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H. R. VAN DEVENTER

ADJUSTABLE RESISTANCE FOR ELECTRICAL APPARATUS

Filed April 4, 1924

Fig. 1

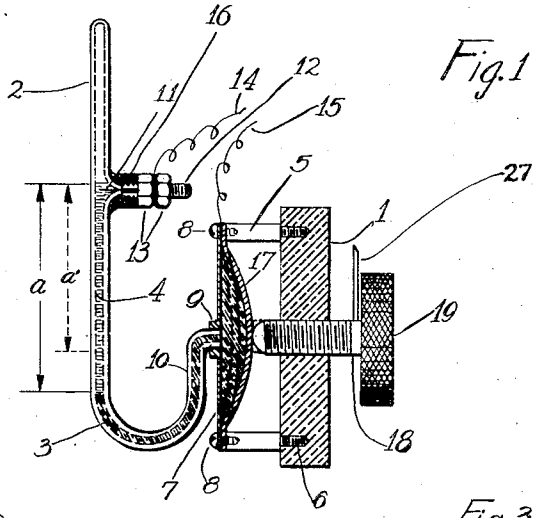


Fig. 2

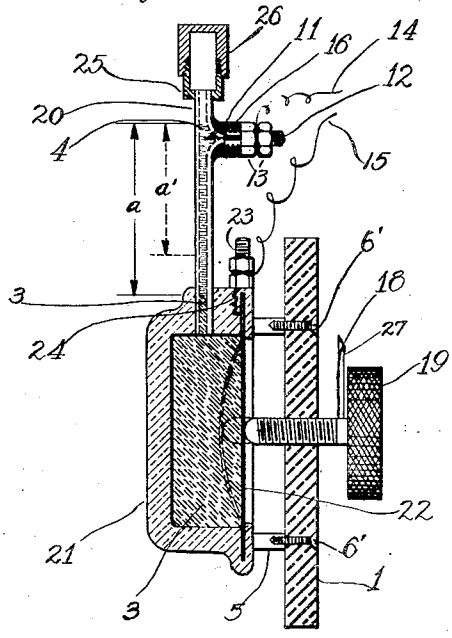
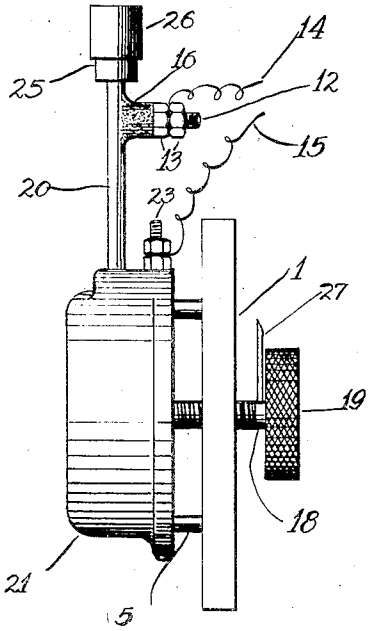


Fig. 3



INVENTOR

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UNITED STATES PATENT OFFICE.

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ADJUSTABLE RESISTANCE FOR ELECTRICAL APPARATUS.

Application filed April 4, 1924. Serial No. 704,182.

To all whom it may concern:

Be it known that I, HARRY R. VAN DEVENTER, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Adjustable Resistances for Electrical Apparatus, of which the following is a specification.

This invention relates to improvements in resistances, especially electrical resistances that are adjustable and adapted for use in radio and other electrical apparatus.

An object of this invention is to provide a device in which the desired resistance is afforded by elements in such a condition, preferably liquid, that they can always be most easily maintained at the highest practicable efficiency, and be capable of ready operation to give the degree of adjustment required.

This and other objects and advantages of the invention will more fully appear from the following description in which, taken with the accompanying drawings, one or more forms for practicing my invention are disclosed; and I of course reserve the right to make changes in the shape, size and arrangement of the various parts that come within the scope and spirit of the invention as defined in the appended claims.

On the drawings,

Figure 1 is a vertical sectional view through one construction in which the idea of my invention is embodied;

Figure 2 is a similar view of another form; and

Figure 3 is a side view of what is shown in Figure 2.

The same numerals identify the same parts throughout.

