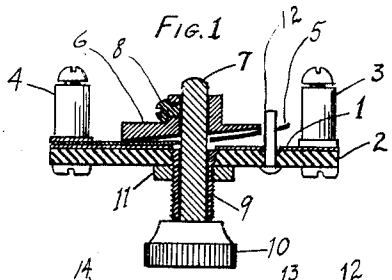
March 5, 1929. E. R. STOEKLE 1,704,154

ELECTRICAL RESISTANCE AND THE LIKE

Filed Feb. 28, 1923

FIG. 1



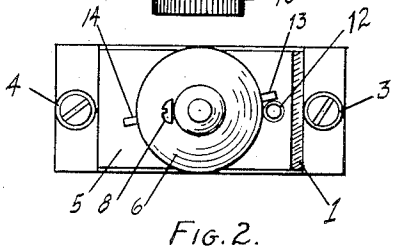


FIG. 2.

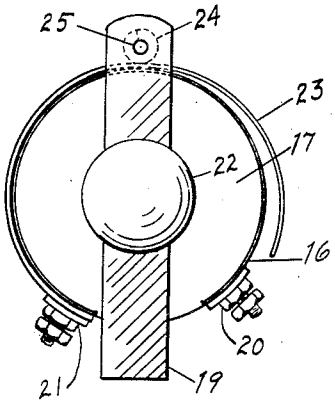


FIG. 3.

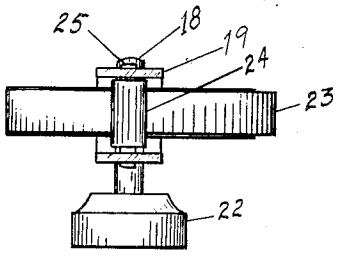


FIG 4.

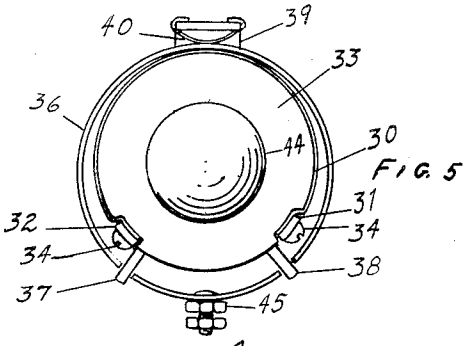


FIG. 5

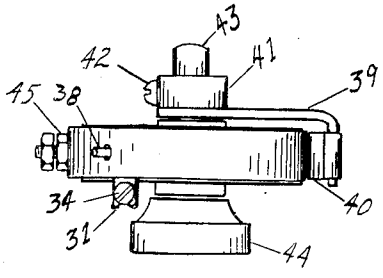


FIG. 6

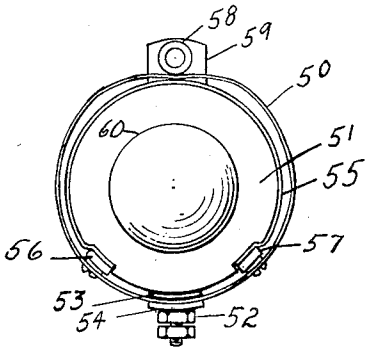


FIG. 7

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Patented Mar. 5, 1929. 1,704,154

UNITED STATES PATENT OFFICE.

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ELECTRICAL RESISTANCE AND THE LIKE.

Application filed February 28, 1923. Serial No. 621,812.

This invention relates to improvements in electrical resistances particularly of the type employing a resistor that would easily be injured by the usual methods of making a sliding or rubbing contact therewith.

In my previous application Serial No. 587,395, filed September 11th, 1922 now Patent No. 1,448,681, dated March 13, 1923, variable resistances were described in which the resistance was varied by pressing a metallic contact member into variable contact with the surface of a resistor, thus obviating the abrasion of the resistor which results from the use of the usual sliding contact members. My present application describes new and improved means for firmly pressing such a metallic contact member into controllably variable contact with the resistor, and also describes improved constructions of the resistor which have been found better adapted to obtaining low values of the resistance than were the resistors described in my above mentioned previous application.

