March 12, 1968 E. F. HAUENSTINE ET AL 3,373,393

VARIABLE RESISTOR UTILIZING NOVEL CONTROL SYSTEM

Filed Aug. 11, 1966 2 Sheets-Sheet 1

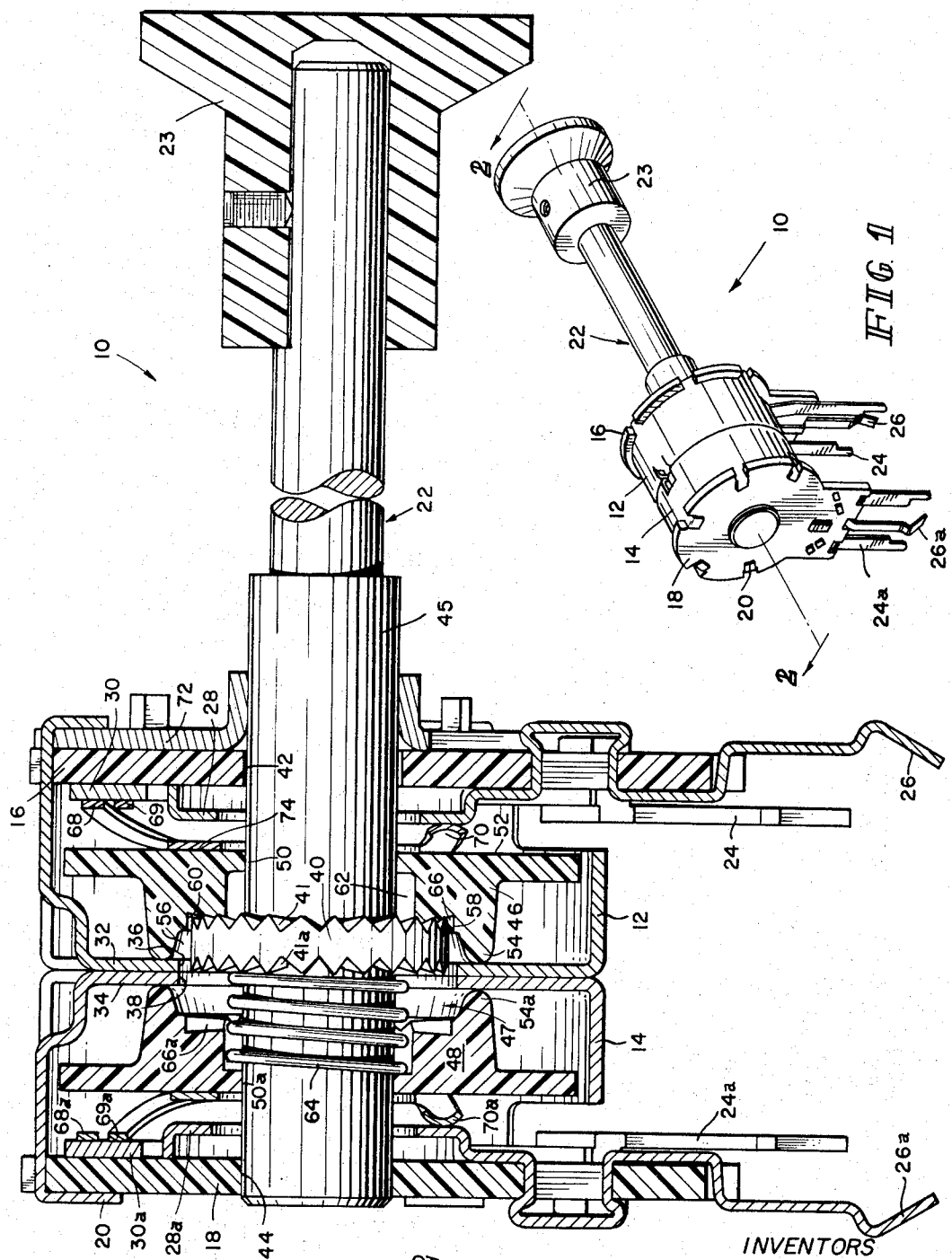


FIG. 2

FIG. 1

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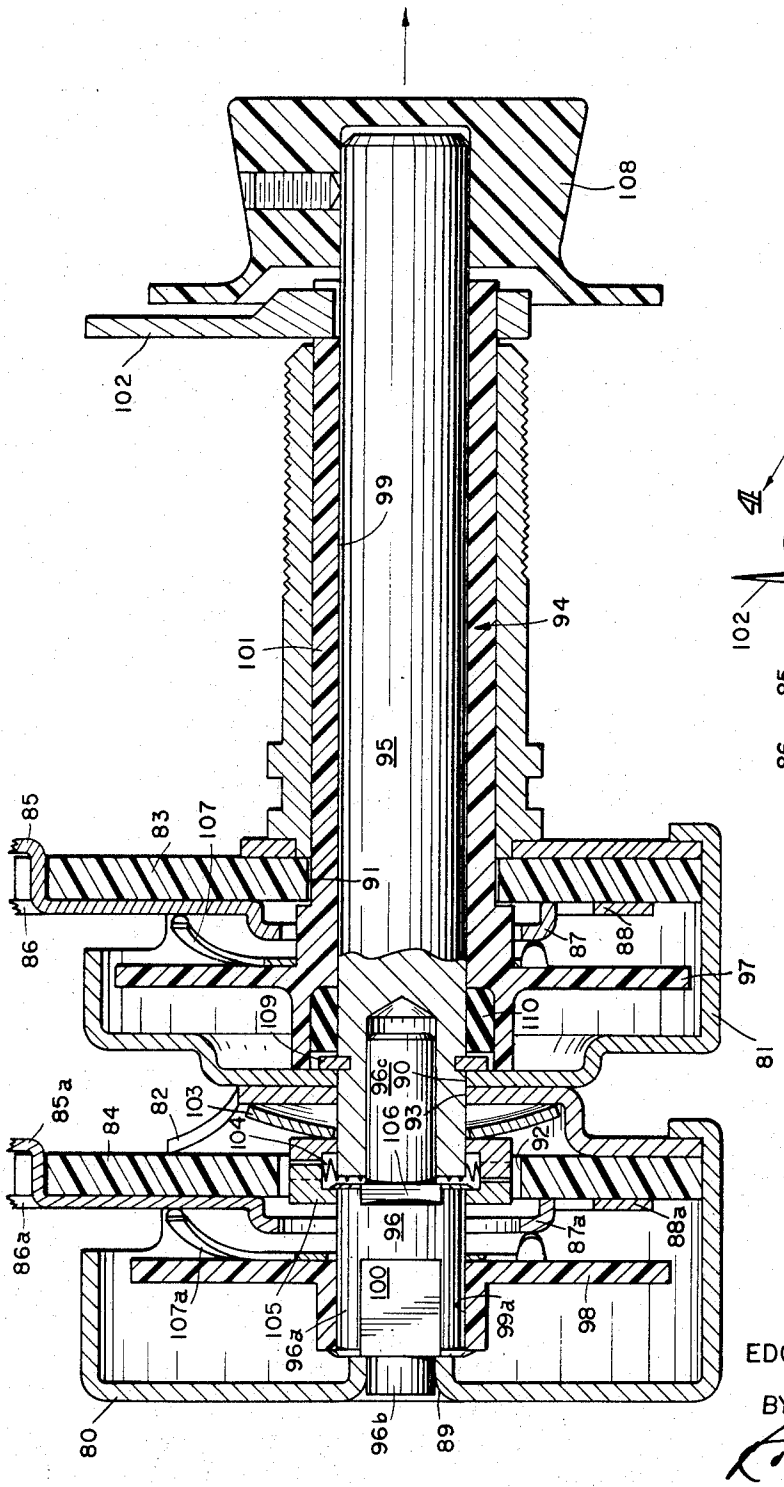


FIG. 4

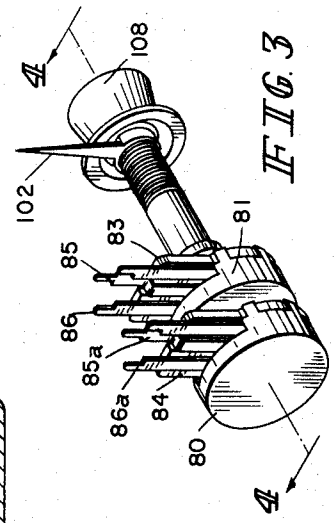


FIG. 3

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VARIABLE RESISTOR UTILIZING NOVEL CONTROL SYSTEM

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ABSTRACT OF THE DISCLOSURE

Two variable resistors are independently operable off of a single drive shaft which is spring biased for axial displacement to alternately engage the resistors through independent driving means.

