

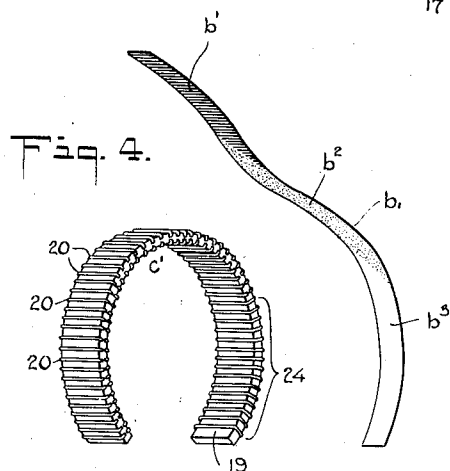
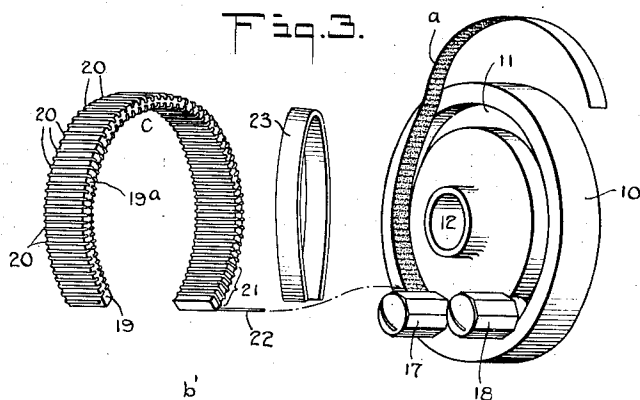
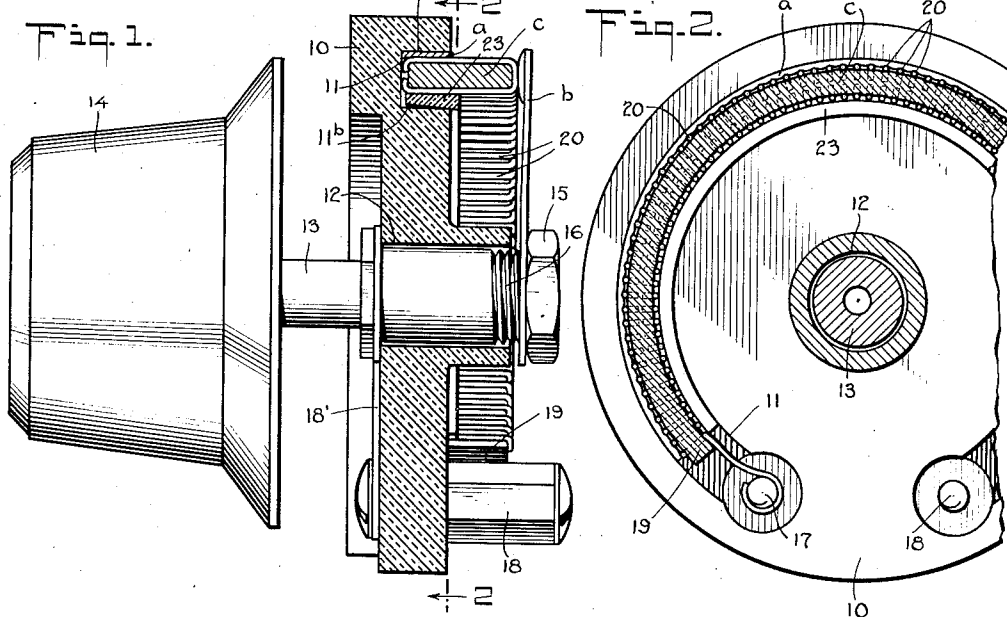
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VARIABLE RESISTANCE DEVICE

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# UNITED STATES PATENT OFFICE.

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## VARIABLE RESISTANCE DEVICE.

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This invention relates to resistance devices, and more particularly to variable or adjustable high resistance units.

In the art of radio communication, adjustable high resistance devices are commonly employed for a number of purposes such as for adjustable interstage amplifier resistor couplers, for variable grid leak resistances, for audio frequency shunt resistances, for B battery voltage control resistances and for audio frequency volume control rheostats. Where resistances of values higher than that which can be economically obtained with wire wound resistors are desired, it is common in the art to employ a high resistance element made up of a base having a graphited or inked surface; and the adjustment or variation of resistance with such elements is obtained by moving a contact element such as a rheostat blade over and in contacting engagement with the graphited or inked surface of the resistance element.

