June 1, 1926. 1,587,136

T. APPLEBY

VARIABLE RESISTANCE

Original Filed March 23, 1920

Fig. 1.

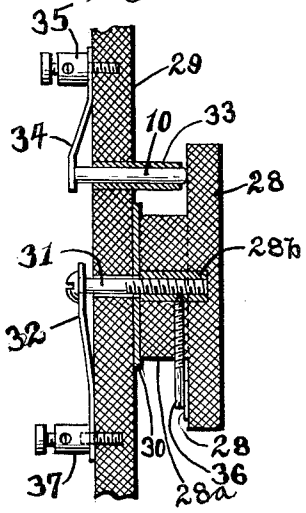


Fig. 2.

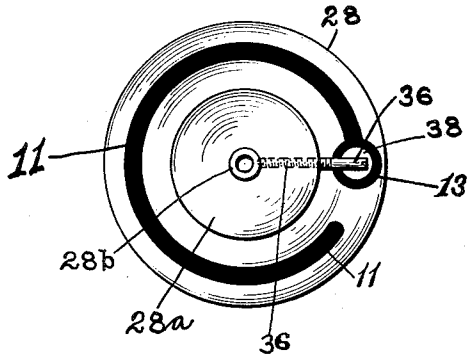


Fig. 3.

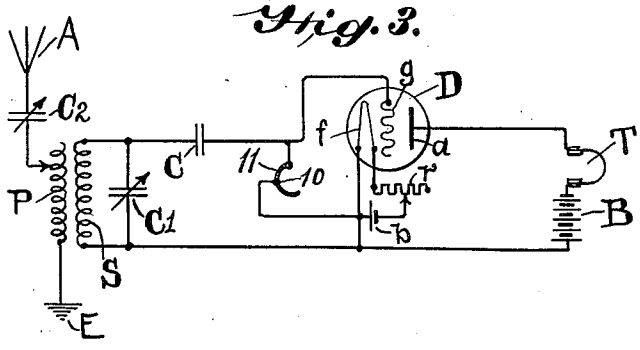
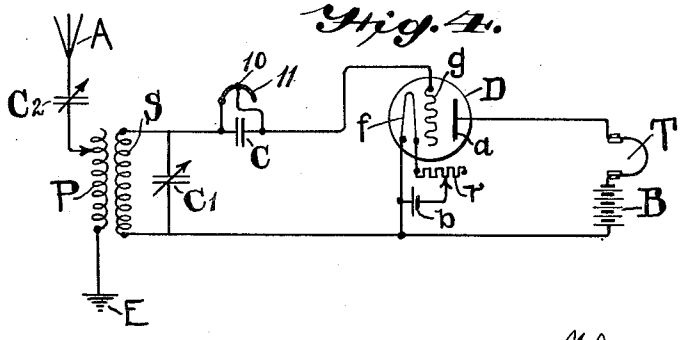


Fig. 4.



INVENTOR.

BY Thomas Appleby

Cornelius D. Ehret

his ATTORNEY.

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UNITED STATES PATENT OFFICE.

THOMAS APPLEBY, OF PHILADELPHIA, PENNSYLVANIA.

VARIABLE RESISTANCE.

Original application filed March 23, 1920, Serial No. 368,046. Divided and this application filed December 21, 1923. Serial No. 681,935.

My invention relates to rheostats or adjustable resistances continuously variable by infinitely small increments and utilizable, particularly when the resistance values are high, for effecting leakage paths in the circuits of or between the electrodes of audions or similar devices utilized in radio systems, or for effecting coupling between circuits of co-operating audions.

In accordance with my invention the resistance element consists of contacting material, such as graphite or equivalent, abraded or worn from a fixed contact of graphite or equivalent by movement with respect to and in engagement with said contact of a rotatable non-conducting base or support, sufficiently rough for the purpose.

This application is a division from my prior application Serial Number 677,163, filed November 26, 1923, which is in turn a division from my prior application Serial Number 368,046, filed March 23, 1920.

My invention resides in a rheostat or adjustable resistance of the character hereinafter described and claimed.

