

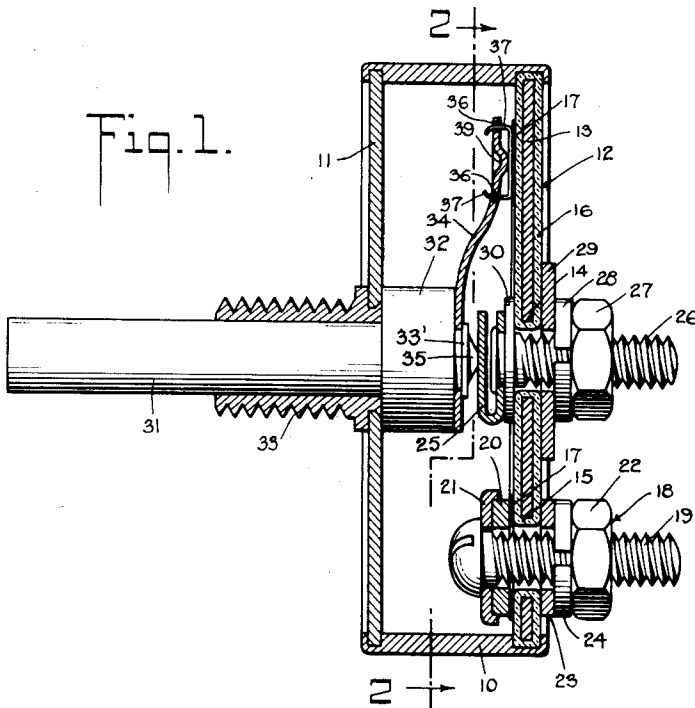
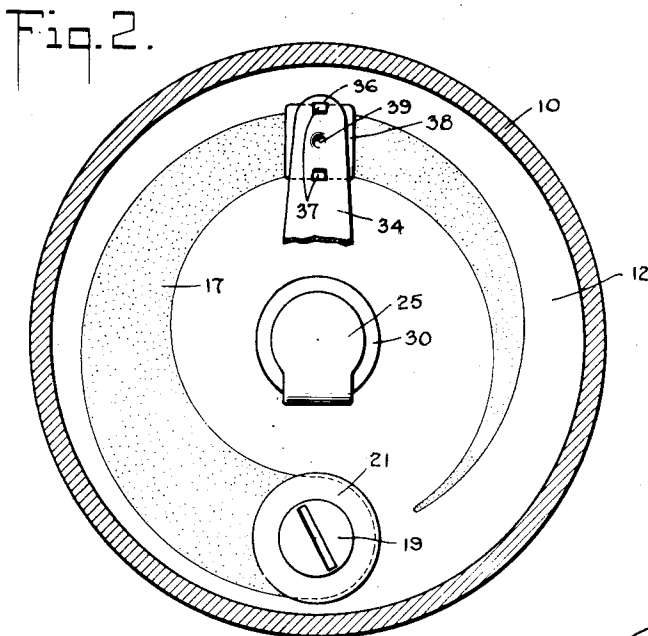
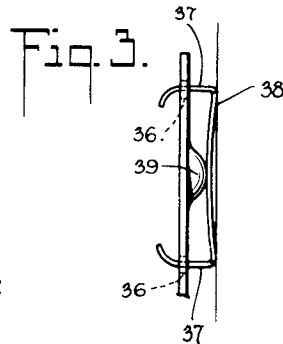
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L. L. JONES

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VARIABLE RESISTOR

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VARIABLE RESISTOR

Application filed May 21, 1927. Serial No. 193,357.

The present invention relates to the construction of variable resistance units, and relates more specifically to the types of continuously variable resistances of the kind having a relatively high maximum resistance and also having a capacity for carrying a relatively high current load.

It is one of the objects of the invention to provide a continuously variable resistance which may be constructed at a very low cost as compared with similar types of continuously variable resistances known hitherto having similar power ratings and resistance values. It is a further object of the invention to provide a resistance of the type described whose resistance value remains constant with time and use.