The use and operation of this known type of variable high resistance unit are, however, attended with a number of disadvantages, prime among which are the absence of effective and sufficient electrical contact between the rheostat blade and the high resistance surface, the presence of microphonic contacts which result in introducing distortions when the resistance is used for example as a volume control rheostat, the change in resistivity of the resistance element and the mutilation and ultimate destruction of the high resistance element due to mechanical abrasion of the same resulting from the repeated movement of the rheostat blade over the high resistance surface.

A prime desideratum of my present invention comprehends the provision of variable high resistance devices in which these disadvantages attendant and incident to the use of known high resistance devices are effectively eliminated, and which possess the advantages characteristic of low resistance wire wound units such as efficient, stable and non-microphonic contacts during the adjustment of the movable contact element, maintenance of the integrity or identity of the resistance unit and its resistivity regardless of movement of the rheostat blade, and the possibility of obtaining gradual and progressive predetermined changes or varia-

tions in resistance upon adjustment of the movable contact element.

To the accomplishment of the foregoing and such other objects as will hereinafter appear, my invention consists in the elements and their relation one to the other, as hereinafter particularly described and sought to be defined in the claims; reference being had to the accompanying drawings which show the preferred embodiments of my invention, and in which:

Fig. 1 is a side elevational view of a preferred embodiment of the invention with parts shown in section.

Fig. 2 is a view thereof taken in cross-section on the line 2—2, Fig. 1.

Fig. 3 is a perspective view thereof showing the parts detached, and

Fig. 4 is a fragmentary view of a modified form of the invention showing the parts in detached relation.

To accomplish the aforementioned objects, the invention in one of its generic aspects comprises the interposition between the high resistance element and the adjustable contact of a wire wound element having its windings conductively disconnected from one another and conductively connected to the high resistance element, the adjustable contact being movable over and making contact with the windings of the wire wound element, the construction being such that the movable contact is always had between metal and metal, and the movement of the adjustable contact produces progressive variations of resistance in the high resistance element.

Referring now more in detail to the drawings, the resistance unit of my invention accordingly comprises generically a high resistance element *a*, a movable contact element such as the rheostat blade *b*, and a wire wound element generally designated as *c* interposed between the high resistance element *a* and the movable blade *b*, the said blade having contact with the windings of the wire wound element, and the said windings being conductively connected to the high resistance element *a*.

In the preferred embodiment of the invention, the resistance device is of the circular or arcuate type, the said resistance device comprising a base 10 made of an insulating material, the said base being provided with an arcuate channel 11 on one side thereof, in which channel the high re-

sistance element *a* and the wire wound element *c* are seated, the said base being provided with a central bore 12 through which is inserted a spindle or shaft 13, which spindle fixedly carries the movable blade *b* at one end thereof and the control handle 14 at the other end thereof, the blade *b* being held fixed to the shaft by means of a securing nut 15 threadedly received by the threaded portion 16 of the spindle 12. The base 10 is also provided with a pair of binding posts 17 and 18, the binding post 17 being connected to the terminal lead of the wire wound element *c*, as will be described more in detail hereinafter, and the binding post 18 being conductively connected to the control shaft 13 by means of a resilient connecting element 18'. The high resistance element *a* desirably comprises a flexible base such as paper, fiber or the like having a graphited or inked surface, as clearly shown in Fig. 3 of the drawings, flexibility and pliability of the high resistance element being desirable so as to permit the ready manipulation of the resistance element and its insertion into the channel 11 against the wall 11<sup>a</sup> thereof, and to permit the windings of the wire wound element *c* to be pressed into intimate contact with the surface of the high resistance element when the parts are assembled to obtain an effective and non-microphonic conductive connection between the windings of the wire wound element and the high resistance surface.

The wire wound element *c*, for economy and convenience of manufacture, comprises a flexible core 19 made of fiber or the like, about which is wound a coil or helix of the desired length, the said coil having its windings severed or cut along one wall thereof after the winding operation, producing contiguously arranged wire elements or windings 20 which are conductively disconnected from one another as will be fully apparent from a consideration of Figs. 1 to 3 of the drawings, each of the windings 20 comprising in effect a discontinuous loop having its severed ends along points in a wall 19<sup>a</sup> of the flexible core 19. Preferably a portion 21 of the coil or helix is left uncut, the terminal lead 22 of this portion being connected to the binding post 17.

