

March 21, 1961

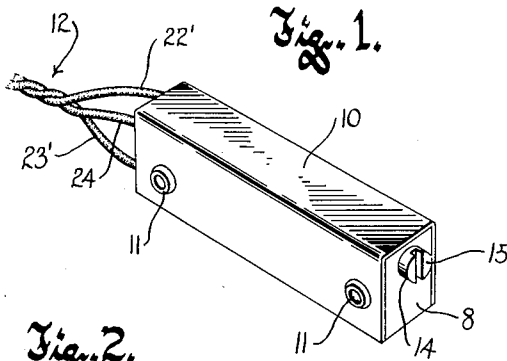
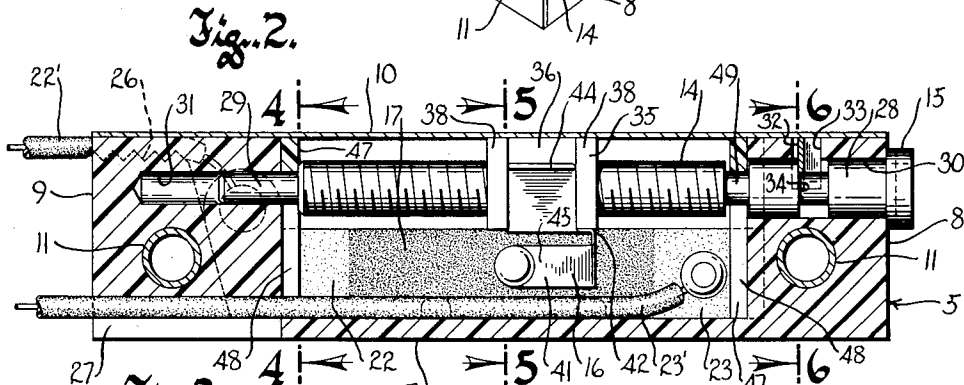
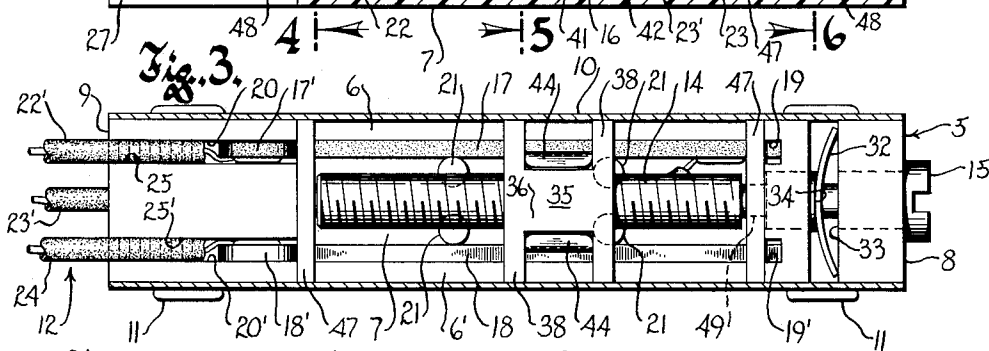
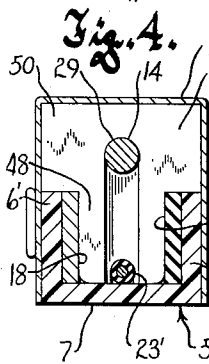
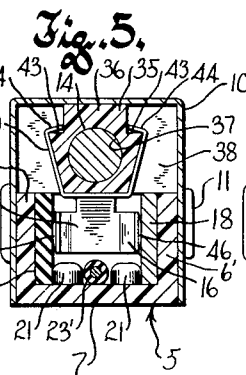
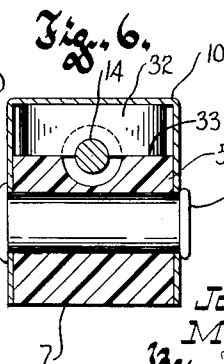
J. DI GIROLAMO ET AL

