March 21, 1939. E. O. THOMPSON 2,151,625

VARIABLE RESISTOR

Filed March 6, 1936

Fig. 2.

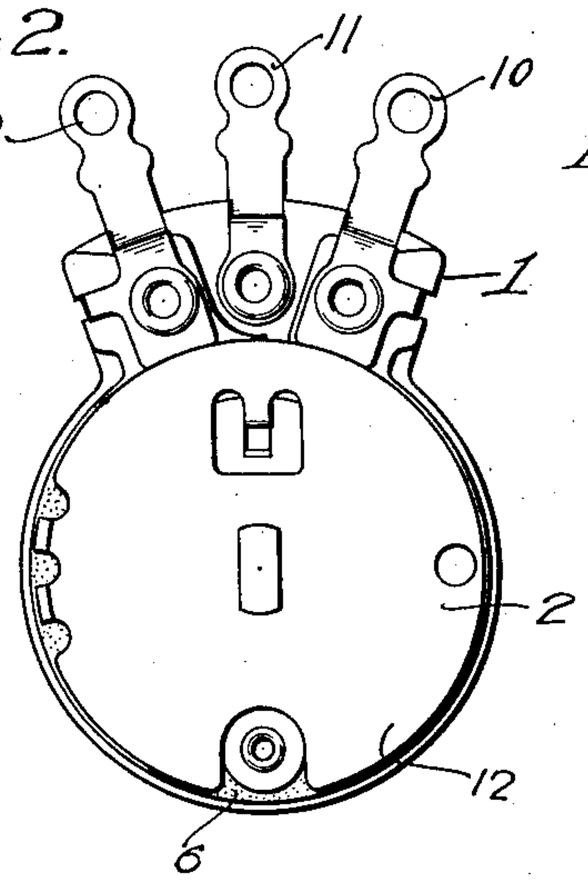


Fig. 1.

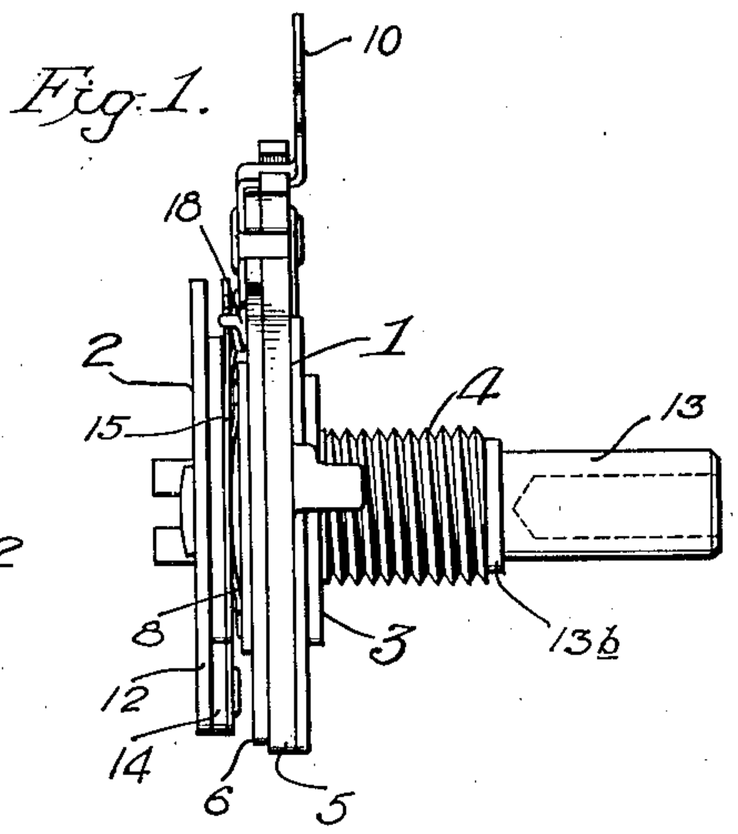


Fig. 4.

