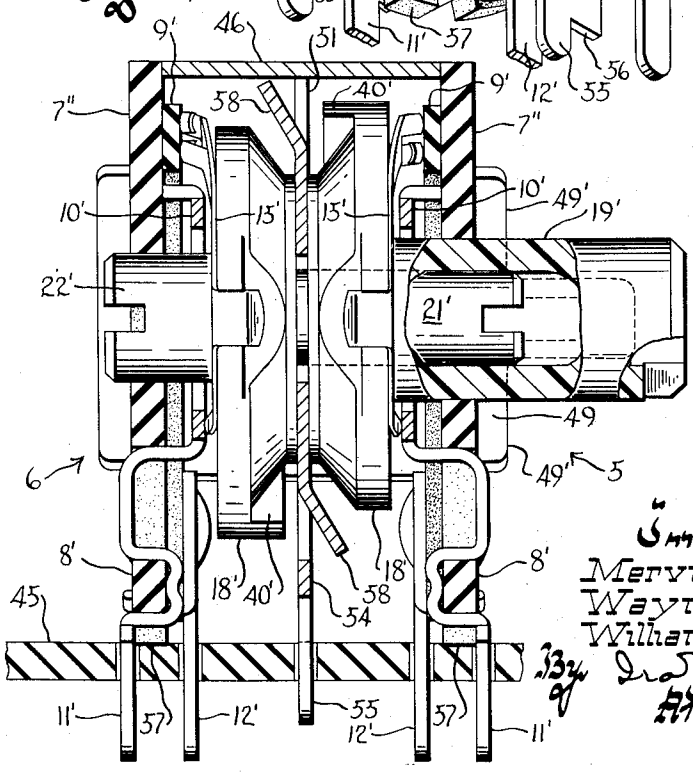


Fig. 6.



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Fig. 7.

