Oct. 6, 1931. J. RAUS 1,826,673

RESISTANCE APPARATUS

Filed Oct. 3, 1925

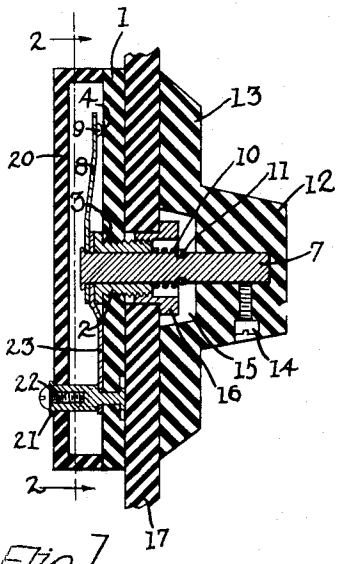


Fig. 1

Fig. 2

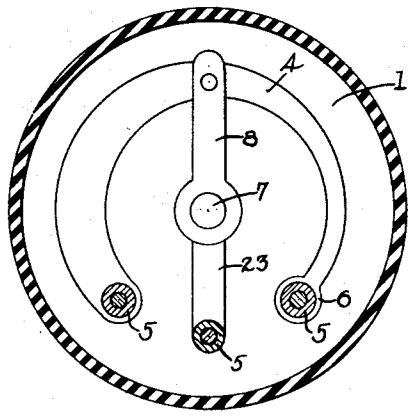


Fig. 3

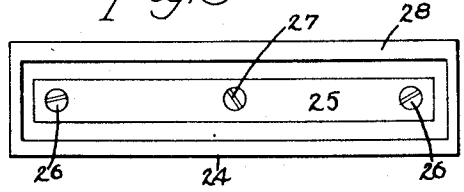


Fig. 4

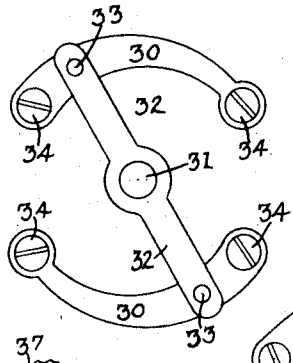


Fig. 5

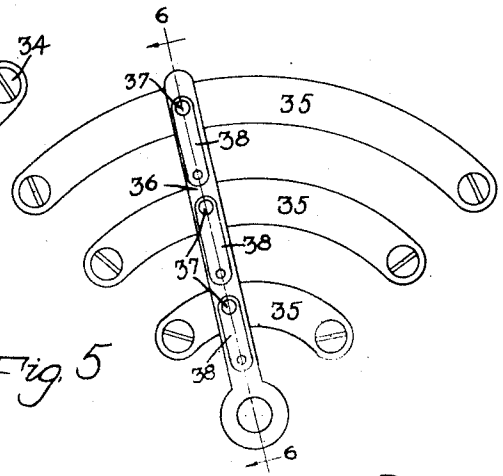
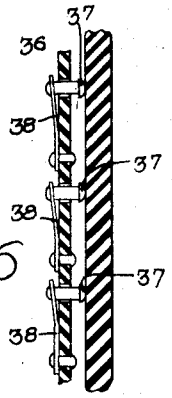


Fig. 6



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UNITED STATES PATENT OFFICE

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RESISTANCE APPARATUS

Application filed October 3, 1925. Serial No. 60,165.

This invention relates to electrical resistance apparatus and has for its object the provision of an electrical conductor of such definite, though limited, current carrying capacity as to be capable of being made of very high resistance coupled with uniformity, reliability, and unchangeability; the provision of a variable resistance of very high value wherein the variation shall be continuous and not by discrete steps; the provision of a combined variable-resistance and potentiometer capable of use with very high potentials and small current flow; the provision of a new and improved construction of resistance cell; the provision of a new and improved resistance element adapted primarily for radio work which can be installed and manipulated with maximum ease; while further objects and advantages of the invention will become apparent as the description proceeds.

In the drawings accompanying and forming a part of this application I have shown certain physical forms in which my inventive idea can be embodied although it will be understood that these are merely illustrative of the general principles of my invention and are not intended to be exhaustive as to its mode of application. Fig. 1 is a central sectional view through a preferred form of my resistance element showing a convenient mode of attaching the same to a radio panel-board; Fig. 2 is a sectional view corresponding to the line 2—2 in Fig. 1; Fig. 3 is a bottom view of another form of resistance unit; Fig. 4 is a face view of a modified form of variable resistance element showing a double opposed or balanced arrangement; Fig. 5 illustrates a multiple resistance; and Fig. 6 is a sectional view corresponding to the line 6—6 of Fig. 5.

An important feature of my resistance element is the composition and nature of the conducting material which I employ, which consists of finely divided carbon such as graphite applied to the face of an insulating body in the form of a suspension in an evaporable liquid which subsequently dries to form a thin continuous ribbon, this ribbon being of a fixed and continuous length in case it be merely desired to make an unchangeable resistance, while in the case of a variable resistance or potentiometer a movable element is associated therewith having a contact button of rounded form made of a non-corrodible and non-disintegratable metal movable along the carbon strip. This carbon material in the form of the so-called "deflocculated graphite" is readily obtainable on the market under the name of "Aquadag", sold by the Atchison Graphite Works of Niagara Falls, New York, and consists essentially of colloidal graphite suspended in water, generally containing a small amount of aqua ammonia. By using a definite stencil and a known density of this graphite suspension a streak or smear of this material is produced which when dried and hardened exhibits a very uniform current carrying capacity of high resistance. This resistance can readily be varied if desired by scraping away more or less of the edges of the smear. This smear may either be straight or curved and used either with fixed or movable contacts. When a movable button is used therewith, the same is preferably made of some metal like tungsten or molybdenum which is unoxidized in air at normal temperatures and is so hard that no grains are worn therefrom by repeated use. In fact the lubricating character of the graphite helps to produce a permanent device. Of course I do not limit myself to this particular material but merely suggest it as a satisfactory and readily available substance.