In assembling the high resistance element and the wire wound element, the wire wound element is bent into arcuate form and inserted in the channel 11 so that the wall 19<sup>a</sup> of the wire wound core 19 is located in the bottom of the channel, after which a flexible arcuate shaped wedge member 23 is forced into position between the wall 11<sup>b</sup> of the channel and the wire wound element *c*, the wire wound element being by this means securely located in the channel with the windings thereof pressed into intimate contact with the surface of the high resistance

element *a*, the contiguous windings embedding themselves firmly in the resistance element to produce a long line contact between each winding and the high resistance element, as is constructionally shown in Figs. 1 and 2 of the drawings, and as is depicted by the relatively dense lines in the high resistance strip *a* shown in Fig. 3 of the drawings.

In the preferred form of the invention as described, the high resistance element *a* is not incorporated as part of the core 19 of the wire wound element *c* but is made of a separate unit or element, the making of the resistance element as a separate unit being preferred by reason of the numerous advantages offered thereby. It is requisite that the resistance path be formed on a base suitable therefor, and it has been found that the fibre strip or core (the core 19) on which the wire is wound is unsuitable for this purpose for a number of reasons. For example, it is not practical to form the resistance path after the flexible strip or core is curled for insertion into the molded base and if it be formed before the core or strip of the wire wound element is curled, the resistance surface if incorporated as part of the core 19 will be damaged by bending of the fibre strip because the fibre strip is from  $\frac{1}{16}$  to  $\frac{1}{8}$  inch wide and tends to compress on its inner side and stretch on its outer side and so break the continuity of the resistance film. If the resistance element is formed on a separate strip *a* such as paper or thin fibre suitable for the reception of a resistance coating, these disadvantages are obviated. Therefore for purposes of economical manufacture and to produce a reliable commercial resistance unit, I have found that the resistance film should be on a strip or element separate and distinct from the strip or core on which the contacting wires are wound. Where the resistance strip is made not only independent of the core 19 but separate from the wire wound element as in the embodiment of the invention illustrated herein, the manufacturer is enabled, moreover, to keep in stock standard contacting or wire wound elements for resistance strips of various sizes, since only the resistance strip elements need vary, the stock required by the manufacturer being thus considerably reduced. By making the resistance element separable from the core or separable from the wire wound element, I am enabled to facilitate the assembling of the parts and to produce a unit which is efficient and durable in use.

With the employment of the principles of my invention, I am enabled to construct resistances having extremely wide ranges of resistivities, one form of such resistance being diagrammatically shown in Fig. 4 of the drawings, in which the high resistance

element  $b_1$  comprises a flexible strip having regions of different resistivities, the region  $b'$  thereof being a very high resistance section made up of an inked surface, the region  $b^2$  thereof being of a comparatively lower resistance made up of a graphited surface, and the region  $b^3$  thereof being left untreated, this high resistance element  $b_1$  cooperating with the wire wound element  $c'$  having an uncut section 24 cooperating with the clear or untreated section  $b^3$  of the high resistance element, the remaining windings of the wire wound element  $c$  being cut and cooperating with the carbonized and inked sections  $b^2$  and  $b'$  of the high resistance element. The variation over each region of the high resistance element and through the transition points may be made continuous and gradual by overlapping the sections and tapering the high resistance surfaces, as is clearly depicted in Fig. 4 of the drawings.

The manner of making, assembling and using the high resistance device of my invention will in the main be fully apparent from the above detailed description thereof. It will be further apparent that with the construction described, the high resistance unit has its filamentary resistance threads connected in parallel at short intervals by the cross resistance wires of the wire wound element, this contributing to the complete elimination of microphonic contacts. It will be further apparent that by having the movable contact engaging the windings of the wire wound element, the integrity or identity of the high resistance unit is maintained in service, the resistivity characteristics thereof being uninterfered with, and the mechanical abrasion and mutilation of the resistance unit incident to prior devices being entirely eliminated. It will furthermore be seen that in a construction embodying the principles of the invention, gradual and progressive predetermined changes or variations in the resistivity of the units may be obtained, as in low resistance wire wound units. A further important advantage of the invention resides in the fact that the resistance units may be manufactured economically, the comparative cheapness in cost of the ink-impregnated or graphited paper strip and the wire wound element and the simplicity of manufacturing and assembling steps being factors in producing an efficient high resistance device at low cost.