2,976,507

ADJUSTABLE RESISTOR

Filed July 28, 1958

2 Sheets-Sheet 1



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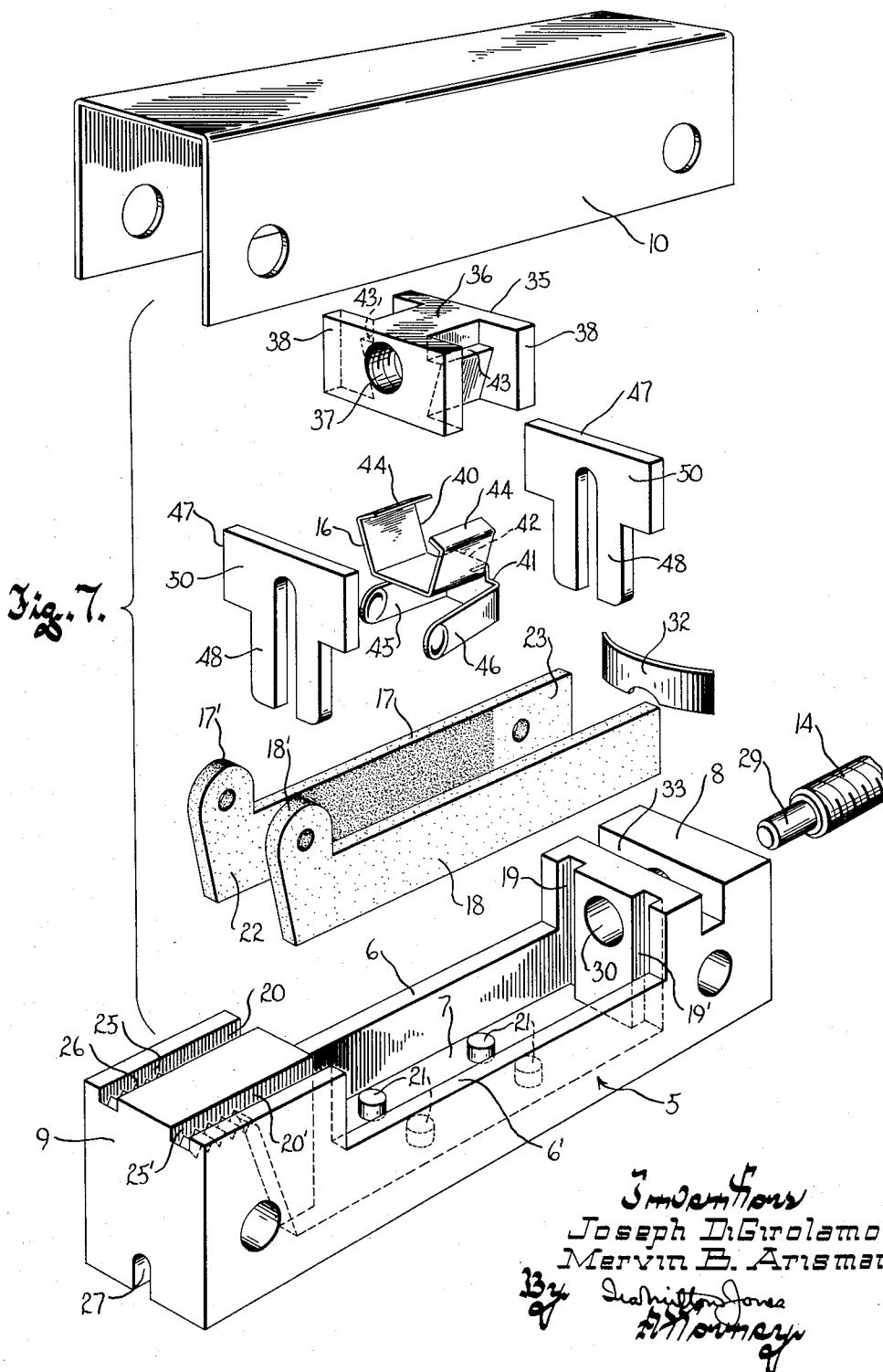
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2 Sheets-Sheet 2



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2,976,507

ADJUSTABLE RESISTOR

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7 Claims. (Cl. 338—180)

This invention relates to variable resistors and refers more particularly to variable resistors especially adapted to be used as trimmer type potentiometers. These instruments are used to obtain fine adjustment of the circuits in which they are connected, and are not intended for frequent manual adjustment as are the conventional variable resistors. Hence, resistors of this type are perhaps better identified as adjustable resistors.

