Sept. 27, 1960 E. BLANCO 2,954,539

VARIABLE RESISTOR

Filed May 27, 1957

Fig. 1.

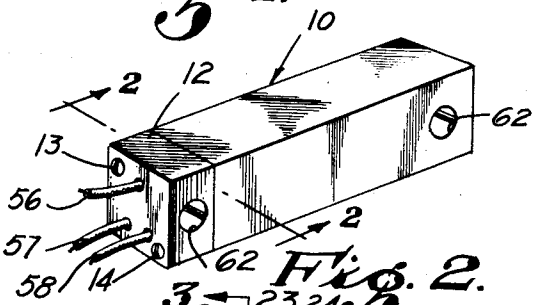


Fig. 2.

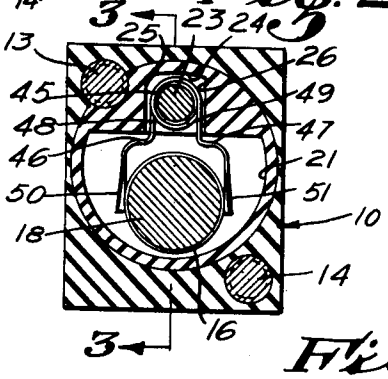


Fig. 4.

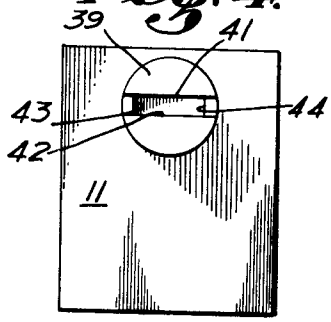


Fig. 3.

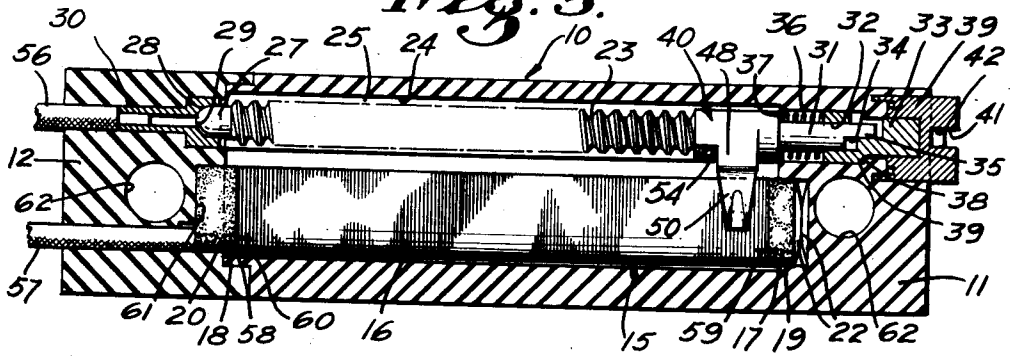


Fig. 5.

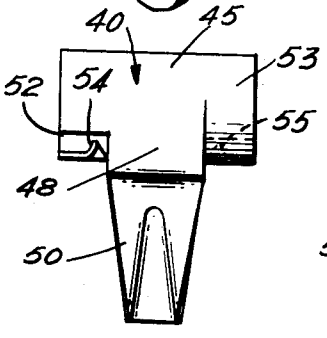
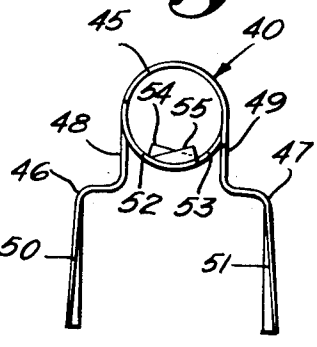


Fig. 6.



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VARIABLE RESISTOR

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4 Claims. (Cl. 338—7)

The present invention relates generally to variable resistors or potentiometers, and is more particularly concerned with devices of this type which may be built in miniature or extremely small size, and yet have stable characteristics under relatively extreme changes in operating conditions.