While I have shown the principles of the invention embodied in the preferred form, it will be apparent that numerous changes in construction and arrangement of parts may be made without materially departing from the essence of the invention. Thus it will be evident that the contiguously arranged wire elements interposed between the mov-

able rheostat blade and the high resistance element need not be of the wire wound type, and it will be further evident that the high resistance element need not be made separate and independent of the wire wound element and arranged externally thereto, and that various other changes and arrangements of the parts may be produced without departing from the spirit of the invention, defined in the following claims.

I claim:

1. A high resistance device comprising a wire wound element including a core and windings thereon conductively disconnected from one another, and a separable high resistance element pressed into intimate conductive engagement with the windings of the wire wound element.

2. A high resistance device comprising a high resistance element surfaced with a resistance material, a wire wound element including a core independent of the resistance element and having windings thereon conductively disconnected from one another and conductively contacting with the said resistance element, and means for pressing the windings of said wire wound element into intimate contact with the surface of the resistance element.

3. A high resistance device comprising a wire wound element including a flexible core and windings thereon severed for conductively disconnecting the windings from one another and a flexible high resistance element separate from said core pressed into intimate conductive contact with an exposed side of the windings of the wire wound element.

4. A variable high resistance device comprising a wire wound element including a core and windings thereon conductively disconnected from one another, a separable high resistance element pressed into intimate conductive engagement with the windings of the wire wound element, and an adjustable contact element movable over and making contact with the windings of the wire wound element.

5. A variable high resistance device comprising a wire wound element including a flexible core and windings thereon severed for conductively disconnecting the windings from one another, a flexible high resistance element separate from said core pressed into intimate conductive contact with a side of the windings of the wire wound element and an adjustable contact element movable over and making contact with the windings of the wire wound element.

6. A variable high resistance device comprising an insulating base, an arcuate channel therein, a separable and flexible high resistance element arranged against a wall of said channel, and an arcuate wire wound element in said channel having windings

conductively disconnected from one another and pressed into intimate contact with said high resistance element and a contact element rotatable in said insulating base and movable over and making contact with the windings of the wire wound element.

7. A high resistance device comprising an insulating base, an arcuate-channel therein, a separable and flexible high resistance element arranged against a wall of said channel, an arcuate wire wound element in said channel having windings conductively disconnected from one another and pressed into intimate contact with said high resistance element, and means for pressing the wire wound element into intimate contact with the high resistance element.

8. A variable high resistance device comprising an insulating base, an arcuate channel therein, a flexible high resistance element arranged against a wall of said channel, an arcuate wire wound element in said channel having windings conductively disconnected from one another and a wedge forced between another wall of said channel and said wire wound element and pressing the windings thereof into intimate contact with said high resistance element.

9. A variable resistance device comprising a high resistance element having regions of different resistivities, and a wire wound element, including a core, independent of the resistance element and having contiguously arranged windings thereon conductively disconnected from one another and in conductive engagement with the different regions of said resistance element.

10. A variable high resistance device comprising an insulating base, an arcuate channel therein, a flexible high resistance element having regions of different resistivities arranged against a wall of said channel, and an arcuate wire wound element in said channel having a portion of its windings cut for conductively disconnecting the same from one another, said windings being pressed into intimate contact with the different regions of said high resistance element and a rotatable contact element movable over and making contact with the windings of the wire wound element.

11. A high resistance device comprising a wire wound element including a core and windings thereon conductively disconnected from one another, an a separate high resistance element independent of the wire wound element and arranged externally to and pressed into intimate conductive engagement with the windings of the wire wound element.

12. A high resistance device comprising a wire wound element including a flexible core and windings thereon conductively disconnected from one another, and a separate high resistance element composed of a flexible base surfaced with a resistance material independent of the wire wound element and arranged externally to and pressed into intimate conductive engagement with the windings of the wire wound element.

Signed at New York city, in the county of New York and State of New York, this 6th day of September, A. D. 1924.

LESTER L. JONES.