Such adjustable resistors or potentiometers play an important part in the control circuits of guided missiles and other aircraft, and for this service they obviously must meet very stringent specifications. Absolute assurance against deviation from a selected setting is one of the requirements. Stability of resistance value under very adverse temperature and humidity conditions is another, and compactness and small overall size, coupled with a rugged mechanical construction is an overriding consideration.

Adjustable resistors specifically designed for this service are not broadly new. The patents to M. E. Bourns et al. No. 2,706,230, and to M. E. Bourns No. 2,776,926, disclose such a resistor. Hence, it is the purpose of this invention to improve upon the adjustable resistors heretofore available.

Aside from this general objective, the invention has as another of its purposes to provide an adjustable resistor of the character described which is more easily manufactured, and one which is so constructed that it is operative completely independently of its cover, so that complete testing and examination thereof can be effected before the cover is applied.

Another object of this invention is to provide an adjustable resistor of the character described, wherein adjustment is effected by a fine actuator screw or lead screw mounted for rotation and constrained against any possible endwise displacement, so that once the resistor has been adjusted by turning the screw to bring the movable contactor to the desired location, axial shifting of the screw and consequently the contactor, is a virtual impossibility.

Finally, it is a purpose of this invention to provide an adjustable resistor of the character described which is so designed and constructed that its component parts are simple and easily produced and assembled.

With the above 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 herein disclosed invention may be made as come within the scope of the claims.

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

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Figure 1 is a perspective view of an adjustable resistor embodying this invention;

Figure 2 is a longitudinal sectional view through the resistor at a scale considerably larger than that of Figure 1;

Figure 3 is a top plan view of the resistor with the cover thereof broken away and in section;

Figure 4 is a cross sectional view through Figure 2 on the plane of the line 4—4;

Figure 5 is a cross sectional view through Figure 2 on the plane of the line 5—5;

Figure 6 is a cross sectional view through Figure 2 on the plane of the line 6—6; and

Figure 7 is an exploded perspective view of the main elements of the resistor.

Referring now particularly to the accompanying drawings, the numeral 5 designates the body of the adjustable resistor of this invention. This body is formed of non-conducting material and is preferably molded of a suitable plastic. It has a generally oblong, box-like formation with spaced parallel side walls 6—6', a bottom wall 7 and end walls 8 and 9. All the instrumentalities of the resistor are mounted on and contained within the body 5; and positioned over the top of the body after the instrumentalities of the resistor have been assembled therewith, is a cover 10.

The cover 10 is formed of light sheet metal and is U-shaped in cross section. Its flanges snugly embrace the body and grip the sides thereof, while its web or bight portion rests upon the end walls 8 and 9. The cover is secured in this position by hollow rivets 11 which pass through its flanges and through the body end walls 8 and 9. These hollow rivets are adapted to receive mounting screws or fasteners (not shown) by which the complete resistor may be mounted on a suitable support or on some part of the apparatus or device with which it is used. Conductors collectively identified by the numeral 12 extend from one end of the unit, in this case from the end wall 9, to provide for the connection of the resistor into the circuit which it is to control; and adjustment of the resistor is effected by rotation of an actuating screw 14 the head 15 of which is exposed at the end wall 8 to permit turning the screw.

Rotation of the actuating screw 14 slides a bridging contactor 16 lengthwise of the body along a resistance element 17 and a stationary contact 18. The resistance element and the stationary contact are identical in shape and size and overlie the inner face of the side walls of the body from end-to-end thereof. They are of uniform width equal to the height of the body side walls, but are longer than the distance between the opposing inner faces of the body end walls 8 and 9. Their end portions are received in vertically inwardly opening grooves 19—19' in the end wall 8, and 20—20' in the end wall 9.

As best seen in Figures 3 and 7, the outer surfaces of the grooves 19—19' and 20—20' are flush with the inner faces of the side walls so that the resistance element and the stationary contact may lie flat against the side walls, in which positions they are held by small bosses or lugs 21 which project up from the bottom wall at distances from the side walls corresponding to the thickness of the resistance element and the stationary contact.

The stationary contact is simply stamped from sheet metal of good conductivity; and the resistance element 17 may be of any suitable composition. In the present embodiment the resistance element comprises a carbonaceous film applied to a strip of insulating material. It could also be in the form of a metalized film applied to a ceramic base, or any other suitable conductive film applied to a metal base coated with a suitable

insulator. However, the particular composition of the resistance element forms no part of this invention.