This invention relates to a novel variable resistor. More particularly it relates to such a resistor wherein the resistance of separate resistors can be varied independently.

A particular feature of the present invention lies in the use of a control system operating off of a single actuator shaft. Such a combination is particularly useful in certain electrical devices. In television, for example, use is frequently made of a single control dial to control two separate functions.

Prior to this invention, variable resistors used to perform this function have been extremely complicated and costly to manufacture. For the most part they operated off of a double shaft arrangement, which in and of itself is a costly, complicated, and to a certain extent an unreliable control system.

It is, therefore, the principal object of the present invention to provide in a variable resistor a control system that is simple and economical to produce.

Another object is to provide a variable resistor wherein the resistance of one resistor can be varied independently of another.

Another object of the invention is to provide such a resistor wherein the control for varying such resistance is effectuated off of a single actuator shaft.

Still another object of the invention is to provide a variable resistor using a double face gear drive to independently drive separate identical rotors which carry the electrical contact brushes for contact with the resistance elements.

Yet another object of the invention is to provide a variable resistor using a segmented actuator shaft and coupling means to independently drive separate identical rotors which carry the electrical contact brushes for contact with the resistance elements.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in a 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 invention here disclosed may be made as come within the scope of the claims.

In the drawings FIGURE 1 is a perspective view of one embodiment of a variable resistor embodying the features of the invention;

FIGURE 2 is a cross-section of the resistor taken through FIGURE 1 along the plane of line 2—2.

FIGURE 3 is a perspective view of another embodiment of a resistor embodying the features of the invention; and

FIGURE 4 is a cross-section of the resistor taken through FIGURE 3 along the plane of line 4—4.

Generally speaking, the invention contemplates providing a dual, variable resistor having first and second cup shaped metal housings which are mated together with the open ends being closed by first and second substantially flat insulated terminal boards. Suitable electric terminals are attached and made part of the terminal board. Apertures are formed centrally in the closed ends of the housing and in the terminal boards such that with the housings in the end to end position the apertures are axially aligned. A spring biased actuator shaft extends through the housing by way of the apertures. Each housing contains an identical rotor which surrounds that actuator shaft. The actuator shaft is constructed and arranged such that each rotor may be rotated separately and independently from the other. Attached to each rotor are contact brushes such that as the rotor rotates the contact brushes slidably brush over a resistance element so as to vary its resistance.

In one embodiment, the spring biased actuator carries a double face gear. Through axial movement of the shaft, the double faced gear is allowed to engage one of the rotors, the rotors having teeth into which the gear can be meshed.

In another embodiment, the spring biased actuator shaft is segmented into two sections with coupling means disposed between the sections. By engaging and disengaging the coupler each segment or section can be independently rotated. Means are provided for connecting an individual rotor to an individual segment or section.

Referring now to FIGURES 1 and 2, the dual variable resistor **10** of this embodiment in the main is composed of a first cup shaped housing **12** that is mated to a second cup shaped housing **14** in end to end position such that the cupped or closed ends mate each other. The open ends of the housing are closed by first and second flat terminal boards **16** and **18** respectively, the housings and the terminal board being held together by lugs **20**. The terminal boards are electrical insulators being constructed from a suitable laminated resin for example. Associated with each terminal board and connected thereto are electrical terminals **24**, **24***a*, **26** and **26***a*, terminals **26** and **26***a* being integrally connected to first and second contact rings **28** and **28***a* which substantially surround actuator shaft **22**, while terminals **24** and **24***a* are integrally connected to first and second ring shaped resistance elements **30** and **30***a*.

The cup shaped or closed end portions **32** and **34** of the housings each contain centrally located and axially aligned apertures **36** and **38**, the diameters of which are somewhat greater than the outside diameter of the double-faced gear **40** which is fixedly attached to actuator shaft **22**. Terminal boards **16** and **18** contain centrally located apertures **42** and **44** both of which are in axial alignment with apertures **36** and **38** and both having diameters slightly larger than the diameter of the shank **45** of actuator shaft **22**. Actuator shaft **22** having a knob **23** extends through both housings by way of the apertures **36**, **38**, **42** and **44**.