As is well known, capacity and inductance-free high resistance elements are made in the art by any of a number of methods, such as by impregnating paper strips or other material with various kinds of carbon inks, by surfacing paper or the like with graphite streaks or lines, by painting insulating bases with graphite and other compositions, or by depositing thin films of metal on insulating bases such as glass tubes or the like. These resistances, although compact, inductance and capacity-free, possess a number of disadvantages either in the process of manufacture of the same or in service, the inked and graphited paper resistances being, for instance, quite microphonic, generally destructible in use, and incapable of carrying any considerable current, the metallic film resistances being unstable by reason of the change in the resistance value thereof which takes place due to the crystallization or oxidation of the thin metal film, and the graphited painted or coated resistances being comparatively difficult to make, due to the necessity of compacting the graphite layer by hand or other means. Some of these resistance elements are also open to the common and serious objection that the resistance values thereof for a given type or make vary within wide limits, it being difficult to manufacture the resistances of uniform value, especially where the same are produced by quantity production methods.

The manufacture of resistance units which do not possess the above-stated objections and drawbacks, and which are characterized by being non-microphonic, stable in value or magnitude, of large current-carrying capacity, durable, and capable of being manufactured uniformly in desired values within wide ranges, and especially without the necessity of manual or mechanical compacting operations, is a prime desideratum of my present invention.

Another object of my present invention is to provide a sliding current-carrying contacting device which will offer a large area of contact with the layer of resistance material and will at the same time always dispose itself in such a manner that it will maintain contact with the high resistance layer over a large surface.

The above objects are accomplished by providing a contacting element which has several degrees of freedom of movement and is thereby adapted to follow any irregularities in the surface upon which the resistance material is deposited and thereby always maintain good and sufficient contact over a large area of its surface.

In the drawings, which illustrate one specific embodiment of the present invention:

Fig. 1 is a cross-section of a resistor unit embodying the present invention,

Fig. 2 is a section along the line 2—2 of Fig. 1, and

Fig. 3 is a detailed showing of the sliding contact.

In the drawings, the reference character 10 indicates a cylindrical casing which may be made of metal or any other material if desired, and is provided with the cover 11. The base 12 of the casing comprises a metal plate 13 having a central aperture 14 and another opening 15. The plate is provided with a layer of insulating material 16 covering both sides as well as the edges thereof and the walls of the openings 14 and 15. This base is preferably made by punching a metal plate to the form desired and subsequently subjecting it to an enameling process so that the layer of insulating material is preferably that of baked enamel, and con-

stitutes a hard, smooth and continuous layer covering all parts of the metal plate 13.

The resistor material utilized in the present embodiment of the invention is of the type disclosed in my copending application Ser. No. 167,583, filed on Feb. 11, 1927, and which has issued as Patent 1,773,105, Aug. 19, 1930, and consists of a film of the resistance paint disclosed therein which is applied to the enamel coating 16 and baked thereon at the temperature of approximately 500° centigrade for approximately one hour. The resistance paint comprises finely divided graphite intermixed with aluminum phosphate in a slight excess of phosphoric acid, as more fully described in the above-mentioned patent.

The resistance paint is applied to the baked enamel to give a layer 17 of the form shown in Fig. 2 of the drawings, having its wider portion immediately adjacent the opening 15 and being disposed in substantially circular form and having its other narrower end reach a point spaced from the said opening 15. The layer 17 is so designed that it is wide at the opening 15 and becomes very narrow at the other end of the layer for the purpose of giving a higher resistance variability at the furthest ends of the layer 17.

A terminal 18 is mounted in the opening 15, the terminal comprising a screw 19, a pair of metallic washers 20 and 21 in contact with the resistor layer 17, and a nut 22 as well as lock washers 23 and 24 which serve to hold the terminal in its rigid assembled form.

The base 12 also carries the center contact 25 which consists of a resilient U-shaped element and is held in place by means of the screw 26 and nut 27 and washers 28, 29 and 30.