The bottoms of the grooves or pockets 20—20' in the end wall 9 are inclined as shown to facilitate placement of the resistance element and the stationary contact into the body, and the adjacent ends of the resistance element and stationary contact are correspondingly inclined to snugly fit the bottoms of the grooves. The end portions of the resistance element and stationary contact received in these grooves have upwardly projecting terminal portions 17'—18', the inner edges of which lie flush with the inner surface of the end wall 9, and the tops of which lie beneath the top face of the end wall 9.

As is customary, the resistance element 17 has hop-off portions 22 and 23 of good conductivity at its opposite ends to assure good electrical connection of the resistance element with its conductor leads, which are two of the leads hereinbefore collectively referred to by the numeral 12. These resistance element leads, more specifically identified by the numerals 22' and 23', are soldered to rivets or eyelets secured in the end portions of the element; and another lead 24 which is also one of those collectively referred to by the numeral 12, is attached to the terminal portion 18' of the stationary contact in like manner, i.e. by being soldered to an eyelet secured to the terminal portion of the contact.

The conductors 22' and 24 are brought out to the exterior of the unit through raceways provided by upwardly opening grooves 25—25' in the top of the end wall 9. These grooves extend from the pockets or grooves 20—20' and the bottom thereof is preferably serrated, as at 26. The minimum depth of the grooves 25—25' is less than the diameter of the conductor wires received therein, so that when the cover 10 is secured in place it presses the conductors down against the serrated bottom of their respective raceways and firmly secures them against endwise displacement.

The conductor 23' which is connected to the other end 23 of the resistance element, extends along the medial portion of the bottom wall and passes out of the interior of the body through another raceway provided by a downwardly opening groove or slot 27 in the bottom of the end wall 9. This groove or slot 27, of course, opens to the interior of the body and extends upwardly above the bottom wall 7 far enough to accommodate the conductor.

The actuator screw 14 has a fine accurate thread along the major portion of its length, and at its headed end has an unthreaded slightly larger diameter journal portion 28. The opposite end of the screw is reduced in diameter to provide a second journal portion 29. The journal portion 28 is snugly but freely rotatably received in a hole 30 which extends through the end wall 8 with its axis parallel to the side and bottom walls of the body, and the journal portion 29 is received in a hole or well 31 which extends into the end wall 9 from its inner face and is exactly coaxial with the hole 30. The holes 30 and 31 thus constitute coaxial bearings in which the actuator screw is journaled, and it is to be noted that the holes are so located in the end walls that the screw is longitudinally centered with respect to the side walls of the body and at an elevation above the upper edges thereof.

The screw is held against axial displacement in one direction by the engagement of its head 15 with the end wall 8, and in the other direction by a retainer in the form of a bowed leaf spring 32 received in an upwardly opening transverse slot 33 in the end wall 8, which slot opens to the hole 30 and thus intersects at least the upper portion thereof. Substantially in line with and slightly outwardly of the transverse slot 33, the journal portion 28 of the screw is reduced in diameter to provide an abrupt shoulder 34 which faces outwardly towards the head of the screw, and it is this shoulder

which the bowed leaf spring retainer 32 bears against in the operative position of the parts.

The bridging contactor 16 is operatively connected with the actuator screw by a nut 35 formed of non-conducting material and to which the contactor is attached. Viewed from the top the nut is H-shaped with a main central portion 36 through which its threaded bore 37 extends, and oppositely projecting spaced parallel arms 38. The nut is of such size that the undersides of its arms 38 seat upon the top edges of the body side walls and of course also the top edges of the resistance element 17 and the stationary contact 18, while the top face of the nut is flush with the plane of the top of the end walls and hence engages the underside of the cover 10.

By virtue of the engagement of its arms 38 with the top edges of the body side walls, the nut is held against rotation about the axis of the screw, and thus will traverse the length of the screw upon rotation thereof, whether or not the cover 10 is in place.