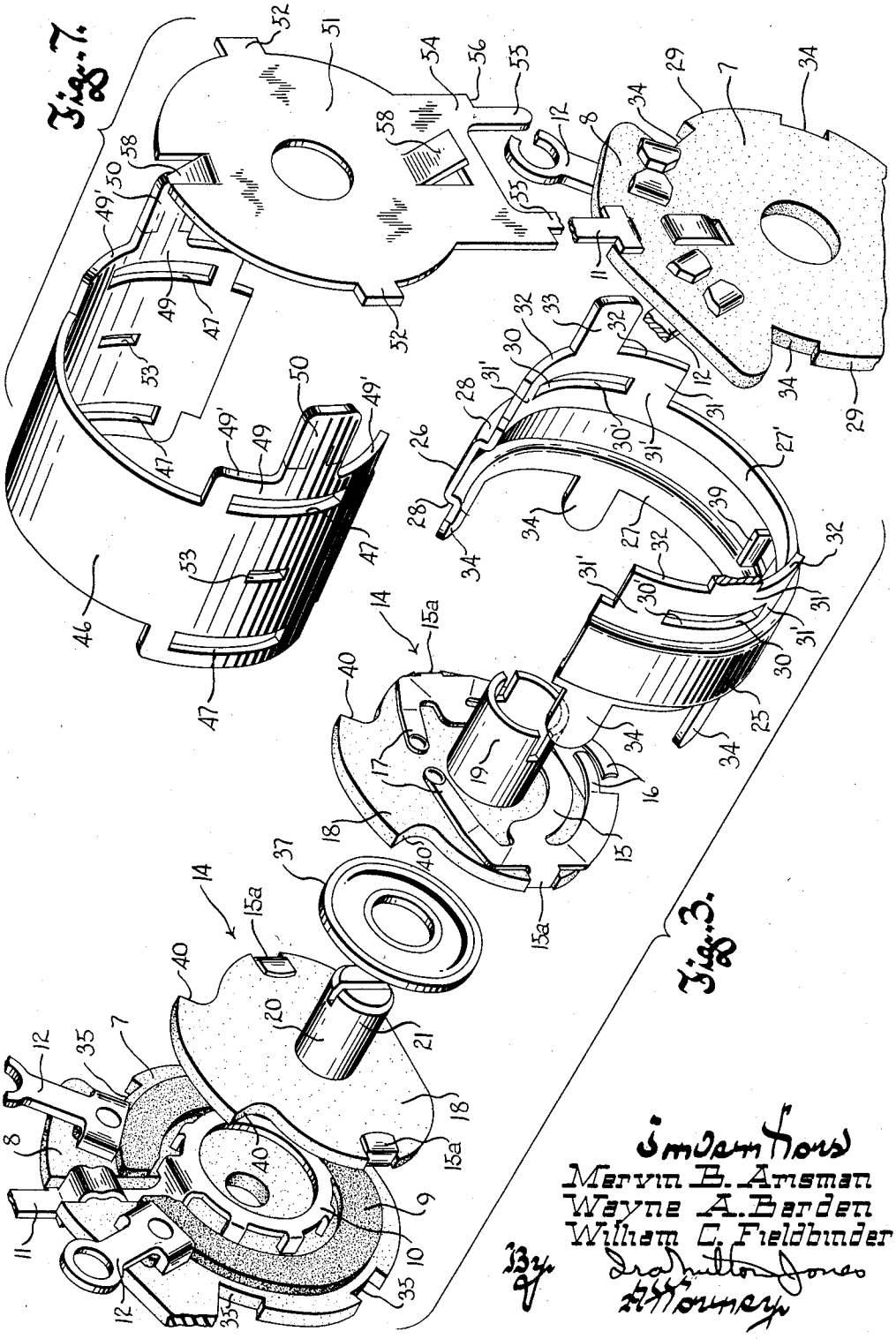


Fig. 3.

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United States Patent Office 2,866,055
Patented Dec. 23, 1958

2,866,055

TANDEM CONCENTRIC VARIABLE RESISTANCE DEVICE

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Application January 6, 1958, Serial No. 707,223

13 Claims. (Cl. 201—55)

This invention relates to variable resistors and refers more particularly to variable resistance control devices of the tandem concentric type wherein two variable resistors complete in themselves are mounted in coaxial tandem relationship but are adjustable by separate and independent shafts accessible from the exterior of the control device, either at opposite sides thereof or from the same side.

Heretofore, it has been customary in control devices of this type for each variable resistor to have its own separate housing, usually in the form of a stamped metal cup secured to the base of the resistor and covering the side thereof at which the instrumentalities of the resistor are located. Hence, in combining the resistors into a single tandem concentric control device, it was customary to merely mount one complete resistor upon the back of the other, as shown for instance in the Barden Patent No. 2,781,436. Obviously, this practice necessitated duplication of all of the parts of a single resistor, and did not permit overall size reduction below twice the size of one of the resistors.

The present invention has as its purpose to provide a tandem concentric control device of this type wherein the two variable resistors are combined in a new and novel manner which reduces the number of piece parts and, hence, effects a reduction in the cost of producing the device and also reduces its size.

This objective is gained by disposing the two variable resistors in face to face relationship and using the bases thereof as the end walls of the housing in which the instrumentalities of the two resistors are located, the rest of the housing being provided by an inexpensive side wall in the form of an arcuate sheet metal strip, which may be blanked out in the flat and then curled up into its intended shape.

It is also a purpose of this invention to provide a tandem concentric variable resistance device of the type described, which lends itself especially well to adjustment of its two units from both the front and the rear of the control, as well as from only the front.

With these and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate three complete examples of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view of a tandem concentric variable resistance control device embodying this invention in one form thereof;

Figure 2 is a longitudinal sectional view through the control device illustrated in Figure 1;

Figure 3 is an exploded perspective view of the control device shown in Figures 1 and 2;

Figure 4 is a side elevational view of a tandem concentric variable resistance device embodying this invention, in a form slightly modified from that shown in Figure 1;

Figure 5 is a perspective view illustrating another modification of this invention;

Figure 6 is a longitudinal sectional view through the control device of Figure 5; and

Figure 7 is a perspective view of two parts of the control device shown in Figures 5 and 6.

Referring now particularly to the accompanying drawings, in which like numerals designate like parts, the numerals **5** and **6** designate generally the front and rear variable resistors which together make up the tandem concentric variable resistance device of this invention.

Basically the two variable resistors **5** and **6** are alike in size and construction and, for all practical purposes, may be considered identical. Each has a base **7**, which is essentially a round flat disc of insulating material with a terminal carrying portion **8** projecting edgewise therefrom. On one side of the base is an arcuate resistance element **9** and a collector ring **10**, the latter being concentrically circumscribed by the former. A center terminal **11** extends radially from the collector ring and is secured to the terminal carrying portion **8** of the base with its outer end projecting therebeyond; and end terminals **12** for the resistance element secure the same to the base and also project beyond the outer edge of the terminal carrying portion **8** at opposite sides of the center terminal.