It is one object of the herein described invention to provide a variable resistor which will have a high degree of accuracy, and which will retain its stability under extreme temperature variations.

A further object of the invention is to provide a variable resistor wherein the resistor and wiper mechanism are associated and supported in such a way that inaccuracies due to strain gauge effect will be eliminated.

A further object is to provide in a miniature or extremely small size resistor of the character considered herein, a unique clutch between the wiper contact and its actuating mechanism.

A still further object is to provide a unitary clutch and wiper assembly which may be constructed from a flat sheet of material.

Another object of the invention is to provide a unique wiper having a double contact construction for engaging diametrically opposite sides of the resistance element, so as to provide increased stability under acceleration conditions and during periods of vibration such as might be met with in aircraft or in guided missiles.

Still another object is to provide in such resistors an improved manually adjustable element adapted to receive an adjusting tool such as a screw driver, and wherein the tool will be retained against inadvertent displacement while making adjustments.

Further objects of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing the invention without placing limitations thereon.

Referring to the accompanying drawings, which are for illustrative purposes only:

Fig. 1 is a perspective view of a variable resistor embodying the features of the present invention;

Fig. 2 is a transverse section taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a longitudinal section taken substantially on line 3—3 of Fig. 2, certain parts being shown in elevation to clarify the cooperative relationship;

Fig. 4 is an end elevational view showing means for manually adjusting the resistor;

Fig. 5 is an enlarged side elevational view of the wiper assembly; and

Fig. 6 is an end view of the same.

Referring more specifically to the drawings, for illustrative purposes, the variable resistor is shown in Fig. 1 as being housed within a hollow boxlike structure, as generally indicated at **10**. This structure forms a casing for the component parts of the resistor and may be constructed of molded plastic or fabricated from other suitable insulating material. The casing is constructed with an integrally formed end wall **11** at one end, while the other end is open ended, this latter end being closed by means of an end wall **12** which forms a terminal block and is removably secured in a position closing this end of the structure by suitable retaining screws **13** and **14**.

A resistance element **15** is supported within the casing, the resistance element comprising a fine resistance wire without insulation which is coiled around an insulated outer surface **17** of an elongate mandrel **18**. The ends of this mandrel are supported in sockets **19** and **20** respectively formed in the end walls **11** and **12**. These sockets support the mandrel at its ends and retain the resistance element against lateral displacement within a main compartment **21**, and out of contact with the surrounding compartment wall. The mandrel, however, is preloaded in an axial direction by means of spring washers **22** positioned within the socket **19** between the adjacent end of the mandrel and the bottom of the socket so as to resiliently bias the mandrel in a direction to cause its opposite end to forceably abut and bear against the bottom of the socket **20**.

As shown in Figs. 2 and 3, an elongate screw **23** extends along side the resistance element, this screw and resistance element having their longitudinal axes in parallel relation. The screw **23** extends through an auxiliary channel **24** formed in the structure **10** and having parallel spaced side walls **25** and **26**.

One end of the screw **23** is formed with an extension **27** having its end surface rounded as indicated at **28**. This end is seated within a socket **29** formed in the head portion of a pickoff which thus rotatably supports this end of the screw and also serves as a terminal connector therewith.

The other end of the screw **23** is formed with an end extension **31** which is positioned at its outer end in a socket **32** of a coupler **33** supported in the end wall **11** for rotational movement. The end extension **31** and coupler **33** have overlapped surfaces **34** and **35** which interlock these two elements together for unitary rotational movement yet permit slight relative axial movements therebetween. As in the case of the mandrel **18**, the screw **23** is likewise preloaded. For this purpose, a coiled compression spring **36** is positioned around the end extension **31**, one end of this spring bearing against an abutment washer **37** carried by the screw **23**, and the other end of this spring bearing against the adjacent end of the coupler **33**. The action of this spring is to force an abutment shoulder **38** on the coupler **33** against a shoulder **39** formed in the end wall **11**. At the same time, the spring biases the screw **23** in a direction to retain the extension **27** in pressure seated position in the socket **29**.