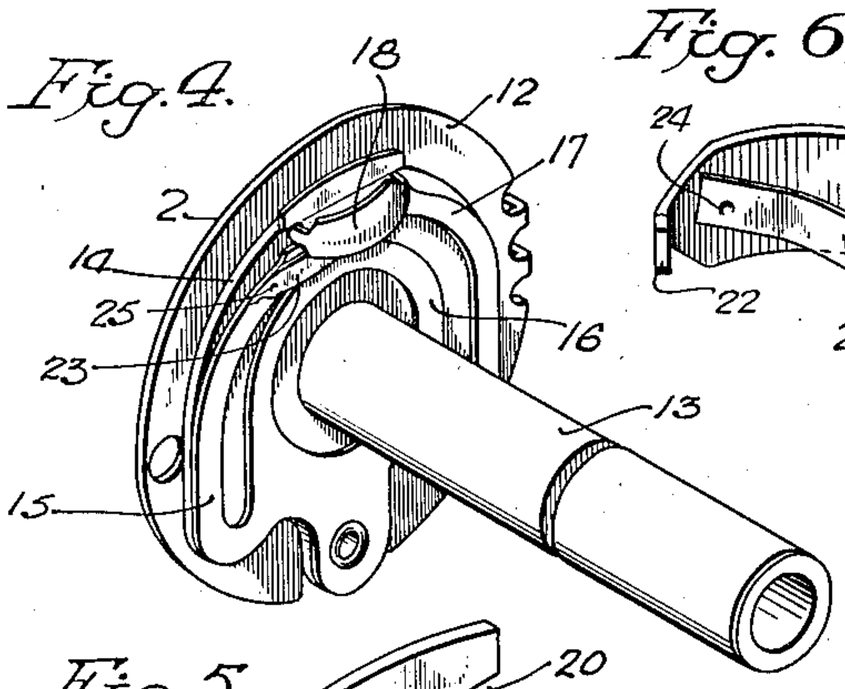


Fig. 6.

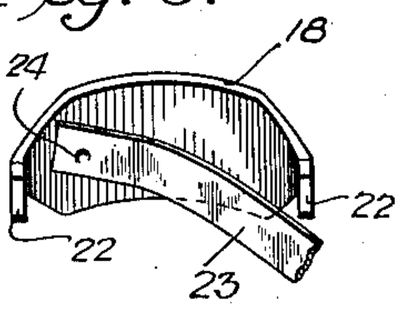


Fig. 3.

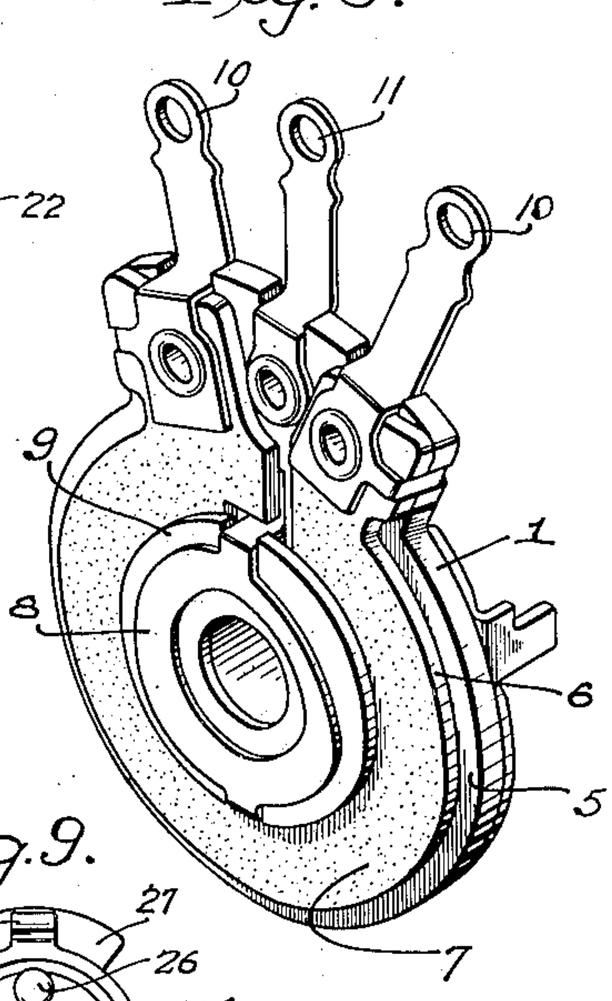


Fig. 5.