In Figs. 1 and 2 I have shown a circular member 1 of hard rubber (bakelite or other insulating substance can equally well be employed) having at its center an externally threaded, internally smooth, brass bushing 2 tightly received in an aperture 3. Carried by one face of this member and concentric with the aperture is a streak or smear 4 of this graphite, subtending the greater part of a circle and making contact with terminals 5—5 at its ends. Preferably, at least for potentiometer uses, this smear varies progressively in width from one end to the other as indicated in Fig. 2, although at the smaller end it is preferably swelled out again as shown at 6, or perhaps thickened, to make the

best possible contact with the corresponding terminal. It is generally best that the surface to which this graphite is applied be very slightly roughened, and this may be either local or general.

Journaled in the bushing 2 is a shaft 7 having tightly secured to one end the radial spring arm 8 whose free end carries the rounded button 9 of some hard and non-corrodible metal as heretofore described contacting with the graphite streak. In order to reinforce the springiness of this arm I have also shown at the opposite end of the bushing 2 a spring 10 surrounding the shaft and interposed between the end of the bushing and an abutment wire 11 sprung into a notch with which the shaft is formed. For turning the shaft a knob 12 is provided accompanied if desired by a dial 13 and fastened to the shaft by a set screw 14. Preferably the interior of this dial is hollowed out as shown at 15 and the bushing is provided with an external nut 16 by which the parts may be secured to a panel board 17. In order to install this resistance unit it is necessary merely to bore a hole in the panel board and secure the member 1 to the back thereof by means of the nut 16, after which the knob is applied.

The resistance and movable arm are preferably encased in some kind of a housing, for example that shown at 20 which consists of a circular cup of insulating material covering the assemblage and here shown as secured in place by the terminals 5, 5, which consist of studs having one end riveted into the plate 1 and having their other ends spun over the member 20 as shown at 21. The outer end of each stud is threaded as at 22 for the reception of a binding screw. I have shown three such studs, one for each end of the resistance elements, and the third connected to the shaft 7 by means of the metal strip 23. In use all three studs are employed for potentiometer work, but only two of them for a mere variable resistance.

In Fig. 3 I have shown a rectangular base member 24 having therein a straight smear 25 of resistance material provided at its ends with terminal fittings 26—26. I have also indicated an intermediate fixed terminal or contact 27 which can be employed if desired. The base member is formed with a rib or flange 28 surrounding and protecting the conducting smear.

In Fig. 4 I have shown two arcuate graphite smears 30—30 concentric to the same shaft 31, the shaft being provided with oppositely extending spring arms 32—32 provided with contact buttons 33—33 movable along the respective conducting paths. These graphite smears are provided with terminals 34—34 as before.

In Fig. 5 I have shown another arrangement wherein three of these graphite smears 35 are located parallel to each other and overhung by a single movable member 36 which is provided with three contact buttons 37—37, the latter being so mounted on independent spring arms 38—38 as to press on their respective conductors with substantially equal force.

From the practical standpoint this construction has so far proven especially valuable for high resistances, such as those from one hundred ohms to ten million ohms. By varying the thickness and width of the graphite smear either of these resistances can readily be included in a device of the size shown in my application drawings, and by suitably tapering the same the desired potentiometer settings between these limits can also be obtained within an apparatus of this same small size and inexpensive construction. Owing to the essential character of the material it is substantially impossible to burn it out or injure it in any way, it is unaffected by atmospheric conditions, it is wear proof and permanent, it is absolutely non-inductive, and as applied to radio use it is particularly valuable in that its variation from point to point is uniform and not by steps so that no rattle is produced with audible devices upon a change of setting.

I have not illustrated in detail the different possible modes of connecting these resistance and potentiometer elements in different circuits inasmuch as the same are very numerous and will be well understood by those skilled in the art. I have not illustrated all possible modifications and detail embodiments of my invention since it will be understood that a great many changes can be made in all matters of detail and that I do not limit myself in any wise except as specifically recited by the terms in my several claims by the state of the art.

Having thus described my invention what I claim is:

1. A resistance element consisting of a narrow patterned smear of dried graphite located upon a non-conducting support, and a round-faced button of tungsten slidable along said smear and yieldingly pressed thereon.

2. Variable resistance apparatus comprising, in combination, an insulating support, a thin dried smear of graphite carried by the face of said support and adhering thereto, a rounded button consisting of one of the metallic elements from the sixth group in the Mendelejeff's table of elements having a melting point above 2500° centigrade movable along said smear, means yieldingly pressing said button against the graphite, and one of more fixed terminals of conducting material secured in electrical contact with the graphite.

In testimony whereof I hereunto affix my signature.

JOHN RAUS.