June 18, 1929. C. P. BROCKWAY 1,717,913

GRID LEAK

Filed Jan. 28, 1924

Fig. 1.

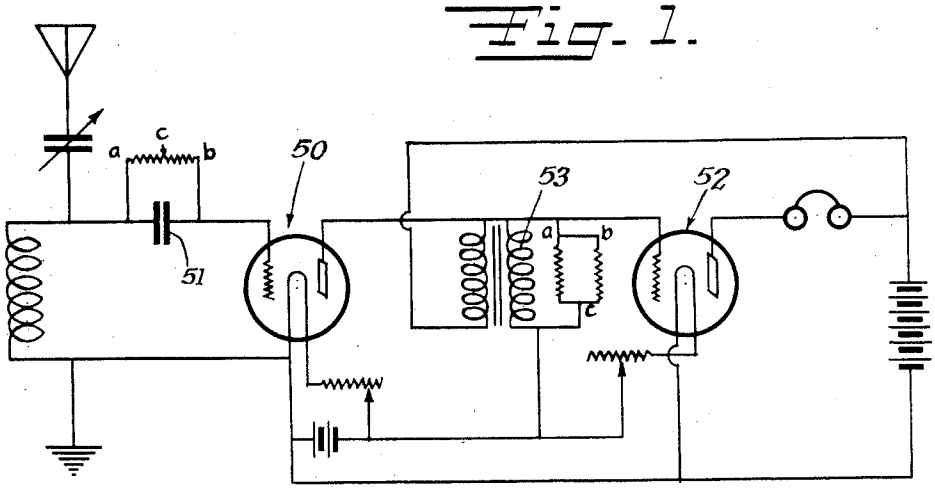


Fig. 4.

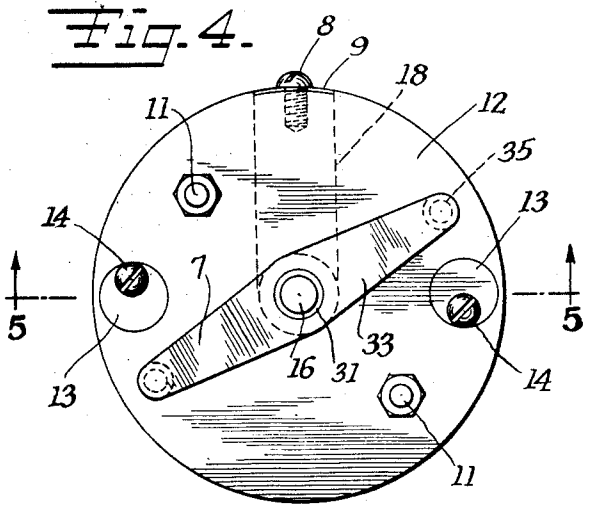


Fig. 2.

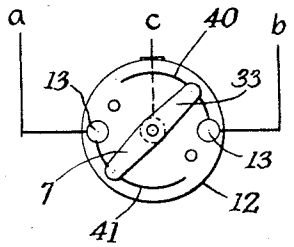


Fig. 3.

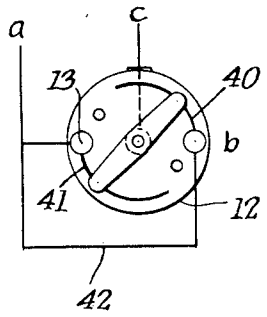
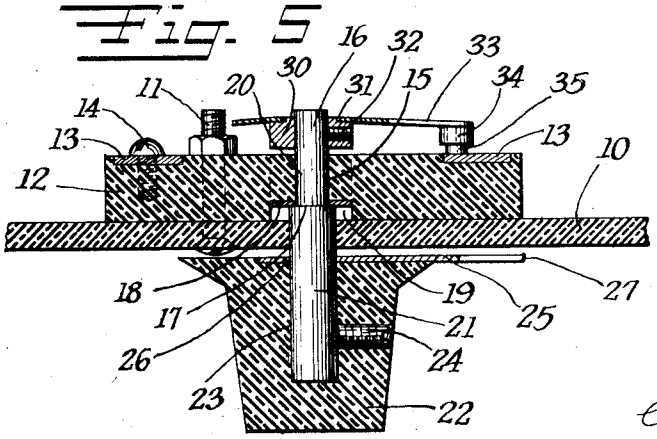


Fig. 5



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Patented June 18, 1929. 1,717,913

UNITED STATES PATENT OFFICE.

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GRID LEAK.

Application filed January 28, 1924. Serial No. 688,986.

This invention relates to high resistance rheostats and has particular application to radio receiving circuits employed in the capacity of a "grid leak".

The invention generally is comprehended in an adjustable rheostat, a portion of the conductor of which is an abradable substance as graphite, the same being deposited on an insulating surface, associated with means such as a lead inset in the base block for preventing a break in the graphite circuit.

Among the important objects of the invention is the provision of a high resistance non-inductive rheostat employing an abradable material which is not easily placed in inoperative condition through the continued manipulation of the movable parts of the device.

Another object is to provide in a conducting path of powdered carbon or graphite a secondary conducting material which forms an intimate connection and union with the powdered material.

Another important object is the utilization in a resistance containing a powdered graphite circuit of means permitting variation in the normal range of resistance values.

An important object is the provision of a rheostat having specific utility in association with the grid of an electron tube when employed as a detector or amplifier in a receiving radio circuit.

Still another object is contemplated in the specific construction of a rheostat, whereby a compact and partially yielding junction of the various parts is obtained without the additional elements other than are essential to the assembly and operation of the device. Further objects will become apparent from a consideration of the specific embodiment of one form of the invention, which may be preferred, hereinafter described and illustrated in detail in the accompanying drawings.