Although the resistors have been shown and described as having resistance elements and collector rings which are self-supporting parts entirely independent of the base, it will be readily appreciated by those skilled in this art that the resistance elements and collector rings could be in the form of films painted, sprayed or otherwise affixed to the bases. For the purposes of this invention, it is of no consequence how the resistance elements and collector rings are formed, as long as each base is provided with an arcuate resistance path and a conductor path of good conductivity parallel thereto, and that both paths are located on the same side of the base.

Each variable resistor, of course, also has a rotor, indicated generally by the numeral **14** and comprising a contractor **15** having spring fingers or paddles **16** and **17** to respectively bear against the resistance element and the collector ring to electrically bridge these two paths and traverse the same as the rotor is rotated. The contactor is a sheet metal stamping secured to a disc-like driver **18** of insulating material, in any suitable manner, as by tangs **15***a* extended from the contactor and folded over the edge of the driver.

In that form of the invention shown in Figures 1, 2 and 3, the driver **18** of the front resistor unit has a tubular metal shaft **19** fixed thereto and projecting forwardly therefrom to be freely rotatably journalled in an appropriately sized hole in the base of the front unit; and the driver **18** of the rear resistor unit has a solid shaft **20** fixed thereto with a front end portion **21** thereof freely rotatably received in the tubular shaft **19**, and a rear end portion **22** journalled in an appropriately sized hole in the base of the rear unit. Screw driver slots in the front ends of the two shafts enable independent adjustment of the variable resistors. The rotors of the two resistors are thus coaxially mounted with their contactors facing and properly disposed with respect to their respective stators (resistance element and collector ring)

but with no means to support the same against the end thrust resulting from the tension in their spring fingers. The manner in which this end thrust is carried will be presently described.

One of the main features distinguishing this invention from the prior art is the face to face disposition of the two resistor units, as already described. Another, resides in the way the housing for the device is constructed. Both end walls of the housing are supplied by parts essential to the resistors, and hence already present, namely, the bases 7. The rest of the housing is a side wall 25 which is secured to the edge portions of the two bases to hold them in fixed parallel spaced apart relation with the rotors of the two units coaxial.

The side wall 25 is simply a stamped-out strip of sheet metal of a length substantially equal to the perimeter of the circular edge portion of the bases 7. After being stamped to size and shape, the strip is formed into a segment of a cylinder somewhat smaller in diameter when free than the size thereof after assembly to the bases 7. Hence, upon assembly of the side wall and bases, the side wall is under a slight degree of tension which condition is utilized in the connection of the parts, as will be hereinafter explained.

In effect, the side wall 25 is wrapped around the circular portion of the bases to extend from one side edge to the other of their terminal carrying portions. The space thus left between the ends of the strip forming the side wall provides an opening into the housing through which the terminals project, and preferably the device is mounted for use with this opening facing downward.

In that form of the invention shown in Figures 1, 2 and 3, the side wall 25 is formed with a central portion 26 flanked by and offset from opposite side portions 27—27'. The steps 28 which join these portions stiffen the side wall and increase its resistance to deformation out of the arcuate shape to which it is initially formed. The outside diameter of the side portions 27—27' in the assembled condition of the parts is the same as that of the circular portion of the bases, so that the opposite edges of the side wall bear directly against the inner faces of the bases to solidly support the bases and accurately establish the distance therebetween.

The connection between the side wall 25 and the base 7 of the front resistor unit is formed by the projection of diametrically opposite lugs 29 on the edge of the base into slots 30 in the adjacent portions 31 of the side wall, such engagement requiring that the arcuate side wall be sprung open sufficiently to permit entry of the lugs 29 into the slots 30, and being maintained by the aforesaid tension in the side wall.

The portions 31 of the side wall in which the slots 30 are formed project forwardly from the edge of the side wall to provide supporting feet. These feet have locating shoulders 32 flanking mounting ears 33 by which the control device may be secured to a mounting panel (not shown) with its shoulders 32 bearing against the panel to properly locate the device thereon, with the front ends of its shafts accessible through a hole in the panel. Notches 34 in the edge of the base define the lugs 29 and receive those parts 31' of the supporting feet which close the ends of the slots 30.

Attention is directed to the fact that the inner edges 30' of the slots 30 are in line with the edge of the side wall portion 27', and that the width of the slots is such as to snugly receive the thickness of the base. Accordingly, the base is accurately and firmly held against the front edge of the side wall.