Disposed within the housings and surrounding the actuator shaft **22** are first and second rotors **46** and **48** both of which are identical in structure and material, the material being an electrical insulator such as nylon for example. Each rotor has a bore **50** and **50***a*, the diameters of which are slightly larger than the diameter of the shank **45** such that an individual rotor can remain fixed as the other is rotated in a manner hereinafter described.

Each rotor has a substantially flat back face 52 and a front face formed from a boss ring 54 having an inside diameter measured at its inner face 56 somewhat greater than the outer diameter of the double faced gear 40, a first recessed portion 58, the inner diameter of which, formed by the face 60 also being somewhat larger than the diameter of the double faced gear 40, and a second recessed portion 62, the inside diameter of which is somewhat larger than the outer diameter of the coil spring 64 which surrounds the actuator shaft 22 and which is held in juxtaposition with gear 40. The first recessed portion contains gear teeth 66 formed to mate the teeth of the double faced gear 40. The axial alignment of the apertures 36 and 38 and the axial positioning of the rotors 46 and 48 with their so formed front faces facing each other results in the formation of cavity 47 thus leaving the double faced gear 40 free to move from one rotor to the other.

The critical feature of this invention lies in the control arrangement of the spring biased actuator shaft, the double faced gear and the rotors. With this arrangement the invention has advanced the state of the art of variable resistors by allowing the resistance of one unit to be varied without varying the other, the complete system operating off of a single shaft. This in itself renders the system simple, economical, and reliable.

In operation, the actuator shaft 22 is biased such that when the actuator shaft is in a relaxed position the teeth 41 of the double faced gear 40 mesh with teeth 66 of rotor 46, as shown. Rotation of the actuator shaft against the bearing support 72 thus causes the rotor to rotate. As the rotor thus rotates it causes the outer contact brushes 68 and 69 to slidably brush over resistance element 30 and the inner contact brushes 70 (one shown) to slidably brush over contact ring 28, the contact brushes being of a unitary construction and being fixedly attached to the rotor as indicated at 74. As rotor 46 rotates, rotor 48 remains fixed due to the loose fit between the shank 45 of the actuator shaft 22 with the bore 50*a* and the frictional pressure asserted by the boss ring 54*a* against the cup section 34 of housing 14 and the frictional pressure asserted by the outer contact brushes 68*a* and 69*a* and inner contact brushes 70*a* against the resistance element 30*a* and contact ring 28*a* respectively.

Movement of the actuator shaft inward compresses the coil spring 64 and engages or meshes teeth 41*a* of the double faced gear with teeth 66*a* of rotor 48. As can then be readily seen subsequent rotation of the actuator shaft brushes the contact brushes 68*a*, 69*a*, and 70*a* over the resistance element 30*a* and the contact ring 28*a*.

Referring now to FIGURES 3 and 4 for another embodiment of the invention, first and the second metal cup shaped housings 80 and 81 are held in tandem position in spaced relationship through adapter plate 82. The open ends of the housings are closed by first and second terminal boards 83 and 84, the terminal board having suitable electric terminals 85, 85*a*, 86 and 86*a*, terminals 85 and 85*a* being contiguous to electric contact rings 87 and 87*a*, while terminals 86 and 86*a* are connected to ring shaped resistance elements 88 and 88*a*. The metal housings, the terminal boards, and the adapter plate 82 each have centrally located and axially aligned apertures 89, 90, 91, 92 and 93 respectively such that actuator shaft 94 can be extended through the housings, the diameters of the apertures being such that the shaft is free to rotate.

Actuator shaft 94 is segmented into two segments or sections 95 and 96, segment 96 being composed of an enlarged shank 96*a* and recessed portion 96*b* and 96*c*, 96*c* being journalled axially in the shaft section 95 such that axial alignment of the sections is insured when both sections are rotated simultaneously.