The contactor 16 is a stamping of sheet metal having the desired resiliency, and as best shown in Figure 7 has an upper U-shaped attaching portion 40, and a lower U-shaped contact portion 41, the bights of these two portions being joined together by a rightangular bend indicated by the numeral 42. The central body part 36 of the nut is keystone shaped in cross section with shoulders or ledges 43 at the top of the keystone, and the upper attaching portion 40 of the contactor snugly embraces this keystone shaped central body portion, and is held thereon by flanges 44 on the contactor arms engaging over the ledges 43.

The lower contact portion 41 of the contactor lies beneath the nut and its arms provide resilient fingers 45 and 46, the extremities of which respectively bear against the resistance element and the stationary contact.

With the contactor constructed and mounted in the manner described, the contact pressure exerted upon the resistance element and the stationary contact does not affect free translation of the nut along the length of the screw nor, does it place any stress upon the screw. All of the adjustable parts are thus free and smoothly adjustable.

As indicated hereinbefore, the resistance element 17 and the stationary contact 18 lie flat against the inner faces of the body side walls, in which positions they are held by the small lugs or bosses 21 which project up from the bottom wall of the body and engage the medial portions of the resistance element and stationary contact. The extremities of the resistance element and stationary contact could be held against relative inward movement away from the side walls by having the slots 19—19' and 20—20' just wide enough to receive the resistance element and stationary contact, but for convenience of assembly it is preferable that these slots be somewhat wider. Other means are therefore provided to hold the end portions of the resistance element and stationary contact against the side walls, namely T-shaped retainers 47. These T-shaped retainers are formed of suitable non-conducting material, and have bifurcated stems 48 to straddle the actuating screw beyond the ends of its threaded medial portion. Thus, one of the retainers straddles the reduced diameter journal portion 29 of the screw, and the other straddles a reduced diameter portion 49 between its medial threaded part and the journal portion 28.

The width of the stem 48 of the retainers is such as to snugly fit between the resistance element and the stationary contact, and the head 50 of the retainers is of a size corresponding to the opposing inner faces of the body end walls above the side walls to overlie the same with the outer edges of the head 50 flush with the sides and top of the body.

The retainers 47 are held in their operative positions by the confinement of their stems 48 between the resist-

ance element and the stationary contact, and by their interengagement with the adjacent reduced diameter portions of the screw. It follows, therefore, that the unit is quickly and easily assembled, and also that it is fully operative without the cover in position. Being able to operate the unit without having the cover in place is an advantage since it enables testing the resistor and making all final adjustments thereof before the cover is riveted in place, and of course once the cover is secured it holds the bowed leaf spring screw retainer 32 and the retainers 47 in their respective operative positions.

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 an adjustable resistor especially well adapted for the service for which it is intended, and that it constitutes a substantial improvement over resistors heretofore available for this service.

What is claimed as our invention is:

1. An adjustable resistor comprising: an elongated box-like body of non-conducting material having spaced parallel side walls, a bottom wall and end walls, the end walls projecting a substantial distance above the top edges of the side walls; means in the upper portions of the end walls providing coaxial shaft bearings; an actuator screw having smooth end portions freely rotatably received in said shaft bearings so that the screw extends from end wall to end wall and is located between the planes of the side walls and at an elevation above the upper edges of the side walls; a resistance element overlying the inner face of one of said side walls; a stationary contact overlying the inner face of the other side wall, opposite the resistance element; a contactor carrier of non-conducting material having a central body portion with a threaded hole in which the actuator screw is received, the cross section of the body portion on a plane normal to the axis of its threaded hole being substantially keystone-shaped; spaced apart parallel flanges projecting laterally from the body portion of the carrier, slidably engaging the upper edges of the side walls to hold the carrier against rotation and cause it to traverse the length of the screw as the screw is turned; and a bridging contactor having a U-shaped attaching portion embracing the central keystone-shaped body portion of the carrier with the arms thereof confined between said flanges, intumed portions on the extremities of said arms engaging over the upper edges of the sides of the keystone-shaped body portion, and contact fingers slidably engaging the resistance element and the stationary contact.

2. The adjustable resistor of claim 1, further characterized by the fact that the resilient fingers of the contactor lie beneath the bight of the U-shaped attaching portion of the contactor and are biased laterally apart from one another.