The base 7 of the rear unit 6 is secured to the side wall 25 after the latter has been assembled to the base of the front unit. For this purpose, tangs 34 project rearwardly from the side wall to be received in notches 35 in the edge of the base and then folded or bent over to solidly hold the base of the rear unit against the rear edge of the side wall. The bases of the two resistors are thus firmly secured in a definite fixed, spaced apart relation parallel to one another.

The inward end thrust upon the rotor of each of the two variable resistor units resulting from the tension in its spring contact fingers, is transmitted to and imposed upon the rotor of the other resistor through an embossed washer 37, encircling the shaft portion 20 of the rear unit and interposed between the drive arms of the two resistor units. This embossed washer bears directly against the drive arm of the rear unit and against the tongues 38 which are integral with the hollow shaft 19 and by which it is secured to the drive arm 18 of the front unit.

In effect, therefore, the rotors of the two variable resistor units are allowed to float axially in their respective side thrust bearings, but are maintained in proper axial position to assure correct contact pressure by the substantially equal and opposite forces resulting from the spring tension in the contact arms of the two units, against one another.

The limits of rotation of the two rotor assemblies are defined by a fixed stop abutment 39 which projects inwardly from the side wall substantially diametrically opposite the open side of the housing, into the path of stop abutments 40 formed on the drive arms of the two rotors.

That form of the invention illustrated in Figure 4 is, for all intents and purposes, identical to that just described, the only difference being in the specific way in which the side wall is connected to the base of the front unit. In this case, the base 7' of the front unit has a ground plate 41 overlying its front face and the side wall 25' has tangs 42 received in suitable notches in the edge of the base 7' and folded over the front of the ground plate 41. Also in this case, the mounting ears 33' by which the entire device may be mounted upon a supporting panel, are formed as integral parts of the ground plate and not of the side wall as previously described. One further distinction resides in the fact that the side wall does not have stiffening beads formed therein.

That form of the invention illustrated in Figures 5, 6 and 7, differs from those already described in two major respects—namely, in the provision of an alternate manner of mounting the control device, and in the provision of a fixed partition wall inside the housing to divide the housing into front and rear compartments. The stator portion of each of the two variable resistors, in this modification, is substantially the same as previously described and, therefore, in each instance has a base 7'' of insulating material which is substantially round or circular for the most part, and has a terminal carrying projection 8' to which the terminals 11' and 12' are secured. However, in this case, all of the terminals project beyond the edge of the terminal carrying portion 8' in parallel relationship to one another to enable the same to be projected through appropriately located holes in a mounting panel 45 (Figure 6) and thus adapt the control device for use with printed circuitry. It is, of course, to be understood that, in such use, the mounting panel 45 has circuit leads formed thereon with portions thereof terminating adjacent to the holes through which the terminals project so that the terminals may be readily connected to thees leads by any of the approved methods, as by dipping the panel with the control thereon into a solder bath.

Although the specific manner in which the terminals 12' are secured to the bases 7'' is somewhat different in this embodiment of the invention from that previously described, it should be understood that this detail has no bearing upon the invention, the only important thing again being that the resistance elements 9' and the collector rings 10' are on the inside faces of the two bases.

The rotors of the two variable resistors of this modification are also somewhat different from those previously described. In this case, the shafts and drive arms to which the contactors 15' are secured are integral moldings of

suitable insulating material such as "Bakelite." Thus, the rotor of the front variable resistor comprises a disc-like driving head 18' with a forwardly projecting holloy cylindrical shaft 19' journalled in an aperture in the base 7'' of the front unit, and the rotor of the rear unit comprises a similar disc-like driving head 18' having a forwardly projecting solid shaft portion 21' and a rearwardly projecting shaft portion 22', the former being received within the bore of the hollow shaft 19' and the latter being journalled in an aperture in the base of the rear unit. The extremities of all of the shafts are preferably provided with screw driver slots to facilitate the application of torque thereto.

The side wall 46, in this form of the invention, extends around the circular portion of the bases, as previously described, and is connected to both bases in identically the same manner, which is like the connection between the side wall 25 and the base 7 of the front unit in that form of the invention illustrated in Figures 1, 2 and 3. In other words, the side wall 46 has a pair of diametrically opposite slots 47 therein near its front edge and also near its rear edge, to snugly receive diametrically opposite lugs 48 which project from each of the bases. As in the embodiment of the invention shown in Figure 1, supporting feet 49 project from the front edge of the side wall and have locating shoulders 49' thereon to engage the back of a panel on which the control may be secured if panel mounting is to be employed. To effect such securement, twist-type mounting ears 50 project beyond the locating shoulders to pass through holes in the panel (not shown) and have their ends twisted over the edges of the holes.