One object of my present invention is to provide improved means for pressing a contact member into controllably variable and firm contact with a resistor whereby the resistance between terminals connected to said resistor may be continuously and smoothly varied.

Another object is to provide improved means for pressing a contact member into firm and controllably variable contact with a resistor, said means not requiring over a single revolution of the operating knob in order to change the resistance over its complete range of variability.

Another object is to provide an improved construction of the resistor element of a resistance of the type described, such construction being particularly adapted to obtain low values of the resistance.

Another object is to provide a resistance of the type described in which the variably contacting member need not be flexed, since such flexure may be subject to elastic fatigue which might cause a slow variation of the resistance.

Another object is to provide a resistance of the type described which is particularly adapted to be used as a so-called potentiometer resistance; that is a resistance in which the variably contacting point on the resistor element may be used to obtain a potential intermediate that applied to the terminals at the ends of the resistor.

Other objects and novel features of this invention will be apparent from the following description and the accompanying drawings of Figures 1 to 7.

Figures 1 and 2 show in cross section and in plan view respectively a construction in which a simple cam structure serves to press the contact member into variable contact with the resistor.

Figures 3 and 4 show a top and side view respectively of a construction in which the resistor and contact member are disposed about a cylindrical surface, and a pressure member is so placed as to press the contact strip against a variable length of the resistor depending upon the position of the pressure member upon the contact member.

Figures 5 and 6 show a top and side view respectively of a form of the resistance adapted to be used as a so-called potentiometer resistance as well as a simple resistance; and which employs a contact member in the form of a loose ring about the circularly disposed resistor.

Figure 7 shows a form of the resistance similar to Fig. 6 except that the contact ring is flexible and can be flexed into contact with the resistor at a variable point by means of a pressure member.

Referring to the Figs. 1 and 2 the resistor element 1 is clamped to the insulating base 2 by means of the terminals 3 and 4. The flexible contact strip 5 is clamped at one end under the terminal 4 and is curved upward having its convex surface adjacent to the resistor. A flat cam element 6 is fastened to the shaft 7 by means of the set screw 8 and both shaft and cam are rotatable in the bushing 9 by means of the operating knob 10. Bushing 9 is clamped to the base 2 by means of the nut 11. Projections 13 and 14 on the cam element 6 serve to limit the rotation of the cam to less than a revolution by engaging the stop pin 12.

The operation of this device is as follows: Rotation of the operating knob 10 moves the lowest point of the cam along the contact strip thus pressing the latter into contact

along an increasing length of the resistor and thus decreasing the resistance between the terminals 3 and 4. In this construction the full range of variation of resistance is accomplished in substantially a half turn of the knob.

Referring now to the Figures 3 and 4 the resistor 16 is in the form of a strip disposed about the cylindrical surface of the insulating drum 17, and is clamped at its ends under the terminal posts 20 and 21. The drum 17 is fastened to the shaft 18 which is rotatable in bearings on the frame or yoke 19. An operating knob 22 is attached to the shaft 18. The contact member 23 is in the form of a circularly bent strip of larger radius of curvature than the drum so that it does not fit on the cylindric surface of the drum except as it is pressed into contact therewith. One end of the contact member 23 is clamped under the terminal 20 with which it is in electrical connection.

The roller 24 has its shaft 25 mounted in bearings on the yoke 19, and is placed at such a distance from the center of the drum that it serves to press the contact member 23 into firm contact with the surface of the resistor. The point at which the contact strip is pressed into contact with resistor is varied by rotation of the drum with respect to the roller; or the construction may obviously be such as to hold the drum fixed and to allow the frame carrying the roller to rotate with respect to the drum.

The operation of the device is as follows:

The current entering at the terminal 21 passes through the contact strip 23 up to the region where the roller 24 presses the contact strip against the resistor at which point the current passes into the resistor leaving the latter again at the terminal 20. The nearer the roller approaches to the terminal 20 the less the resistance between the terminals, and in the closest approach of the roller to the terminal 20 actual electrical connection may be established between the contact strip and terminal 20 whereby the resistor is entirely cut out. It is thus possible to vary the resistance between the terminals 20 and 21 from the maximum value of the resistor to practically zero, by means of less than one complete rotation of the operating knob 22.

