Sept. 12, 1933. E. G. LODGE 1,926,206

VOLUME CONTROL DEVICE

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Fig. 1.

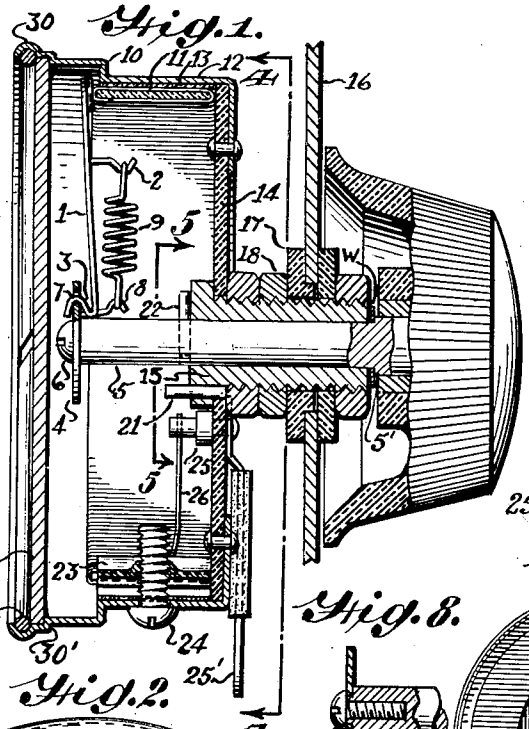



Fig. 6.

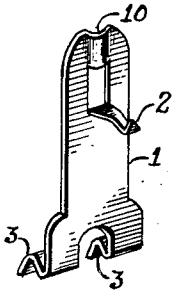



Fig. 5.

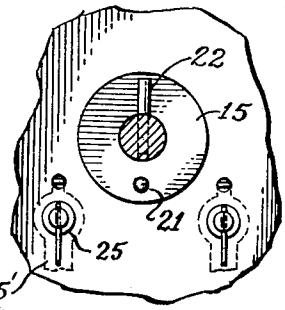



Fig. 7.

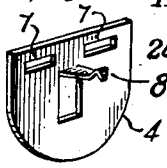



Fig. 8.




Fig. 4.

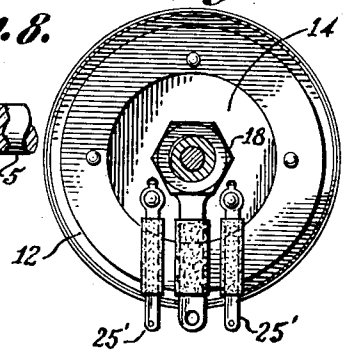



Fig. 2.

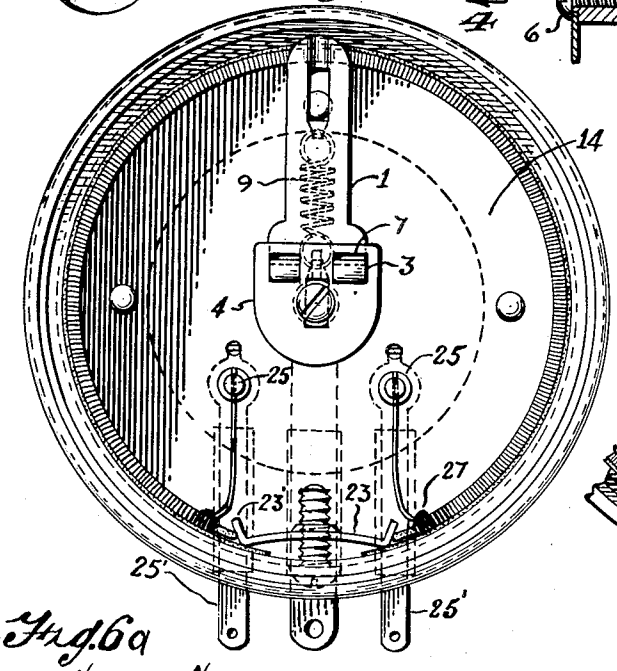



Fig. 3.