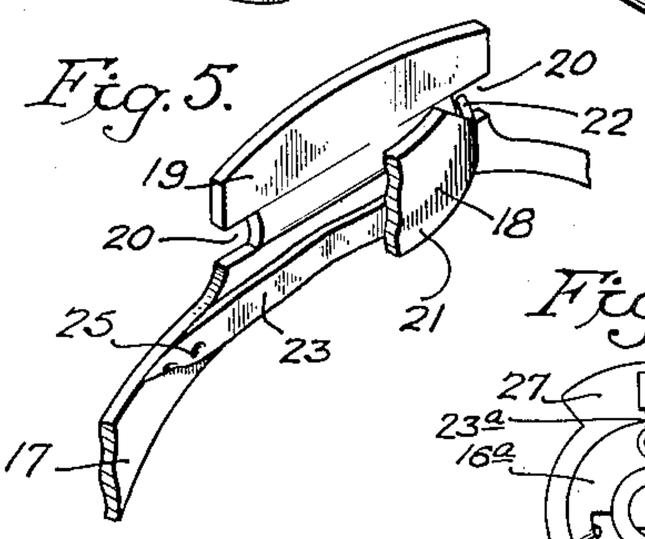


Fig. 8.

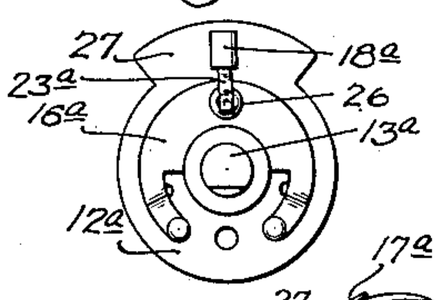


Fig. 9.

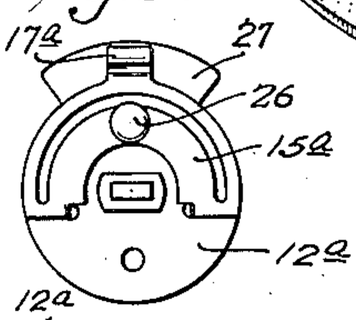


Fig. 10.

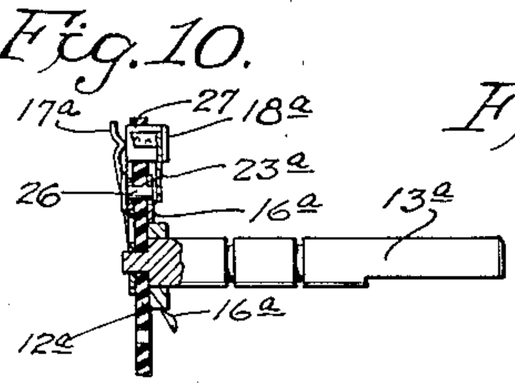
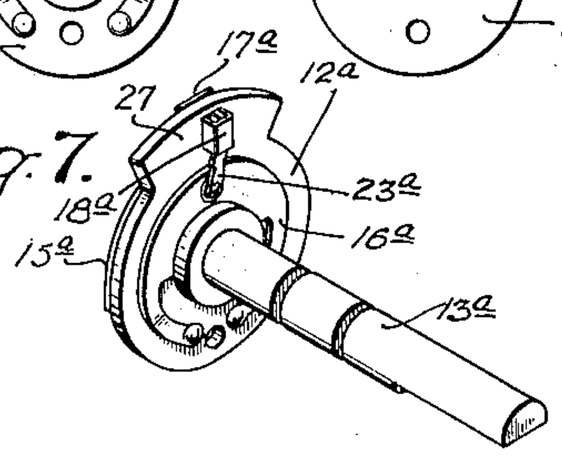


Fig. 7.