Referring to the Figures 5 and 6 the resistor element 30 is again shown stretched around the cylindric surface of an insulating drum 33 and is fastened at its ends to the drum by means of the terminals 31 and 32. These terminals are of a commonly used flat type and are fastened into a recessed portion of the drum as shown so that their upper surfaces are about on a level with the upper surface of the resistor strip. The parts of these terminals containing the screws 34 and 35 for binding on the connecting wires extend out away from the drum as shown in Figure 6 in order not to interfere with the movement of the contact ring clear up to the ends of the resistor strip.

The contact member 36 is an annular ring of larger diameter than the drum and is fixed so that it can not rotate about the drum and thus produce a sliding or rubbing action on the resistor element. In the drawing this is accomplished by the pins 37 and 38 which are fastened into the insulating cylinder 33 and extend through holes in the ring 36. The ring is free to slide radially on these pins, and they also serve as stops to the arm 39 which carries the sliding shoe 40. A terminal 45 is provided for making electrical connection to the ring.

The arm 39 is fastened to the collar 41 which is fastened to the shaft 42 by means of the set screw 43. The shaft 42 extends rotatably through the drum and is fastened to the operating knob 44. The sliding shoe 40 is shown as a curved spring member pressing upon the outer surface of the ring although a roller as shown at 24 in Figure 4 may also be used for this purpose.

The operation of this device as an electrical resistance is as follows: Current enters at the terminal 31 passes through the resistor strip 30 to the region where the shoe 40 presses the contact ring into contact with the resistor. At this point the current enters the ring 36 and passes to the terminal post 45 from which it leaves the device. It is apparent that as the sliding shoe 40 is moved towards terminal 31 the resistance between the terminal posts 31 and 45 is decreased until the shoe strikes the stop pin 38 when the ring is in actual contact with the terminal 31 and the resistance between 45 and 31 is practically zero.

In operating the device as a potentiometer resistance, a fixed potential difference is applied between the terminals 31 and 32 and any intermediate potential difference may be obtained between the terminal 45 and either of the terminals 31 or 32.

The Figure 7 shows a construction similar to that shown in Figures 5 and 6 except that the contact ring 50 is firmly fastened to the insulating cylinder 51 by means of the terminal nut 52 and the plates 53 and 54. The contact ring 50 is preferably made of a thin flexible material such as phosphor bronze and is held normally away from the resistor 55 by means of the plate 53. The resistor is held at its ends by the terminals 56 and 57 in a manner similar to that shown in Figures 5 and 6. The roller 58 is pivoted to the arm 59 which is fastened to a rotatable shaft and an operating knob 60 in the same manner as shown in Figure 6.

The roller 58 is placed at such a distance from the center of the cylinder that it serves to bend the ring 50 and press it into firm contact with the resistor in a region directly beneath the roller. A sliding shoe similar to

40 of Figures 5 and 6 may be used in place of the roller 58.

The operation of the device of Figure 7 as an electrical resistance is as follows: Current entering at the terminal 52 will pass through the contact ring 50 to the region where it is pressed into contact with the resistor strip. At this point the current enters the resistor and passes through it to either of the terminals 56 and 57 either one of which may be used for connection to the external circuit. As the roller 58 is made to approach the terminal 57 the resistance between the terminals 52 and 57 is obviously decreased while the resistance between terminals 52 and 56 is increased.

When the device is operated as a potentiometer resistance, the terminals 56 and 57 are connected to the fixed potential and the intermediate potential difference is obtained between the terminal 52 and either of the terminals 56 or 57. It is apparent that as the roller is made to approach terminal 57 the potential difference between the terminals 52 and 57 will decrease while that between 52 and 56 will increase.

In the above description the term resistor has been used without any special reference to its construction. For high resistance a resistor of the type described in my Patent No. 1,448,681, hereinabove identified, namely a strip of yielding material such as woven fabric, asbestos, heavy paper, cardboard or the like impregnated or coated with a conducting material has been found preferable in view of the fact that a better pressure contact can be made with such materials than can be made with rigid materials such as carbon or compositions of carbon and a hard binding material. Experiments with resistances employing the above described type of pressure contact between a metal and a hard material of relatively high specific resistance have shown that good contact is very difficult to obtain, and when resistances employing such contacts are used in radio receiving sets, for example, undesirable noises will be heard in the receivers. A preferable resistor for the devices described in this invention is therefore of the yielding type described in my above mentioned previous application.