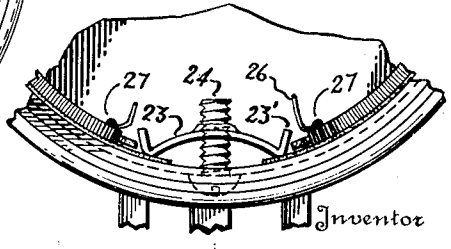
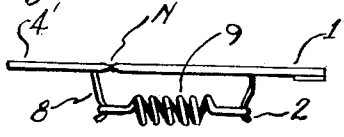



Fig. 6a




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Fig. 9.

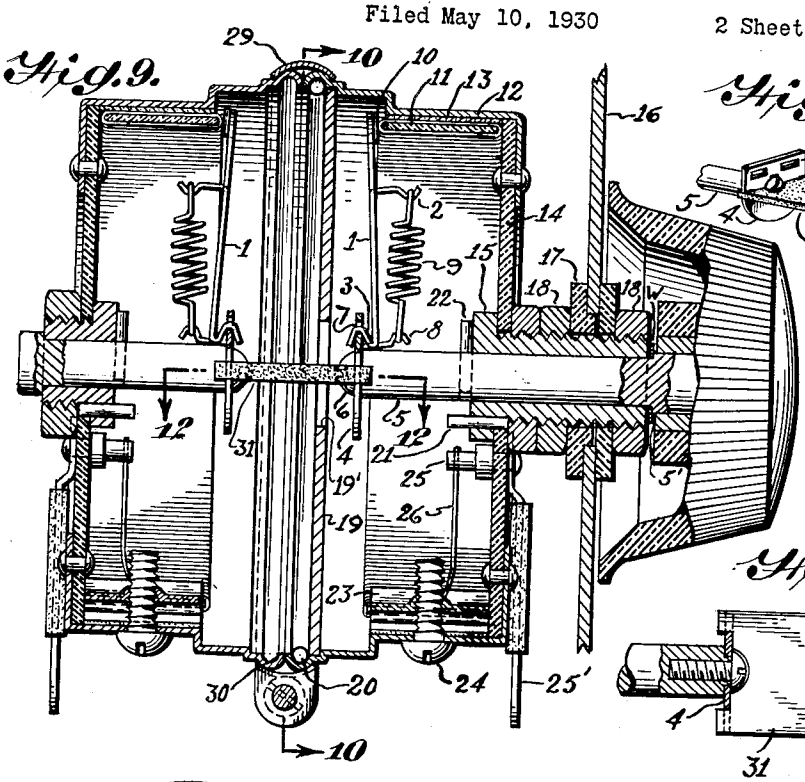



Fig. 11.

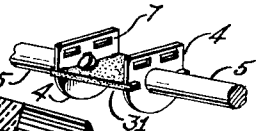



Fig. 12.




Fig. 10.

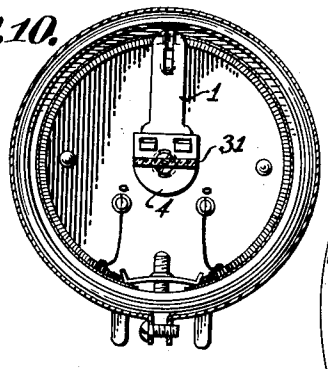



Fig. 13.

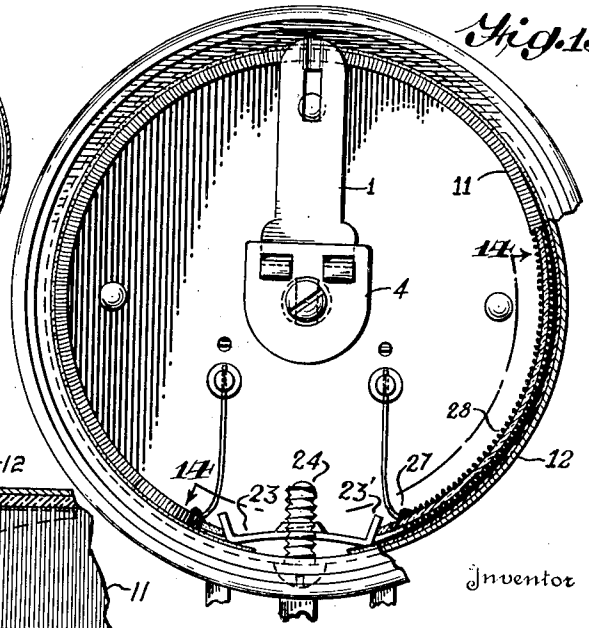
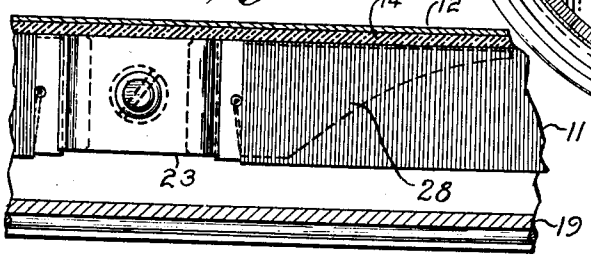