Disposed with each housing 80 and 81 are first and second rotors 97 and 98 respectively, the rotors each

having a bore 99 and 99*a*, the diameter of bore 99 being slightly larger than the diameter of actuator shaft segment 95. The bore 99*a* has oppositely formed flat portions (not shown) which mate oppositely formed flat portions 100 of segment 96 such that rotor 98 is fixedly attached to the segment. Rotor 97 additionally has an extension shaft 101 connected to a dial indicator 102.

In operation, the actuator is spring biased through spring washer 103 such that when the shaft is in the relaxed position the teeth 104 of coupler 105 are engaged or meshed. Rotation of the actuator shaft then causes segment 96 to be rotated, thus causing rotor 98 to rotate (independently of rotor 97), the coupler being fixedly attached to the segment 96 through flats (not shown) corresponding to oppositely placed flats 106. Rotation of rotor 98 causes contact brush 107*a* to rotate and brush over resistance element 88*a* and contact ring 87*a*.

Axial movement of the actuator shaft 94 caused by pulling the shaft through knob 108, disengages the coupler 105 while simultaneously effectuating a press fit connection between segment 95 and rotor 97 through stop ring 109 being brought to bear against the ring 110, ring 110 being made from a resilient material such as rubber. Rotation of the actuator shaft now causes rotation of the rotor 97 independent of rotor 98, to thus cause contact brush 107 to rotate and brush over resistance element 88 and contact ring 87.

It should be understood that various apparatus changes may be made in the present device without departing from the spirit or scope of the invention. For example, in FIGURE 2 the biasing of the actuator shaft 22 could be done in such a manner that the double faced gear 40 would be meshed with the rotor opposite than as shown when the actuator is in the relaxed position. Or, as another example, the engagement of the actuator shaft with the rotors through the double faced gear could be accomplished with a spline arrangement.

From the foregoing description, taken in connection with the accompanying figures of the drawing, it will be readily apparent to those skilled in the art that this invention provides a new and improved variable resistor, the control feature of which may be applied to various arts and devices. Accordingly, it is contemplated that the scope of the invention is to be determined from the following appended claims.

What is claimed is:

1. A variable resistor comprising in combination a pair of cup shaped metal housings, said housings being held in end to end position; a pair of electric terminal boards positioned in the open ends of said housings to close the same; electric terminals with electrical contact elements connected to said terminal boards; said housings having apertures in their closed ends; said apertures being axially aligned with apertures formed in said terminal boards; separate resistance elements disposed within each of said housings, independently operable electrical contact brushes within said housings arranged to slidably brush said resistance means and said electrical contact elements; independently operable rotatable driving means for rotating said brushes a single drive shaft being spring biased for axial displacement and extending through said housings by way of said apertures; rotatable driving means connected to said shaft; axial displacement of said drive shaft causing said driving means to alternately engage said driving means for said contact brushes.

2. A dual variable resistor comprising in combination:

(a) first and second cup shaped housings each having open ends; centrally located apertures in the closed ends; first and second terminal boards each having a centrally located aperture, said boards being positioned in each of said open ends to close the same, each of said boards further having electrical terminals attached thereto;

(b) said first and second housing being held in end to end position such that the closed ends mate and the

apertures of said closed ends and the terminal boards are in axial alignment;

(c) a single actuator drive shaft being spring biased for axial displacement and extending through said first and second housing by way of said apertures;

(d) first and second rotors surrounding said shaft, one each disposed in each of said housings;

(e) first and second ring shaped resistance elements substantially surrounding said shaft and being disposed, one each, within each of said housings;

(f) first and second contact brushes substantially surrounding said shaft and being disposed, one each within each of said housings, said contact brushes being connected to said rotors and being in electrical contact with said resistance element and said electric terminals;

(g) said axially spring biased actuator shaft having means to engage one of said rotors upon axial displacement of said shaft independently of the other of said rotors such that rotation of said shaft causes rotation of the engaged rotor whereby the resistance of one of the resistance elements can be varied independently of the other.

3. A variable resistor according to claim 2 wherein said actuator shaft engaging means comprises a double faced gear and said first and second rotors have teeth for meshing with said gear.