Referring particularly to the construction shown in the drawings, I employ the numeral 1 to indicate a suitable support, which is of some insulating material; and mounted upon this support is a glass tube 2, containing a quantity of mercury indicated at 3, and a quantity of some other liquid of much greater resistance than mercury, such as xylol alcohol 4, or a similar substance through which an electric current may pass, but having very low conductivity. As the mercury is metallic in its nature, it offers comparatively little resistance to the passage of electric energy, and the resistance of the liquid contents of the tube 2 will vary accordingly as the amount of alcohol in series with the mercury is less or greater. The liquid in the tube 2 will of course be in the form of a column of suitable cross-section, as in an ordinary thermometer, with the mercury in the lower end of the tube 2 because of its greater weight.

Fixed in the support 1 will be a suitable number of studs 5 having threaded ends 6 which screw into threaded holes in the support, and fast to the outer ends of the studs will be a plate 7 secured to the studs by screws 8. The middle of the plate 7 will be provided with a hole surrounded by a boss or rim 9, making a bearing into which one end of the tube 2 is fitted. The bearing 9 will tightly engage the adjacent end of the tube 2; and, as shown in Figure 1, this tube is bent to such a form that it comprises two upright portions connected at their lower ends by a curved section; the shorter of the two upright portions of the tube being indicated at 10, and having its end bent to enter the bearing 9. In the other or longer upright portion or arm of the tube 2, is a conductor 11 which passes through the wall of the tube to the interior, and this conductor is connected to a binding post 12 on the outside of the tube, to receive fastening nuts for the purpose of attaching to the binding post 12 a conductor or lead 14. Another lead or conductor 15 is connected to the plate 7, which is preferably of metal, and when the two ends of an electric circuit are attached to the conductors 14 and 15, the current of this circuit, for example, will flow first through the mercury and then through the alcohol to the binding post 12 and the conductor united thereto. The resistance offered by the mercury and the alcohol in the tube 2 will be greater or less accordingly as the column of alcohol 4 between the end of the mercury column and the conductor 11 is longer or shorter; and the regulation is obtained by adjusting the mercury column 3 in the tube 2 so as to increase or lessen the distance between the end of the mercury column, upon which the column of alcohol 4 rests, and the conductor 11. The binding post 12 may be attached to the longer arm of the tube 2 by cement 16.

To permit variation of the resistance, the plate 7 is associated with a diaphragm 17, and with this diaphragm constitutes a

casing of suitable capacity in communication with the shorter arm 10 of the tube 2 through the end of this tube which fits tightly into the bearing 9. The edges of the diaphragm may be secured to the edges of the plate 7 in any suitable manner, and the screws 8 utilized to hold both the plate and the diaphragm together against the ends of the studs 5. The support is also perforated to receive a threaded screw 18, having a milled head 19, the end of this screw being rounded to engage the outer surface of the diaphragm 17, so that when the head 19 is turned to make the screw 18 press against the diaphragm, the diaphragm will be forced towards the plate 7, and the mercury impelled outward into the tube 2 and force the alcohol 4 up as high as one wishes, in the longer vertical arm of this tube. This longer vertical arm may be sealed or closed at the top as Figure 1 illustrates.

The mercury 3 will of course be in sufficient quantity to fill the casing, consisting of the plate 7 and diaphragm 17, and a pre-determined portion of the tube 2, with the column 4 of alcohol between the outer end of the mercury column, and the conductor 11, the portion of the tube between the conductor 11 and the closed upper end of same being long enough to permit the range of adjustment desired. With the screw 18 turned back, the arrangement may be such that the upper end of the column of alcohol 4 just about reaches and makes contact with the conductor 11. Then, the whole length of the column of alcohol 4 is in circuit with the conductors 14 and 15, and the resistance is a maximum. To lower the resistance the screw 19 is turned to press the diaphragm 17 toward the plate 7. Such action forces more mercury out into the tube 2 and raises the column of alcohol 4, so as to decrease the distance between the end of the mercury column, and the conductor 11; thus leaving a smaller quantity of alcohol between the mercury and the conductor 11. The resistance is, therefore, reduced because the length of the column of alcohol between the mercury and the conductor is so much less.

This device is particularly useful as a grid leak in connection with vacuum tubes in radio apparatus.

In Figure 2, the studs 5 are shown as secured to the support 1 by screws 6′, and the mercury 3 is contained in a suitable casing 21, which is closed by a diaphragm 22; the casing 21 being securely attached to the studs 5 in such a position that the screw 18 can bear against the diaphragm 22 at the middle.