Fig. 14.




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# UNITED STATES PATENT OFFICE

1,926,206

## VOLUME CONTROL DEVICE

Edmund Gilbert Lodge, Oak Lane, Pa., assignor to Hugh H. Eby, Philadelphia, Pa.

Application May 10, 1930. Serial No. 451,326

9 Claims. (Cl. 201—55)

My invention relates to variable resistors, particularly the type used for controlling volume of reproduction in radio receiving circuits.

One of the objects of my invention is to provide a variable resistor or potentiometer which when used for control of volume in a radio circuit gives quietness of operation and which has a long life of useful operation.

Another object of the invention is to provide a simplified rugged structure which is easily and cheaply made, being particularly adapted to quantity production, and requiring practically no subsequent repair.

Other objects of the invention will appear as the description progresses. In the drawings:

Fig. 1 shows a side elevation view of a completely assembled variable resistor embodying several features of the invention.

Fig. 2 is a bottom view of the resistor, the bottom cover plate of Fig. 1 being removed.

Fig. 3 is a fragmentary view corresponding to Fig. 2 except that it illustrates an unfinished operation.

Fig. 4 is a section, reduced in size, of Fig. 1 taken on line 4—4.

Fig. 5 is a fragmentary section of Fig. 1 taken on line 5—5.

Fig. 6 is a perspective view of my novel contact arm for the resistor.

Fig. 6—*a* is a side view of a modified form of contact arm.

Fig. 7 is a perspective view of the supporting structure for the arm of Fig. 6.

Fig. 8 shows a sectional view of the end of the resistor shaft of Fig. 1 with the support of Fig. 7 secured thereto.

Fig. 9 is a view similar to Fig. 1 showing structure for combining two resistors for simultaneous operation.

Fig. 10 is a reduced sectional view of Fig. 9 taken on the line 10—10, omitting the partition.

Fig. 11 shows a fragmentary sketch of means for coupling the shafts of Fig. 9.

Fig. 12 is a sectional view of the same means, taken on lines 12—12.

Fig. 13 is a bottom view of the resistor with portions cut away to show one means for obtaining a taper.

Fig. 14 is a sectional view of the resistor element and the taper means, taken on line 14—14 of Fig. 13.

Like reference figures denote the same parts thruout.

Referring to the drawings in detail: 1 represents the contact arm having struck out hook portion 2, and bent back portions 3. Conjugate arm member 4 which is secured to the end of shaft 5 by screw 6, acts as a fulcrum for arm 1, slots or sockets 7 being provided to receive finger portions 3. There is likewise a hook portion 8 struck out from 4, and a coil spring 9 resiliently connects 2 and 8 causing 3 to bear firmly against 7. Contact tip 10 is caused to bear uniformly against the edge of the wire-wound resistor element 11.

Casing 12 is a one-piece metallic stamping, with insulation strip 13 interposed between 11 and said casing. 14 is a disc of insulation fastened as by rivets to housing 12, and supporting the bushing in which the shaft 5 turns. A spring washer W is inserted between shoulder $5^1$ of shaft 5 and the bushing or bearing 15 to give firm contact. The extensive area of 14 between the housing 12 and shaft and bushing or grounded metal panel 16 of the radio set reduces to a minimum the capacitance associated with the resistor. It is desired that such capacitance be reduced to a small value when the resistor is used directly in a radio frequency path for reasons well known in the art. 17 represents insulating washers to insulate the shaft from the metal panel 16, suitable locking nuts 18 being used.