The outermost end of the coupler **33** carries a cap member **39** which projects outwardly from the end face of the end wall **11** and provides means by which the screw **23** may be rotated to move associated resistance wiper means **40** therealong. The projecting end of the cap **39**, as shown in Fig. 4, is provided with a transversely extending slot **41** for the reception of a suitable adjusting tool such as a screw driver. The making of adjustments is further facilitated by providing a recessed bottom portion **42** between the ends of the slot **41**, whereby spaced abutment surfaces **43** and **44** are formed adjacent and inwardly spaced from the respective ends of the slot **41**. The adjusting screw driver may be inserted within the recessed bottom portion **42** and will be held against axial displacement via the ends of the slot by the abutment surfaces **43** and **44**.

The wiper means **40** is of unique construction in that it may be fabricated from a flat sheet of resilient material having good electrical conducting characteristics. The blank is deformed to provide a tubular portion **45**, Figs. 5 and 6, which surrounds the threads of the screw **23** and is slidable therealong. Integrally formed arms **46**

and 47 extend from the opposite ends of a diameter of the tubular portion. These arms respectively have tangentially extending portions 48 and 49 which are in parallel relation and connect with outwardly offset portions 50 and 51. As shown in Fig. 2, the portions 48 and 49 extend into the auxiliary channel 24 and cooperate with the side walls 25 and 26 thereof to retain the tubular portion against rotation with the screw 23, while the portions 50 and 51 are respectively disposed on diametrically opposite sides of the mandrel 18 and form contacts resiliently engaging with the resistance wire 16. With this construction, the wiper means and resistance wire engaging contacts are effectively stabilized against displacement due to vibrations etc.

The wiper means has a unique clutch connection with the threads of the screw 23. The opposite ends of the tubular portion 45 is fabricated with oppositely extending resilient curved arms 52 and 53 which conform generally to the curvature of the tubular portion 45. The outermost end of the arms 52 and 53 are respectively deformed to provide inwardly extending projections 54 and 55 which are arranged to be normally positioned between adjacent threads of the screw 23. With this arrangement, under normal conditions rotation of the screw will cause the wiper means to be axially moved along the screw and carry the contacts 50 and 51 into engagement with successive turns of the resistance wire. However, when the limits of travel of the wiper means takes place, the tubular portion will abut the end wall 11 or end wall 12, as the case may be. At these limit positions, further attempt to move the wiper means in a direction of the abutment by rotating the screw 23 will cause the threads to act with a cam action against the projections 54 and 55, flexing the arms 52 and 53 so as to disengage these projections from the threads. Movement of the screw 23 in a direction to motivate the wiper means away from the abutment will permit the projections to function in normal manner for movement of the wiper means.

Connections are made to the device by means of conductors 56, 57 and 58, as shown in Fig. 1, these conductors being carried through passages formed in the end wall 12. As shown in Fig. 3, the conductor 56 is connected with the pickoff terminal so that an electrical path is established through the pickoff, the screw 23 and the wiper means to the coil turns of the resistance wire 16 wound on the mandrel 18.

The wire 57 is shown as being connected to one end of the mandrel 18 which serves as a conductor for completing an electrical path from this conductor through the mandrel which is connected through a soldered or otherwise formed connection 59 between one end of the resistance wire and the mandrel. The conductor 58 is shown as being connected through a soldered or otherwise formed connection 60 by which an electrical flow path is established with the other end of the resistance wire.

Further stability is obtained due to the loading effect of the springs 22 and 36 on the mandrel 18 and screw 23 respectively, and since these elements are supported at their ends, the material constituting the elements is free to expand and contract under temperature variations. Since there are no adhesives or other anchoring means utilized along the mandrel or screw, objectionable strain gauge effects and errors resulting therefrom will be avoided.