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UNITED STATES PATENT OFFICE

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VARIABLE RESISTOR

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Application March 6, 1936, Serial No. 67,531

6 Claims. (Cl. 201—55)

This invention relates to variable resistance devices, such as are commonly employed in radio apparatus and the like. One type of variable resistor which has come into wide use in radio apparatus, particularly as a volume control device, comprises a carbonized resistance surface and a floatingly mounted contact element or shoe slidably engaging the said surface and pressed thereagainst by a resilient electrically conductive member, the contact element being free of direct attachment to the said member so that the electrical connection between these parts is obtained solely by the engagement of the parts. By virtue of the loose or floating mounting of the contact element or shoe, this element is enabled to follow the contour of the resistance surface and is maintained in good electrical contact with the surface throughout the contact area of the said element.

Resistors of this type, however, when employed in radio apparatus as volume control devices for example, exhibit a tendency to become noisy; that is, after they are in use for some time, such resistors tend to cause electrical oscillations which are reproduced as noise by the receiver. Heretofore it has been thought that the noise was due to some condition which developed at the contact of the shoe with the carbonized resistance surface, and much effort has been directed toward the prevention of development of this supposed deleterious condition. Such effort has failed to solve the problem, however, and the noisy condition has continued. I have discovered that the noise is caused by variations in the electrical contact between the contact element or shoe and the conductive member associated therewith as above mentioned. The variation in the electrical contact between these parts introduces a variation in the contact resistance between them. This is due to a large extent to the high contact resistance caused by oxidation of the metallic surfaces of the said parts which oxidation gradually takes place during use of the device.

It will be obvious that it is highly desirable to eliminate this defect, since it not only varies the electrical characteristics of the resistor but also gives rise to the objectionable noisy operation above mentioned. By the present invention, there is provided a simple and effective method of eliminating this defect by providing a thin flexible electrically conductive strip connected between the said contact element or shoe and the resilient conductive member pressing thereagainst, the said strip serving to electrically connect these parts and eliminating the dependence upon the physical engagement of the parts for electrical connection thereof.

The object of the invention is, therefore, to provide an improved resistor of this type wherein the objectionable feature above noted is eliminated by the provision of a simple electrical bond between the offending parts, which bond in no way interferes with the loose or floating mounting of the contact element or shoe or with the functioning of this element in cooperation with the resistance surface.

The invention may be clearly understood by reference to the accompanying drawing illustrating certain forms of resistors of this general type embodying the present invention.

In the drawing:

Fig. 1 is a side elevational view of one type of variable resistor embodying the invention;

Fig. 2 is a face view of this device, as viewed from the left in Fig. 1;

Fig. 3 is a perspective view of the stationary part of the device;

Fig. 4 is a perspective view of the movable or rotating part of the device;

Figs. 5 and 6 are fragmentary detail perspective views illustrating more clearly the feature of the invention;

Fig. 7 is a perspective view of the rotating part of an alternative form of the resistor embodying the present invention;

Fig. 8 is a face view of the same;

Fig. 9 is an opposite face view of the same part; and

Fig. 10 is a partial sectional view serving to more clearly illustrate the inventive feature.

Referring particularly to Figs. 1 to 4 of the drawing, the variable resistor or potentiometer illustrated comprises a stationary part or structure 1 and a rotating part or structure 2. The part 1 comprises a metal disk 3 carrying an extended threaded sleeve 4 at one side and an insulating disk 5 on its opposite face. The disk 5 may be formed of "Bakelite" or any other suitable insulating material. On the front face of the disk 5, as viewed in Fig. 3, there is provided a ring or disk 6 of insulating material having an annular carbonized high resistance surface 7. The member 6 is provided with the carbonized surface 7 in a manner well known and commonly practiced in the art. A resilient metallic ring 8 is also carried by the supporting disk 5 and is insulated from the resistance surface 7 by means of an insulating ring or washer 9. The terminals of the device are carried by the supporting disk

5, as clearly illustrated, the outer terminals 10 being electrically connected to the ends of the resistance surface 7, while the inner terminal 11 is electrically connected to the ring 8.