The cover 11 of the casing 10 carries a rotatable shaft 31 having an enlarged portion 32 which abuts the inner face of the cover 11. The cover 11 also carries the externally threaded sleeve 33 for the proper mounting of the entire unit wherever desired, the shaft 31 being made rotatable within the sleeve 33. Mounted upon the inner end of the shaft 31 and held rigidly thereon by means of the shoulder portion 33' is the rotatable arm 34 made of a resilient conducting material such as phosphor bronze or the like. The shaft is also provided with a cone portion 35 which presses against and always remains in contact with the resilient center contact 25.

The rotatable arm 34 is provided at its free end with a pair of longitudinally disposed apertures 36 adapted to receive the upwardly extending lugs 37 of the contact plate 38. The contact plate 38 is made preferably of a soft non-oxidizing and highly conductive metal such as silver or the like. The

contact plate 38 is preferably made slightly bowed, as shown in Fig. 3, the arch of the bow being of the order of one or two-thousandths of an inch. The lugs 37 of the said contact plate 38 are preferably slightly bent towards each other, as shown in the drawings. The movable arm 34 is provided with a protuberance 39 disposed approximately midway between the openings 36.

When the various units of the device are properly assembled, the arm 34 will be flexed in such a manner that it will exert a substantial pressure against the center of the contact plate 38 by means of the hemispherical protuberance 39 and will thereby force the slightly bowed plate 38 to assume a perfectly flat position or a position which is slightly bowed convexly to a very slight degree, with the result that almost the entire surface of the plate 38 will be forced into intimate contact with the surface of the resistor layer 17 and thereby make it possible to transfer a large current from the contact plate 38 to the resistor layer 17.

It will be seen from the above that the contact plate 38 constitutes a free rider which has several degrees of freedom of motion, partly due to the manner in which it is mounted on the arm 34 and partly due to the fact that the apertures 36 are relatively large as compared with the size of the lugs 37. As the result of this arrangement, the contact plate or rider 38 is capable of adjusting itself to any irregularity in the surface of the enamel or in the surface of the resistor in such a manner that it always maintains a large contact area with the resistor.

The material of the contact plate 38 is chosen with the view in mind of having a contact surface which is softer than the surface of the resistor layer 17. The resultant effect is that no scraping of the resistor layer takes place and the resistance of said layer remains constant throughout the life of the device. Moreover, I have found that after the device has been in use for but a comparatively short period of time, the abrasive action between the contact plate and the resistor layer brings about a deposition and uniform distribution of metallic particles over the surface of the resistor. I have further found that these metallic particles do not affect the resistance value of the resistor and serve to establish a very intimate electrical contact between the contact plate 38 and the resistor layer 17. I therefore take advantage of this quality of my device and I subject the device to a number of oscillations immediately after its assembly, for the purpose of causing the deposition of these metallic particles over the surface of the resistor layer and causing said metallic particles to imbed themselves within the resistor layer. I have further found that there is no tendency

on the part of the silver contact plate 38 to deposit and to form a continuous metal conducting streak along the resistance film.

One of the advantages that flows from the use of the highly conductive and non-oxidizable material such as silver for the contact plate 38 is that it tends to prevent any excessive local heating at the contact area. The absence of partially insulating metallic oxides, together with the high electrical and heat conductivity of the plate 38, contribute to this result.

The high current load which the device constructed in accordance with my invention may carry is due in part to the nature of the resistance film and in part to the construction of the contact plate, and is also due in a large part to the nature of the base on which the resistance film is applied. Any heat that may be generated in the film is easily conducted through the enamel surface to the metal base underneath, which readily dissipates it through the remaining metal parts of the structure. This effectively prevents the generation of any excessive amounts of heat or high temperatures over a small section of the resistance, such as has been found to occur in the resistance units known hitherto. Even when only a relatively small section of the resistance path is in use, practically the entire metal in the base is available for the dissipation of heat formed in that small section.