On this casing is a binding post 23 to secure the end of the conductor 15, and this binding post is connected by a short length of wire 24 or the like to the diaphragm 22 which must be of some electrically conducting substance as before. The casing 21 carries a tube 20, which communicates with the interior thereof, and may be a straight tube projecting upward from the top of this casing. The casing 21 is filled with some liquid conducting substance offering low resistance, such as mercury 4 as before, and on the top of the mercury is another liquid element offering high resistance, such as xylol alcohol 4, as in the case of Figure 1. This tube also carries a conductor 11, and binding post 12 to secure the end of the conductor 14, and the top of this tube may be provided with a cup-shaped mouth 25, to receive a screw-cap, or closure 26. This cap will seal the mouth of the tube, but by removing it, one can easily fill the device, or replenish the contents in case some of the alcohol should evaporate.

The terminals of the device may be taken as the part 11, and the part of the casing to which the lead 15 is attached, and the liquid resistance elements 3 and 4 of different conductivity are between these terminals. By the adjusting means comprising the casing with the diaphragm, the quantity of the mercury in the casing with respect to the quantity of mercury in the tube, and therefore the relative quantity of the two liquids between the two opposite terminals of the device may be regulated. When the length of the alcohol column between the end of the mercury and the terminal 11 is the same as the arrow *a* in Figures 1 and 2, the total resistance will be more than when more mercury is forced out into the tube to decrease the effective length of the alcohol column between the mercury and the terminal 11 to the value indicated by the arrow *a′*. Thus a wide range of resistance variation can be secured.

The screw 18 or head or knot 19 may have a pointer or index element 27 thereon, and the face of the support 1 may be graduated, so that the value of the resistance between the terminals of the device can be indicated.

In both forms of the invention above described, the construction may be such that a vacuum may exist in the top of the tubes 2 and 20, above the liquid therein. The diaphragm 17 may be of metal and sealed to the plate 7 and likewise the diaphragm 22 may be of metal and sealed in the casing 21.

Having described my invention, what I believe to be new and desire to secure and protect by Letters Patent of the United States is:—

1. The combination of a pair of terminals, elements for offering resistance to the passage of electric current, between said terminals, said elements being of different conductivity, and means for adjusting said elements to vary the resistance to the passage of current therethrough.

2. The combination of a pair of terminals, a liquid metallic substance, and a liquid substance of relatively low conductivity between said terminals to afford resistance to the passage of current between said terminals, and means for varying the relative quantities of said liquids between said terminals, to regulate said resistance.

3. The combination of a casing, a conductor attached to said casing, a tube extending from said casing, a conductor carried by said tube, liquids of different conductivity in said tube, and means for varying the relative quantities of said liquids between said conductors, to regulate the resistance to the passage of current between said conductors.

4. The combination of a support, a casing comprising a diaphragm mounted upon the support, a tube communicating with said casing, a terminal carried by the tube remote from said casing, said casing being a conductor, a resistance element in liquid form within said tube, and a resistance element of much lower conductivity in series with the first element, said elements extending from the terminal to the casing, and a member for pressing upon said diaphragm to vary the relative quantities of the two elements between said terminal and said casing, to regulate the resistance offered to the passage of current between said terminals.

5. The combination of a support, a casing comprising a diaphragm mounted upon said support, a conductor connected to said casing, a bent tube communicating with said casing at one end, a conductor carried by said tube adjacent its opposite end, a quantity of liquid mercury in said casing and said tube, a quantity of liquid of lower conductivity in said tube, and a screw for engaging the diaphragm, to vary the relative quantities of the mercury in the tube and in the casing.

6. The combination of a support, a casing comprising a diaphragm mounted on the support, a binding post in circuit with said diaphragm, a tube communicating with said casing, and mounted thereon, a closure for the outer end of said tube, a terminal carried by said tube and extending into same, a fluid of low conductivity in said tube, a fluid of high conductivity in the casing, and a screw carried by the said support to bear against said diaphragm and force the fluid in the casing to a greater or less extent out into the tube.

7. The combination of a casing, a conductor attached to said casing, a tube extending from said casing, a conductor carried by said tube, liquids of different conductivity in said tube, and means for varying the relative quantities of said liquids between said conductors, to regulate the resistance to the passage of current between said conductors, said means being associated with an element for indicating the value of said resistance.

In testimony whereof I affix my signature.

HARRY R. VAN DEVENTER.