The housing is sealed by means of metallic disc 19 which is secured in place against shoulder $30^1$ by split ring 20 which fits in groove 30. This provides a casing which is practically air tight, and easily accessible. In some instances I have omitted the ring 20 and formed the edge 30 over against 19 applying lacquer to the casing to make a permanent seal.

For best operation I have discovered that the presence of pure mineral oil on the wire and contact surface materially reduces corrosion, gives better electrical contact, smoother mechanical action, and makes for still quieter operation in varying of volume of reproduction. This housing is especially adapted to retain a small amount of oil in the bottom, and the oil is picked up by the end of the rotating arm 1 and distributed around the resistor element.

Abutment pin 21, Figs. 1 and 5, cooperates with pin 22 to limit rotation of the shaft and contact arm 1. Pin 21 extends thru the flange of the bushing 15 into a keyway in disc 14 as shown for purposes of assembly.

Another novel detail in my construction consists in the means for firmly and simply holding the arcuate resistor element 11 in engagement with the walls of the casing. This means consists in a toggle element 23 specifically in the form

of a bowed clamp and screw 24, better shown in Figs. 2 and 3. In place of the screw a rivet may be used or it is possible to simply bend 23 downward relying merely on the set of the metal to hold it. The upturned ends $23^1$ form an acute angle with the core of the resistor element.

As shown in Fig. 3 the resistor element is inserted in the position shown, the lower edge resting on the insulation disc 14. Next the screw 24 is turned, spreading the ends of 23 outward and exerting considerable pressure upon the ends of resistor element 11, forcing said element outward against the walls of casing 12 thruout its length. This firm fit prevents displacement of the risistor element, assists in maintaining the turns of wire in place due to the clamping action between the core of 11 and the lining strip 13, and further allows good heat conduction from the element 11 to the metal casing 12.

Electrical connection is made between the ends of the resistor element and the terminal members 25 and $25^1$, which are carried by disc 14, by means of leads which may be continuations of the wire on the resistor element; in such case at least one of these leads is copper plated to reduce the resistance so that a close approximation to zero is obtainable when the contact arm is in "zero" position. For the sake of ruggedness and lowering of resistance, I prefer to use relatively heavy copper conductors for these leads, soldering to the ends of the resistor element. I have found that there are no ordinary methods of soldering to "nichrome" (nickel-chromium) wire so I prefer to copper plate the end turns of the resistor element, as in application #438,496 to Lodge and Da Costa filed March 24, 1930, and then solder to the copper plating at 27. I also prefer to obtain a taper on one end of the element by a low resistance metallic plating, this being disclosed and claimed in this same copending application. This taper is shown in Figs. 13 and 14, section 28 representing the plated wire.

The construction of my device is such that two of them can readily be combined to operate simultaneously as shown in Fig. 9. Substantially no special apparatus is necessary except a curved band 29 which holds the bases of the housings together at 30, and the insulated coupling element 31 shown in Figs. 9 and 10, and in more detail in Figs. 11 and 12. I have found that in dual volume controls, depending upon their relative positions in a radio circuit, a slight electrical disturbance in one is picked up by the other and amplified in the circuit. To minimize this disturbance I propose to insert one of the plates 19, to act as a shield, in one of the housings, cutting a hole $19^1$ for the coupling element 31. Plate 19 is in electrical contact with the housing. In this combination construction it is frequently advisable to ground the metallic housing, and sometimes it is advisable to do so in the single resistor.

I have found that my improved construction gives a practically noiseless control action. The hinged contact arm actuated by the coil spring causes the arm to bear on the wire with considerable pressure which is uniform. I have found this much superior to the usual construction which depends upon the resiliency of the arm itself to provide the contact pressure. This old type is very critical in adjustment, an axial displacement in the shaft or variation in the level of the resistor element resulting in a large variation in pressure. Furthermore, I have found that for a given contact pressure the action of my improved arm is smoother. Altho very fine wire, e. g. size #38 to #48, is used there is no rupture or displacement of the wires, even with the relatively heavy contact pressure used and operating life tests have shown an equivalent life of several years with imperceptible wear.