As explained in connection with that form of the invention shown in Figures 1, 2 and 3, the side wall 46 is initially and intentionally formed to an undersize diameter so that after assembly of the parts, it is under tension to maintain itself assembled with the front and rear bases.

As indicated hereinbefore, one of the major distinctions between this form of the invention and the others described, is in the provision of a partition wall 51 which divides the interior of the housing into front and rear compartments, and against which the drive arms 18' of the two variable resistors bear to receive solid support against the end thrust resulting from the tension in the spring fingers or paddles of the contactors. The rotors of the two resistors in this case, therefore, do not float axially as they do in the previously described embodiment of the invention.

The partition wall 51, as best shown in Figure 7, is a stamped flat disc essentially circular in shape, but with two diametrically opposite ears or lugs 52 projecting from the edge thereof to engage in slots or holes 53 in the side wall 46 and thereby positively and firmly secure the partition wall in place with respect to the side wall, it being understood that the diameter of the partition wall corresponds to the inside diameter of the side wall in the assembled condition of the parts.

The partition wall also has a downwardly projecting extension 54 which protrudes through the open bottom of the housing and terminates in a pair of spaced apart parallel fingers 55 which are flanked by locating shoulders 56. The locating shoulders 56 lie in a plane tangent to the lower or outer edges 57 of the terminal carrying extensions of the bases, and normal to the fingers 55 and all of the parallel terminals. Accordingly, the locating shoulders 56 coact with the lower or outer edges of the terminal carrying extensions of the bases, to locate the control device in a definite position with respect to the panel 45 in which position the common axis of the rotors is parallel to and spaced a predetermined distance from the panel.

The engagement of the lower edges 57 with the panel, of course, holds the control device against rocking about the shoulders 56 in a forward and backward direction, i. e. parallel to the axis of rotation of the control shafts, and the shoulders 56, by their engagement with the panel 45, hold the device against lateral rocking.

The projection of the fingers 55 through the panel 45, as shown in Figure 6, allows these fingers to be electrically connected, as by soldering, to ground leads, and thereby provides for grounding the metal side wall when the device is mounted in this fashion. When the control device is panel mounted, the grounding is, of course, obtained through the twist ears and the forwardly facing locating shoulders as in the other embodiments of the invention.

The partition wall 51 has an additional function, namely, to provide stationary stop abutments 58 to coact with shoulders 40' on the rotors to define their limits of rotation. The shoulders 40' on the two rotors are disposed diametrically opposite one another so that the stationary abutments 58 may be located at different points on the partition wall with one projecting forwardly and the other rearwardly.

From the foregoing description, taken in connection with the accompanying drawings, it will be readily apparent to those skilled in this art, that this invention provides a tandem concentric variable resistance device which possesses many substantial improvements over those heretofore available, particularly with respect to reduction in cost made possible through a reduction in the number of piece parts, and also by the simplification of the parts themselves and the manner in which they are assembled.

What is claimed as our invention is:

1. A variable resistance device of the concentric tandem type wherein two variable resistors are disposed in axially spaced coaxial relationship and each such resistor comprises the following instrumentalities—an arcuate resistance path and a conductor path parallel thereto on one side of a base, and a rotary contactor having portions thereof bearing upon said paths to traverse the same as the contactor is rotated, and thereby electrically bridge said paths at different points along the length thereof, characterized by the fact that: said instrumentalities of the two variable resistors are contained within a housing having end walls formed by the bases of the two resistors and a side wall joined to the edge portions of the bases and holding the bases in fixed spaced apart relation with the sides thereof at which the resistance and conductor paths are located facing one another.

2. The variable resistance device of claim 1 further characterized by the fact that: the base of each of the two variable resistors is a flat generally round disc of insulating material with a terminal carrying portion projecting edgewise therefrom; and by the fact that the side wall comprises a strip of sheet metal formed into a segment of a cylinder extending along the perimeter of the base from one side edge to the other of the terminal carrying portions of the bases.

3. The variable resistance device of claim 2 further characterized by the fact that the securement between the side wall and at least one of the bases comprises substantially diametrically opposite lugs on the edge of the base snugly received in apertures in the side wall.