3. An adjustable resistor comprising: an elongated box-like body of non-conducting material having spaced parallel side walls of equal and uniform height, a bottom wall and end walls, the end walls projecting a substantial distance above the top edges of the side walls, the end walls having coaxial bearings in their upper portions which bearings are centered with respect to the side walls and at an elevation above the upper edges thereof; an actuating screw threaded in said bearings and extending from end wall to end wall; the end walls having inwardly opening vertical grooves in their opposing inner faces directly adjacent to the inner faces of the side walls; a resistance strip overlying the inner face of one of the side walls; a stationary contact strip overlying the inner face of the other side wall, the upper edge of the resistance strip and of the stationary contact strip being flush with the upper edges of the side walls, and the length of said resistance strip and stationary contact strip being greater than the distance between the opposing inner faces of the end walls, the end portions of said resistance strip and the stationary contact strip being

received in the vertical grooves in the end walls; bifurcated substantially T-shaped retaining members straddling the portions of the actuator screw adjacent to the end walls with the stems thereof received between the resistance strip and stationary contact strip, and with the undersides of the head thereof seating upon the upper edges of the side walls and of the resistance element and stationary contact to hold the element and contact down in place; a nut threaded on the screw and having portions thereof slidably engaging the upper edges of the side walls; and a contactor carried by the nut and having resilient fingers bearing under outward bias against the resistance strip and the stationary contact strip so that each of the said strips receives the biasing reaction of the fingers against the other, and none of the biasing reaction is transferred to the nut.

4. An adjustable resistor comprising: an elongated boxlike body of non-conducting material having spaced parallel side walls, a bottom wall and end walls which project a substantial distance above the top edges of the side walls, one of the end walls having a round hole therethrough with its axis parallel to the side and bottom walls, and also having a transverse slot opening to its top face and intersecting the upper portion of said hole; means in the upper portion of the other end wall providing a shaft bearing coaxial with said hole; an actuator screw having smooth end portions, one of which is freely rotatably received in said hole and the other of which is journaled in said shaft bearing, so that the screw extends from end wall to end wall, the axis of the hole and shaft bearing being so disposed that the screw is located between the planes of the side walls and at an elevation above the upper edges of the side walls; a head on the actuator screw bearing against the outer face of the end wall which has the hole therethrough; means providing a shoulder on the shaft facing its head and positioned to lie in a plane between the inner and outer faces of said transverse slot; a bowed leaf spring in the slot confined between said shoulder and the outer face of the slot to hold the screw in place; a resistance element loosely overlying the inner face of one of said side walls with its ends contiguous to the end walls; a stationary contact element overlying the inner face of the other side wall opposite the resistance element and also having its ends contiguous to the end walls; a T-shaped retainer overlying the inner face of each of the end walls to hold the resistance element and the stationary contact element in place, said retainers having their stems confined between said elements and their heads engaging the top edges of the elements; shoulders on the screw engaging the retainers to coact with the confinement of the stems of the retainers between the elements in holding the retainers in place; a contactor carrier having a threaded connection with the actuator screw; and a bridging contactor mounted on the carrier and having resilient fingers bearing upon the resistance element and the stationary contact element.

5. The adjustable resistor of claim 4, further characterized by the provision of abutments projecting up from the bottom wall and engaging the inner faces of said elements medially of the ends thereof, to hold the medial portions of said elements flat against their respective side walls and thus coact with the T-shaped retainers in securing the elements in place.

6. The adjustable resistor of claim 4, further characterized by the fact that the end wall at which the shaft bearing is located has deep pockets opening to its inner face and upwardly opening grooves extending across the top of said end wall lengthwise of the body from said inwardly opening pockets to provide conductor raceways; terminal portions on said elements received in said pockets; and lead-in conductors in said raceways connected to said terminal portions.

7. A contactor assembly for an adjustable resistor comprising a carrier member having a screw threaded hole therethrough and opposite sides parallel to the axis of

the threaded hole; said opposite sides having inwardly directed ledges; and a unitary stamping of sheet metal having upper and lower U-shaped portions, the upper U-shaped portion embracing the carrier member and having the extremities of its arms bent inwardly over the ledges on the carrier member to hold the stamping to the carrier member, the bight of the lower U-shaped portion being joined to and extending perpendicularly from one end of the bight of the upper U-shaped portion so that the two U-shaped portions are at right angles to one another, and the arms of the lower U-shaped portion being biased outwardly away from one another and providing the contact fingers of the contact assembly.

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