For resistance of the order of a few ohms, however, a new form of resistor has been used in the devices herein described. This resistor was made by pasting a strip of thin metallic foil upon a smooth piece of thin cardboard which served as a slightly yielding base so that intimate pressure contact could be made over an appreciable area of the foil. If very thin metal foils are placed upon a hard unyielding base the slight irregularities in the contact member and in the base create point contacts at which the current density may become destructive to the thin metal.

Since no rubbing contact is established between the resistor and the contact element in the above described devices the resistor may be of relatively delicate construction; a piece of gold or aluminum leaf mounted on cardboard being successfully used.

The resistor used on the devices described herein may be in the form of a flat band of reflexed wire with which the contact member makes contact. When such a resistor is used a continuous contact of the contact member with the wire of the resistor may be effected and therefore the resistance may be continuously varied as distinguished from the step-by-step variation obtained in a coil wound resistor.

One of the chief advantages of the variable resistances described in this and in my above mentioned previous application is the freedom from abrasion of the resistor which is common with the usual sliding contact type of variable resistance. It is therefore to be understood that the type of variable contact employed on the resistances herein described is not limited to use on resistors such as those herein described but may be used on any resistor which is of such delicate construction that it can not continually withstand the abrasion of a sliding contact shoe.

What I claim as new and desire to secure by Letters Patent is:

1. An electrical resistance comprising an insulating base having a convex surface; a resistor mounted upon the convex surface of said base; suitable terminals for making electrical connections to the ends of said resistor; a flexible contact strip having one of its surfaces adjacent said resistor, and controllable means for establishing contact between said flexible contact strip and said resistor along a variable length of the latter whereby the resistance between said terminals may be varied.

2. An electrical resistance comprising a cylindrical insulating base, a resistor mounted upon the cylindric surface of said base; terminals for making electrical connections to the ends of said resistor; a flexible curved metallic band having one end fastened to one of said terminals and having its concave surface extending adjacent said resistor; a rotatable arm carrying a pressure member bearing on the outer surface of said contact member and pressing the latter into contact with said resistor; means for rotating said arm whereby a variable length of said resistor is brought into contact with said contact arm and the resistance between said terminals is varied.

3. An electrical resistance comprising an insulating cylindrical base; a resistor in the form of an electrically conducting band stretched around the cylindrical surface of said base; suitable terminals for making electrical connections to the ends of said resistor, a metallic contact member in the form of a

ring of larger radius than said cylindrical base and so placed as to have its inner surface adjacent said resistor; means for preventing rotation of said ring upon said base and controllable means for pressing said ring into contact with said resistor at a variable location along said resistor whereby the resistance between said contact ring and either of said terminals may be controllably varied.

4. An electrical resistance device comprising an insulating drum, a resistor disposed on the periphery of said drum, terminals for making electrical connections to said resistor, a curved contact member of larger diameter than said drum disposed around the latter and constrained against sliding contact with said resistor, and means for pressing said contact member into variable contact with said resistor, whereby the resistance between said terminals may be varied.

5. An electrical resistance device comprising a drum of insulating material, a resistor disposed on the periphery of said drum, terminals for making contact therewith, a ring-shaped contact member of larger diameter than the drum and resistor combined disposed around said drum and free to move radially in respect thereof but constrained against circumferential movement, and means for pressing said contact member into variable contact with said resistor to vary the resistance between said terminals.

6. An electrical resistance device comprising a drum of insulating material, a resistor disposed on the periphery of said drum, terminals for making contact therewith, a ring-shaped contact member of larger diameter than the drum and resistor combined disposed around said drum and free to move radially in respect thereof but constrained against circumferential movement, an element movable circumferentially relatively to said drum and arranged to co-act with said contact member for pressing the latter into variable contact with said resistor, and means for effecting such movement of said element.

In witness whereof, I have hereunto subscribed my name.

ERWIN R. STOEKLE.