4. The variable resistance device of claim 2 further characterized by the fact that the side wall is under tension tending to reduce its diameter.

5. The variable resistance device of claim 4 further characterized by the fact that the side wall has a reinforcing bead formed therein and extending lengthwise of its arcuate length to strengthen the same against outward deformation.

6. The variable resistance device of claim 1 further characterized by the fact that the portions of the contactors which engage the resistance and conductor paths are spring fingers under tension; and by the fact that the contactors are disposed back to back with a thrust washer therebetween so that the spring tension in the fingers of one contactor reacts against and is balanced by the spring tension in the fingers of the other contactor.

7. The variable resistance device of claim 1 further characterized by the fact that the side wall secures the bases of the two variable resistors in definite fixed spaced relationship to one another; by the fact that the contactors of two variable resistors are each mounted upon rotatable carriers which include shaft portions journalled in their respective bases; and by the provision of means interposed between said rotatable carriers to hold them in predetermined spaced relationship without interfering with free rotation thereof.

8. The variable resistance device of claim 7 further characterized by the fact that said spacing means interposed between the two rotatable carriers is fixed to the side wall.

9. The variable resistance device of claim 1 further characterized by the provision of a partition wall interposed between the two variable resistors and joined to the side wall.

10. The variable resistance device of claim 9 further characterized by the fact that the contactors of the two variable resistors are fixed to insulated rotatably mounted drive members, and that their portions which bear upon the resistance and conductor paths are spring fingers; and by the fact that said insulated drive members have portions thereof bearing against the opposite sides of the partition wall to thereby maintain the spring fingers of each contactor under a predetermined state of tension.

11. A concentric tandem resistance device comprising: a pair of like variable resistors, each having a base with an arcuate resistance path and a conductor path of good conductivity paralleling the resistance path on the same side of the base, a contactor rotatably mounted on the base for rotation about an axis concentric to the arcuate resistance path, said contactor having spring contact fingers bearing on said paths to traverse the same as the contactor is rotated, and terminals for said paths fixed to the base and projecting from the edge thereof in juxtaposition to one another so that only a portion of the total perimeter of the base is occupied by the terminals; a side wall secured to the edge portions of the two bases and extending about that part of their perimeters not occupied by the terminals; said side wall holding the two bases in fixed spaced apart relation with the sides thereof on which their resistance and conductor paths are located facing one another and with their rotary contactors coaxial, whereby the side wall coacts with the two bases to provide a housing for the control device; and shaft means for the contactor of each variable resistor, with a part thereof accessible from the exterior of the housing to enable independent adjustment of the two resistors.

12. A variable resistance device of the concentric tandem type, wherein two variable resistors are disposed in axially spaced coaxial relationship and each such resistor comprises the following instrumentalities—an arcuate resistance path and a conductor path parallel thereto on one side of a base, and a rotary contactor having portions thereof bearing upon said paths to traverse the same as the contactor is rotated, and thereby electrically bridge said paths at different points along the length thereof, characterized by the fact that: the base of each of the two variable resistors is a flat generally round disc of insulating material with a terminal carrying portion projecting edgewise therefrom; by the provision of terminals for the resistance and conductor paths fixed to said terminal carrying portions and projecting beyond the outermost edge thereof in spaced parallel relationship; by the fact that said instrumentalities of the two variable resistors are contained within a housing having end walls formed by the bases of the two resistors and a side wall joined to the edge portions of the bases and holding the bases in fixed, spaced apart relation with the sides thereof at which the resistance and conductor paths are located facing one another; and by the fact that said side wall comprises a strip of sheet metal formed into a segment of a cylinder extending along the perimeter of the base from one side edge to the other of the terminal carrying portions of the base, so that the housing has an opening to accommodate the parallel projecting terminals.

13. The variable resistance device of claim 12 further characterized by the provision of a partition wall interposed between the two variable resistors and joined to the side wall, said partition wall having a portion thereof projecting through the open side of the housing and terminating in laterally spaced locating shoulders and parallel fingers projecting beyond said shoulders parallel to the terminals, said shoulders lying in a plane tangent to the outermost edges of the terminal carrying portions of the bases beyond which the terminals project, to coact therewith in supporting the entire device in a predetermined position upon a mounting panel having holes through which the terminals and said fingers project, whereby the terminals and said fingers may be soldered to leads on the panel having portions contiguous to the holes therein.

No references cited.