The rotating part of the device, as shown clearly in Fig. 4, comprises a supporting plate 12 mounted on the end of shaft 13, which shaft extends through the central opening in the stationary part when the device is assembled, as clearly shown in Fig. 1. An insulating plate or disk 14 is loosely mounted on the shaft 13 and is interlockable with plate 12 by a lug and recess (not visible). The plate 14 carries a conductive member 15 having an annular portion 16, which engages the ring 8 of part 1, and also having a resilient or springy U-shaped portion 17 which loosely or floatingly carries a contact element or shoe 18 which may be gold plated. When the parts are assembled, the contact element or shoe 18 is pressed into engagement with the resistance surface 7. Thus the surface of the ring 16 is continually in contact with the resilient ring 8 and the shoe 18 is held against the resistance 7 by the resilient member 17. The shaft 13 is held in place by a key seated in a slot of the shaft, as shown clearly at 13*a* in Fig. 1. The resilient portion 17 is formed with a head 19 and opposed recesses 20 so as to loosely position or floatingly seat the contact shoe 18. The contact shoe is formed with an arcuate body 21 and inwardly extending diminished end portions 22 which seat in the recesses 20. In the manufacture of the carbonized resistance surface 7, this surface is made as smooth and flat as possible. Such a surface does, however, have a slight tendency to warp out of shape. In order to minimize variations in contact resistance and to allow for uniform wearing of the surface, it is essential to cause the shoe to contact the surface along a radial line which extends across the surfaces. This is done by forming the shoe 18 to have the curved surface, as shown, and by mounting the shoe so that it can twist or rotate about the points 20 where it is held to the arm 17. In this way the shoe 18 is held against the surface of 7 so as to be in contact therewith all the way across its width rather than at a single point.

As above pointed out, heretofore the electrical connection between the contact shoe 18 and the conductive member 15 has depended solely upon the physical engagement of these parts when the shoe is pressed against the resistance surface by the resilient portion 17. This has resulted in the objectionable condition above mentioned. In accordance with the present invention, there is provided a thin, flexible, metallic strip 23 having one end attached to the contact shoe preferably by spot welding, as shown at 24, and having its other end attached to the conductive member 15 also preferably by spot welding, as shown at 25. This strip is preferably formed of nickel, although it will be apparent that it may be formed of any suitable material capable of serving the purpose of the invention. By virtue of its flexibility and lightness in weight, this strip does not interfere with the floating mounting of the contact shoe, nor does it interfere with the normal functioning of the shoe in cooperation with the resistance surface. The strip provides an electrical bond between the contact shoe and the member 15, thereby eliminating the variable electrical association of these elements which has heretofore been relied upon and which has caused the objectionable defect above mentioned. By the present invention, the noisy condition characteristic of prior device is entirely eliminated and the electrical characteristics of the resistor are preserved.

In Figs. 7 to 10, there is illustrated another form of resistor embodying the invention. As shown, the rotating part of this resistor comprises a shaft 13*a* carrying a supporting insulating plate or disk 12*a*. On one side of the disk 12*a*, there is secured a metallic ring 16*a* which is adapted to cooperate with a corresponding element on the stationary part of the device. On the opposite side of the disk 12*a*, there is provided a metallic member 15*a* electrically connected to the ring 16*a* by means of a rivet 26 or the like. The supporting disk 12*a* is provided with an extension 27 having an aperture therein to seat the ends of a U-shaped contact element or shoe 18*a*. Thus, the contact shoe is loosely or floatingly carried by the disk 12*a*. The member 15*a* is provided with a resilient portion 17*a* which engages the contact shoe and presses it against the resistance surface when the device is assembled.

In accordance with the present invention, there is provided a thin flexible strip 23*a* secured to the shoe 18*a* and to the rivet 26 preferably by spot welding. This element is similar to and performs the same function as the corresponding element in the device above described.

From the illustration and above description, it will be seen that the invention provides a simple and effective method of overcoming the defect in variable resistors which caused a large part of the electrical noise generated therein. At the same time, the simple electrical bonding means provided by the invention does not in any way interfere with the normal functioning of the device. The devices illustrated are conventional devices of this type of resistor to which the present invention has been applied and which have been found to operate in a materially improved manner by virtue of the invention. It will be understood, of course, that the invention is applicable to any variable resistance device of this general character and is not limited to the specific embodiments illustrated for the purpose of disclosure.