4. A variable resistor comprising in combination:

(a) first and second cup shaped housings each having open ends; centrally located apertures in the closed ends; first and second electric terminal boards each having a centrally located aperture, said boards being positioned in each of said open ends to close the same, each of said boards further having electric terminals attached thereto;

(b) said first and second housings being held in end to end position such that the closed ends mate and the apertures of said closed ends and said terminal boards are in axial alignment;

(c) an actuator shaft extending through said first and second housings by way of said apertures, said shaft having means to cause axial and rotational movement, a double faced gear attached to and surrounding said shaft, and a coil spring in juxtaposition between said gear and one of a pair of first and second rotors;

(d) said first and second rotors surrounding said shaft each having a bore slightly larger in diameter than said shaft, said rotors being disposed one each within said housings, each of said rotors having a substantially flat back face and a front face formed from a boss ring having an inside diameter greater than the outer diameter of said double faced gear, a first recessed portion having an inner diameter slightly larger than the outer diameter of said double faced gear and having teeth protruding from the inner face of such recessed portion formed to mesh the teeth of the double face gear, and a second recessed portion having an inside diameter somewhat larger than said spring, said rotors being held within said housings such that said boss rings bear against the closed ends of said housings such that a cavity is formed between said rotors;

(e) first and second ring shaped resistance elements and first and second contact rings substantially surrounding said shaft and being disposed, one each, within each of said housings, said resistance elements and said contact rings being attached to said terminal boards; and

(f) first and second contact brushes substantially surrounding said shaft and being disposed, one each, within each of said housings, said contact brushes being connected to the said back face of said rotors and being in contact with said resistance elements and said contact rings.

5. A dual variable resistor comprising in combination:

(a) first and second cup shaped housings each having open ends, centrally located apertures in the closed ends, first and second terminal boards each having a centrally located aperture, said boards being positioned in each of said open ends to close the same, each of said boards further having electrical terminals attached thereto;

(b) said first and second being held in tandem position such that the apertures of said closed ends and the terminal boards are in axial alignment;

(c) a single drive actuator shaft being spring biased for axial displacement and extending through said first and second housings by way of said apertures;

(d) first and second rotors surrounding said shafts, one each disposed in each of said housings;

(e) first and second ring shaped resistance elements substantially surrounding said shaft and being disposed, one each, within each of said housings;

(f) first and second contact brushes substantially surrounding said shaft and being disposed, one each within each of said housings, said contact brushes being connected to said rotors and being in electrical contact with said resistance element and said electric terminals;

(g) said axially spring biased actuator shaft being segmented into two axially aligned sections, each section being associated with one each of said rotors, and one of said rotors being fixedly attached to one of said segments with means being provided to effectuate a connection between the other of said rotors and the other of said sections; and

(h) coupling means disposed between said sections for alternately connecting and disconnecting said sections upon axial displacement of said section having the means to effectuate a connection between one of said rotors.

6. A dual variable resistor comprising in combination:

(a) first and second cup shaped housings each having open ends; centrally located apertures in the closed ends; first and second terminal boards each having a centrally located aperture, said boards being positioned in each of said open ends to close the same, each of said boards further having electric terminals and first and second resistance elements attached thereto;

(b) said first and second housings being held in spaced tandem position through an adapter plate having a centrally located aperture such that the apertures of said closed ends, the terminal boards and the adapter plate are in axial alignment;

(c) an actuator shaft extending through said first and second housings by way of said apertures, said shaft being spring biased through a spring washer disposed within said adapter plate, said shaft further being segmented into two axially aligned sections one of said sections being composed of a shank portion spaced between two reduced sections, one of said reduced sections being journalled in the other of said shaft section for assuring axial alignment between said shaft sections;

(d) a coupler disposed between said sections for alternately connecting and disconnecting said sections;

(e) first and second rotors surrounding said shaft, one each disposed within each of said housings, and one of said rotors being fixedly connected to one of said shaft sections, the other of said rotors being capable of being connected to the other of said sections through means for providing a press fit between the two upon axial movement of said actuator shaft, said means comprising a stop ring integrally connected to and surrounding said other section, said ring being adapted and arranged to bear against a resilient ring disposed between said section and its corresponding rotor; and

(f) first and second contact brushes substantially surrounding said actuator shaft and being disposed, one each within each of said housing, said contact brushes being individually connected to said rotors and being in electrical contact with said resistance element and said electric terminals whereby rotation of one of said shaft sections rotates a corresponding rotor individually of the other to vary the resistance of one of said resistance elements independently of the other.

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