For an illustration of one of the various forms my invention may take, reference is to be had to the accompanying drawing, in which:

Fig. 1 is a sectional view of a rheostat structure embodying my invention.

Fig. 2 is a side elevational view of a rotatable structure carrying the resistance element.

Figs. 3 and 4 are diagrams illustrating applications of my variable resistance.

Referring to Figs. 1 and 2, the knob or disk 28 of insulating material, such as hard rubber, fibre, moulding material and the like, is carried by and rotatable with respect to the fixed member or panel 29, preferably of insulating material. A washer 30 may intervene between the fixed member 29 and the shank or extension 28^a on the rotating member 28 for effecting a bearing surface for the rotating structure. Within the rotatable structure in the metal bushing 28^b into which threads the screw 31 extending through a hole in the member 29, the screw serving as a pin or shaft upon which the rotatable structure rotates with respect to the member 29. A spring 32 engages under the head of the screw 31, holding the parts in the position indicated in Fig. 1, and effecting also electrical connection with the fixed circuit terminal or binding post 37. The fixed contact 10, of graphite or other suitable abradable resistance or conducting material, slides longitudinally within the metal tube or sleeve 33 and is firmly pressed against the inner face of the knob or disk 28 by the flat spring 34 which is held by and electrically connected with the other fixed circuit terminal or binding post 35 upon the member 29. The set screw 36 effects the double purpose of locking the rotatable member 28 to screw 31 and of completing electrical connection from binding post 37 to the washer or disk 38 which is in contact with the enlarged portion 13 of the resistance element 11 consisting of graphite or equivalent material of the fixed contact 10 abraded therefrom by and deposited on the side face of the knob or disk 28. Contact 10 is of relatively low electrical resistance due to its size, but when its material is deposited in the form of a thin film or coating 11 it forms a path of extremely high resistance, the enlarged portion 13 serving to make a relatively low resistance connection with the washer 38 which is in electrical communication with the binding post 37.

It will be understood that prior to the first rotation of member 28 in engagement with the contact 10, the resistance of the uncoated face of the member 28 between the contact 10 and the previously prepared portion 13 is practically infinite, but as the member 28 is rotated in engagement with the contact 10 there will be deposited upon the member 28 a thin film or coating 11 of material abraded from the contact 10, in much the same manner as a graphite line is drawn upon paper with an ordinary lead pencil. The film or coating 11 thus applied to the member 28 will have a relatively high electrical resistance and continuous variation of this resistance by infinitely small steps may be secured by rotating the member 28 to such position with respect to the contact 10 as desired until a suitable value of resistance between the binding posts 35 and 37 is obtained. Each successive excursion of the member 28 with respect to and in contact with the fixed contact 10 will cause more of the material of contact 10 to be deposited on the member 28, and thus the resistance of the film 11 will, at least after a few such excursions, be decreased. It will therefore

be noted that the resistance element 11 has the property of resistance-decrease with use. Should the resistance of the element 11 eventually become too low the coating 11 may be erased with an ordinary rubber eraser in the same manner as a pencil mark is erased, and a new film may be deposited upon the member 28 as before.

Referring to Figs. 3 and 4 there is indicated at D a thermionic vacuum tube of the audion type, comprising anode *a*, grid *g*, and cathode or filament *f*. The grid circuit is associated with radio receiving apparatus, in well known manner, and in the grid circuit is included the usual grid condenser C when the device D is to be utilized as a detector. The grid circuit includes the variable tuning condenser C^1 and the secondary S of the coupling transformer whose primary P, together with the variable tuning condenser C^2, is connected in circuit between the antenna A and earth or counter-capacity E. In the anode circuit are connected as usual the telephone T and the battery B. As usual the filament or cathode F receives its current from the battery *b* through the adjustable resistance *r*.

The adjustable resistance of the character hereinbefore described is connected, in Fig. 3, directly to the grid *g* and cathode *f*, while in Fig. 4 the variable resistance is connected in shunt to the grid condenser C.