I claim:

1. In a variable resistor for radio apparatus and the like, a stationary part comprising a substantially annular resistance element of the carbon surface type, and a rotatable part comprising an electrically conductive element, a contact shoe loosely carried by said rotatable part free of direct attachment thereto, resilient means on said rotatable part for pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the rotatable part, and a flexible electrical connection between said shoe and said conductive element and positively connected to both the shoe and said conductive element for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

2. In a variable resistor for radio apparatus and the like, a stationary part comprising an annular resistance element of the carbon surface type, an annular contact element insulated from said surface, and separate terminals for said surface and said element, and a rotatable part comprising a rotatable shaft extending centrally through said stationary part, contact means carried by said rotatable part and engaging said annular contact element so as to wipe over the same during rotation of said shaft, a

contact shoe loosely carried by said rotatable part free of direct attachment thereto, a resilient member attached to said contact means for pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the shaft, and a flexible electrical connection between said shoe and said contact means and positively connected to both the shoe and contact means for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

3. In a variable resistor for radio apparatus and the like, a stationary part comprising an annular resistance element of the carbon surface type, an annular contact element insulated from said surface, and separate terminals for said surface and said element, and a rotatable part comprising a rotatable shaft extending centrally through said stationary part, contact means carried by said rotatable part and engaging said annular contact element so as to wipe over the same during rotation of said shaft, a contact shoe loosely carried by said rotatable part free of direct attachment thereto, a U-shaped resilient member attached to said contact means for pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the shaft, and a flexible electrical connection between said shoe and said contact means and positively connected to both the shoe and said contact means for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

4. In a variable resistor for radio apparatus and the like, a stationary part comprising an annular resistance element of the carbon surface type, an annular contact element insulated from said surface and separate terminals for said surface and said element, and a rotatable part comprising a rotatable shaft extending centrally through said stationary part, a contact element carried by said rotatable part and engaging said annular contact element so as to wipe over the same during rotation of said shaft, a resilient member carried by said last-mentioned contact element, a contact shoe loosely carried by said resilient member free of direct attachment thereto, said resilient member pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the shaft, and a flexible electrical connection between said shoe and said resilient member and positively connected to both the shoe and said resilient member for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

5. In a variable resistor for radio apparatus and the like, a stationary part comprising an annular resistance element of the carbon surface type, an annular contact element insulated from said surface, and separate terminals for said surface and said element, and a rotatable part comprising a rotatable shaft extending centrally through said stationary part, a contact element carried by said rotatable part and engaging said annular contact element so as to wipe over the same during rotation of said shaft, a U-shaped resilient member carried by said last-mentioned contact element and having an extension with opposed recesses, an arcuate contact shoe having ends seated in said recesses to thereby loosely mount said shoe on said resilient member free of direct attachment thereto, said resilient member pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the shaft, and a flexible electrical connection between said shoe and said resilient member and positively connected to both the shoe and said conductive element for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

6. In a variable resistor for radio apparatus and the like, a stationary part comprising an annular resistance element of the carbon surface type, an annular contact element insulated from said surface, and separate terminals for said surface and said element, and a rotatable part comprising a rotatable shaft extending centrally through said stationary part, an insulating disk carried by said shaft, a contact element on one side of said disk engaging said annular contact element so as to wipe over the same during rotation of said shaft, a contact shoe seated loosely in an aperture in said disk free of direct attachment thereto, a resilient member on the opposite side of said disk attached to said last-mentioned contact element, said resilient member pressing said shoe into engagement with said annular surface to cause the shoe to ride on said surface during rotation of the shaft, and a flexible electrical connection between said shoe and said last-mentioned contact element and positively connected to both the shoe and said conductive element for preventing noise in said radio apparatus incident to the loose mounting of said shoe while maintaining a floating mounting of the shoe.

ELMER O. THOMPSON.