It will be seen from the above that the prime desideratum of the present invention, which resides in providing a continuously variable resistance device which has a high current-carrying capacity, is due to the cooperation of each of the following factors:

1. A hard and durable high resistance film of the type described in my copending application.

2. A heat conductive metallic body having only a thin layer of baked enamel thereon serving as a base for the resistance film.

3. A sliding contact of a soft, highly conductive, non-oxidizable metal.

4. The construction of the contact plate and of the rotatable carrying arm and their cooperation which serves to constantly maintain a large contacting area between the contact plate and the resistance film.

5. The combination of a resistance paint having durable qualities, combined with a movable plate or rider such that the paint is caused to abrade the rider instead of having the rider or contact plate abrade the resistance paint.

While I have shown and described my invention in its preferred form, it will be apparent that many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. In a variable resistance, a substantially flat continuous resistance element, a movable contacting device comprising an oscillatable resilient arm, a separate bowed resilient contact plate slidable over the surface of said resistance element, means for holding said plate on said arm and affording said plate freedom of movement with relation to said arm, and means on said arm pressing against an intermediate portion of said plate tending to flatten the same against said resistance element.

2. In a variable resistance, a substantially flat continuous resistance element, a movable resilient arm, a floating rider mounted on said arm and comprising a bowed contact plate slidable on said resistance element, and means for pressing and tending to flatten said contact plate in contact with said resistance element.

3. In a variable resistance, a smooth continuous resistance element, a bowed resilient contact plate of a highly conductive non-oxidizable metal, lugs projecting from the ends thereof, a movable resilient arm having openings to freely receive said lugs whereby said plate is afforded a plurality of degrees of freedom, and means on said arm engaging the bowed portion of said plate intermediate the said lugs for tending to flatten the plate against the resistance element.

4. A variable resistance device comprising an enamel coated metal plate, a continuous thin resistance film on said plate composed of finely divided conductive particles held in a vehicle and binder, and a slidable contact made of silver which, when wear occurs, takes the wear instead of wearing away said resistance film.

5. A variable resistance device comprising a plate, a thin resistance film on said plate composed of finely divided conductive particles held in a vehicle and binder, a metal contact plate made of silver which, when wear occurs, takes the wear, and means for sliding said plate and tending to increase the contact area between said plate and said film.

6. A variable resistance device comprising an insulation base, a resistance film on the face of said base composed of conductive particles held in a binder of metallic phosphate in a slight excess of phosphoric acid, a silver contact plate, and means for sliding said plate and tending to increase the contact area between said plate and said film comprising a resilient arm and interengaging means between said plate and arm affording said plate freedom of tilting movement with relation to said arm in order to permit the plate to seat itself as perfectly as possible on the film.

7. A variable resistance device comprising a casing, a base of insulating material mounted in said casing, a contact mounted

on and disposed centrally of said base, a film of resistance material painted on said base, a cover for said casing, a rotatable shaft passing through said cover and held thereby against said center contact, a resilient arm mounted on said shaft within the casing, and a contacting plate disposed to slide over said film mounted on said arm.

8. A variable resistance device comprising a casing having an enamel coated sheet metal base, a film of resistance material composed of finely divided graphite held in a binder and painted on said enamel base, a rotatable shaft mounted in said casing, a resilient arm mounted to rotate with said shaft, and a metal contact plate mounted on said arm to slide over said film.

9. A variable resistance device comprising an enamel coated metal plate, a resistance film on said enamel, and a slidable silver plate contact which, when wear occurs, takes the wear, rather than the resistance film.

10. A variable resistance device comprising an insulating base, a resistance film on said base, a silver contact plate slidable on said film, and metallic silver particles embedded in the surface of said film.

11. A variable resistance device comprising an insulation base, a resistance film on said base, and a slidable silver contact plate which, when wear occurs, takes the wear, rather than the resistance film, so that silver particles are embedded in the surface of said film until a smooth surface results.

Signed at New York, in the county of New York and State of New York.

LESTER L. JONES.

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