Moreover, it should be pointed out that the bottom surface of the socket 20, as indicated by the numeral 61, is substantially in the same transverse plane as the surface 28. By constructing the mandrel 18 and the screw 23 of materials having substantially the same coefficient of expansion, variations of the mandrel and screw with respect to the reference plane of the surfaces 61 and 28 will be of the same order, and relative movement between the screw and mandrel due to temperature changes will be susbtantially eliminated so that greater accuracy will be obtained and the device will be stable under widely varying temperature conditions. Copper alloys have been successfully utilized for the construction material for the mandrel and the screw.

In some installations, it is desirable that the variable resistors of the type disclosed herein be arranged for mounting in stacked superposed relation. In the present instance, the ends walls 11 and 12 are provided with holes 62 for receiving posts (not shown) upon which the resistors may be stacked and secured in superposed relation.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of my invention, and, hence, I do not wish to be restricted to the specific form shown or uses mentioned except to the extent indicated in the appended claims.

I claim:

1. A variable resistor, comprising: a support; a mandrel; a resistance element carried by said mandrel; an elongate screw, said screw and mandrel each having one end restrained in said support against axial movement in one direction; resilient loading means associated with the other ends of said screw and mandrel applying pressure thereto in said one direction, but permitting corresponding expansion and contraction of said screw and mandrel with respect to said support at said one end in response to ambient temperature changes; and movable wiper means actuated by said screw having contact with said resistance element, said mandrel and screw being constructed of materials having substantially the same coefficient of expansion.

2. A variable resistor, comprising: a support; a mandrel; a resistance element carried by said mandrel; an elongate screw extending along one side of said mandrel, said screw and mandrel having substantially the same coefficient of expansion; abutment surfaces carried by said support providing points of abutting engagement for the adjacent ends of said screw and said mandrel, said points of engagement lying substantially in a common plane at right angles to the longitudinal axis of said screw and mandrel; movable wiper means actuated by said screw having contact with said resistance element; and spring means associated with the other ends of said screw and mandrel for applying a load biasing pressure thereon in a direction towards said abutment surfaces, whereby said screw and mandrel are free to expand and contract together without disturbing the wiper setting relative to said resistance element.

3. A variable resistor, comprising: a housing defining an elongate main compartment extending between end walls; an elongate mandrel having its ends respectively supported in said end walls; a resistance element carried by said mandrel; an auxiliary channel extending between said end walls, said channel having spaced side walls on opposite sides of an elongate opening facing said resistance element; a screw in said channel having its ends rotatably supported in said end walls, said screw being rotatable from the exterior of one of said end walls; and wiper means carried by said screw including a pair of arms having outer ends resiliently contacting said resistance element on opposite sides of said mandrel, and inner end portions respectively lying in close proximity to said side walls, whereby said wiper means are stabilized laterally.

4. A variable resistor, comprising: a housing defining an elongated main compartment extending between end walls; an elongate mandrel having its ends respectively supported in said end walls and retained at one of said end walls against axial movement in a direction towards the same; a resistance element carried by said mandrel; an auxiliary channel extending between said end walls, said channel having spaced side walls on opposite sides of an elongate opening facing said resistance element;

a screw in said channel having its ends rotatably supported in said end walls and retained at said one of said end walls against axial movement in a direction towards the same, said screw and mandrel being constructed of materials having substantially similar coefficients of expansion; means at the other of said end walls spring loading said screw and mandrel in an axial direction towards said one of said end walls; means for rotating said screw from the exterior of said housing; and wiper means carried by said screw including a pair of arms having outer ends resiliently contacting said resistance element on opposite sides of said mandrel, and inner end portions respectively lying in close proximity to said side walls, whereby said wiper means are laterally stabilized.

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