While Fig. 1 shows an actual hinge construction it is possible to obtain substantially the same effect by equivalent constructions, for example as shown in Fig. 6—*a*. Here a portion N of the arm is necked in so that the arm is substantially free to flex at this portion. The spring 9 provides most of the contact pressure. It is also possible for manufacturing purposes to make the entire arm of material as thin as portion N, resorting to well known methods of longitudinal ribs or bent edges to strengthen portions $4^1$ and $1^1$.

While I have illustrated my invention in connection with wire-wound resistors it is obvious that the same features of my invention may apply to other types, e. g. the high resistance impregnated paper kind. In Fig. 9, altho both resistors are shown as the wire-wound type, one may be of a different kind.

There may be other modifications made by those skilled in the art without departing from the principle of my invention. I, therefore, do not desire to limit myself to the details shown and described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A housing for a volume control resistor comprising a stamped sheet metal cylindrical wall with an integral inwardly disposed flange portion at one end thereof, an insulation disc extending from wall to wall and secured to said flange portion inside the bend of the flange, a shaft and contact arm rotatably supported in said disc, a resistor strip disposed circumferentially about the inner face of said wall, supported from said wall and insulated therefrom, the lower edge of said strip resting on said disc and terminals on said disc for said resistor.

2. A housing for a volume control resistor comprising a stamped sheet metal cylindrical wall with an integral inwardly disposed flange portion at one end thereof, an insulation disc extending from wall to wall and secured to said flange portion inside the bend of the flange, a resistor element within said housing resting directly on said disc and a shaft bearing a contact arm for said resistor rotatably supported in said disc.

3. A variable resistor comprising a housing having a cylindrical metal wall, a flange portion on one end of said wall, a circular disc of insulation within said housing secured to said flange and forming with said flange an end closure, a shaft rotatably supported in said disc, a shoulder at the other end of said housing and a metallic disc supported by said shoulder and closing the other end of said housing, making a tight joint with said housing.

4. A variable resistor comprising a housing with a cylindrical wall, a circular resistor strip disposed circumferentially on the inner face of said wall and having a space between adjacent ends of said strip, a radially workable member intermediate and engaging said ends, adapted to spread with radial movement and means for partially and progressively straightening the member intermediate the said ends and thereby spread the strip.

5. A variable resistor comprising a housing with a cylindrical wall, a circular resistor strip disposed circumferentially around the inner face of said wall with the ends of said strip adjacent each other, a bowed clamp inside the wall with the concave side thereof facing radially outward and means for compressing said clamp toward said wall to exert pressure endwise on said strip.

6. A contact arm for a variable resistor having a rotating shaft, comprising a pressed metal plate having angularly adjustable screw connection with the shaft on the end of the shaft at the axis thereof, an ear on the plate near the shaft extending some distance back along the shaft, a contact arm portion hinged to the plate for contacting toward its outer end with the resistor, a second ear intermediate the resistor and first ear and a tension spring connecting the ears.

7. A contact arm for a variable resistor comprising a fulcrum plate with slots, said plate having screw connection with the shaft on the end of the shaft at the axis thereof and having an extension near the shaft for some distance back along the shaft, a contact arm member in hinged relation with said plate, having members engaging said slots and having a second extension generally parallel to the first and intermediate the resistor and first extension and a tension spring stretched between the extensions.

8. A contact arm for a variable resistor comprising a fulcrum plate, a contact arm member having bent Z-shaped fingers on the top thereof for engaging said fulcrum plate, a tension spring anchored to the bottom of said plate and said arm member respectively, whereby the latter is maintained in engagement with said fulcrum plate and biased to rotate toward said spring.

9. A contact arm for a variable resistor comprising a fulcrum plate, slots in said plate, a hook member struck out from said plate below the surface thereof, a contact arm member with fingers at one end bent up above the surface thereof and in hinged engagement with said slots, a second hook member struck out from below said arm member and a coil tension spring suspended between said hook members.

EDMUND G. LODGE.