It will be understood however that the variable resistance of the character described may also be used for coupling the anode circuit of a thermionic vacuum tube to the grid circuit of another, as explained and described in my aforesaid prior applications.

What I claim is:

1. A variable resistance comprising a fixed support, a conducting shaft carried by and passing through said support, a spring on one side of said support engaging said shaft and electrically connecting therewith, a member of insulating material rotatable about the axis of said shaft, a fixed contact or abradable conducting material engaging said rotatable member to form thereon a resistance element, and an electrical connection from said shaft to said resistance element.

2. A variable resistance comprising a fixed support, a conducting shaft carried by said support, a member carried by said support and engaging with said shaft and electrically connecting therewith, a member of insulating material rotatable about the axis of said shaft, a fixed contact of abradable conducting material engaging said rotatable member to form thereon a resistance element, an electrical connection from said shaft to said resistance element, and a member carried by said support and having an aperture receiving said fixed contact.

3. A variable resistance comprising a fixed support, a conducting shaft carried by said support, a member carried by said support and engaging with said shaft and electrically connecting therewith, a member of insulating material rotatable about the axis of said shaft, a fixed contact of abradable conducting material engaging said rotatable member to form thereon a resistance element, an electrical connection from said shaft to said resistance element, a member carried by said support and having an aperture receiving said fixed contact, and a spring pressing said contact against said rotatable member.

4. A variable resistance comprising a fixed support, a conducting shaft carried by said support, a member carried by said support and engaging with said shaft and electrically connecting therewith, a member of insulating material rotatable about the axis of said shaft, a fixed contact of abradable conducting material engaging said rotatable member to form thereon a resistance element, an electrical connection from said shaft to said resistance element, a member carried by said support and having an aperture receiving said fixed contact, a spring pressing said contact against said rotatable member, and a circuit terminal connected with said spring.

5. A variable resistance comprising a fixed support, a member carried thereby and having an aperture, a fixed contact of abradable conducting material disposed in said aperture, and a rotatable member carried by said support and engaging said contact to form on said rotatable member a resistance element.

6. A variable resistance comprising a fixed support, a rotatable disk, a headed member about whose axis said disk is rotatable, a fixed contact, a resistance element on said disk in the form of a thin film, said resistance element electrically connected with said headed member, a conducting member carried by said support and engaging under the head of said headed member and electrically connecting therewith, and a spring carried by said support and holding said contact against said film.

7. A variable resistance comprising a fixed support having an aperture, a rotatable disk, a contact of abradable conducting material loosely supported in said aperture, and spring means for biasing said contact into engagement with said rotatable disk to form thereon a resistance element.

8. A variable resistance comprising a fixed support having an aperture, a binding post carried by said support, a rotatable disk, a contact of abradable conducting material loosely supported in said aperture, and spring means held by said binding post and engaging said contact for biasing the latter

into engagement with said rotatable disk to form thereon a resistance element.

9. A variable resistance comprising a fixed support, a binding post carried thereby, a disk, a member passing through said support for rotatably supporting said disk, a fixed contact of abradable conducting material engaging said disk to form thereon a resistance element, and spring means connecting said binding post and member.

10. A variable resistance comprising a fixed support, a rotatable member, a member for supporting said rotatable member, a fixed contact of abradable conducting material engaging a face of said rotatable member to form thereon a resistance element, and another member carried by said rotatable member for effecting a conductive connection between said second-mentioned member and said resistance element.

11. A variable resistance comprising a fixed support, a rotatable member having an aperture, a member for supporting said rotatable member, a fixed contact of abradable conducting material engaging a face of said rotatable member to form thereon a resistance element, and another member received by the aperture in said rotatable member for conductively connecting said second-mentioned member and said resistance element.

12. A variable resistance comprising a fixed support, a binding post carried thereby, a rotatable member having an aperture, a member electrically connected to said binding post passing through said support for supporting said rotatable member, a fixed contact of abradable conducting material engaging a face of said rotatable member to form thereon a resistance element, and a member passing through the aperture of said rotatable member for conductively connecting said second-mentioned member and said resistance element.

THOMAS APPLEBY.