Referring to the drawings:

Fig. 1 is a diagram of a common form of receiving circuit, showing the application of the rheostat to the detector and amplifier tubes;

Fig. 2 is a view showing the series circuit connections of the rheostat;

Fig. 3 is a view showing the parallel circuit connections of the rheostat;

Fig. 4 is a view of the bottom side of the rheostat;

Fig. 5 is a section through the rheostat along the lines 5—5 of Fig. 4.

Referring to Figs. 4 and 5 of the drawing, there is illustrated a panel board 10 to which is attached, as by bolts 11, the base block 12 of the rheostat, the same being formed of glass, bakelite, hard rubber or other material of sufficiently high dielectric properties.

At diametrically opposite points on the rear face of this plate, adjacent the periphery thereof are inset circular flat leaden plates 13, the same being held in place by means of machine screws 14 which are positioned preferably at one side of the plates. Positioned centrally of the base 12 is an aperture 15 in which is mounted a spindle 16 adapted to operate the contact elements. This spindle has a shoulder 17 which contacts against a plate 18 set in a recess 19 on the front or panel side of the base, this shoulder dividing the spindle into a section 20 having a smaller diameter and a section 21 having a larger diameter, the section 20 passing through the base block 12 and the section 21 passing through the panel board 10 and extending on the front side of the panel. To the portion 21 of the spindle is attached appropriate means for rotating the spindle and setting the same at predetermined degrees of movement, in the present instance these means being shown as a knob 22 formed of suitable dielectric material, the same being formed with a recess 23 adapted to receive the portion 21 of the spindle. A set screw 24 in the side of the knob is utilized to hold the knob in fixed relationship to the spindle.

Means for indicating the set of the rheostat is provided for in a pointer arm 25 placed in a groove 28 in the base of the knob 22, the pointing finger 27 of which is adapted to pass over appropriate graduations formed upon the panel board surface. These graduations may be merely arbitrary markings, by means of which the operator may determine the change of resistance in terms of number of degrees of rotation of the device.

The portion 20 of the spindle 16 extends beyond the base block 12 and is adapted to receive a collar 30 having an annular recess 31 and held from rotation and removal by means of the set screw 32. The contact arms 33 and 7 extending on both sides of the spindle 16 are preferably formed of a single cross

plate of resilient sheet metal which is apertured at its center to fit in the annular recess 31 and at the outer ends thereof carries the contact cups 34 in which a plug or pencil 35 of graphite, carbon or similar abradable, conductive material is adapted to be inserted. The arms 33 and 7 are mounted on the rheostat in such a way as to maintain a certain amount of tension, thereby holding the shoulder 17 of the spindle in contact with the washer 18 and at the same time causing compression of the graphite on the surface of the base plate. By this method of assembly, it is apparent that as the graphite wears away, the flexible arm will adjust itself, thereby maintaining the parts in closely assembled position.

The recess 19 is in the form of a channel extending from the aperture 15 to the edge of the base block 12. In this channel the plate 13 extends transversely across the edge of the same, and is held in position by the screw 8.

The machine screws 14 and 8 serve as terminals for the electric circuits, the terminals 14 being adapted to connect in the main circuit in series relationship to the conducting elements of the switch while the terminal 8 is adapted to be used where the rheostat is used in parallel to the circuits.

Considering now the operation of the rheostat, it is necessary in order to make the device operative to first rotate the arms 33 and 37 causing by said rotation the two curved marks 40 and 41 to be formed on the base of the plate by the graphite or other conductive abrasive material positioned in the ends of the arms. The marks thus formed are paths for the passage of electricity but because of the small cross sectional area of the paths thus formed, the resistance is very high. Referring to Fig. 2, the current entering the rheostat at *b* passes through the lead plate 13, graphite path 40, rheostat arms 33 and 7, graphite path 41, lead plate 13 to circuit *a*, this constituting the series connection. In Fig. 3, the circuit is connected to terminals *a* and *c*, the current passing from *c* through the plate 18 to the contact arm and thence to both branches 7 and 33 of the arm to the graphite paths 40 and 41, the current from path 41, passing directly to the terminal *a* and the current from path 40 passing by means of shunt 42 to terminal *a*. This constitutes a parallel connection. It is apparent further that by removing the shunt circuit 42, which may be applied exteriorly of the rheostat, and otherwise leaving the connections as in Fig. 3, there will be a series connection for the circuit only through the path 7, 41 from *c* to *a*, thus decreasing the resistance by half. It is obvious further that additional variations of the resistance may be obtained by providing different conducting materials for either path such as graphite in one path and lead in the other. Additional variations in the resistance may be obtained by varying the width of the lines 40 and 41 or by varying the resilient pressure of the arm 33, the greater the pressure, the greater the amount of the material deposited along the base.

A distinctive feature of the invention resides in the utilization of the lead plates 13 adjacent the machine screw terminals 14. Heretofore, in devices employing an abrasive material, such as graphite, as a conducting path for electricity, it has been found that the junction point between the metal electrode and the non-conducting base is subject to rupture because of the gradual dispersion of the powdered granules forming the graphite. This dispersion is due largely to heating effects and to the fact that there is little natural adhesion between the graphite and the particular metals employed. Applicant has discovered that by using a small disc of lead inserted so as to have its surface flush with that of the plate so that the pencil may ride over the same, there is formed a practically permanent pathway over the junction point of the lead and graphite, this being due primarily to the natural coherence of the lead with graphite or carbon. There is thus maintained constantly a circuit through the graphite which is not diminished by heating effects and which consequently makes possible a more accurate and uniform adjustment than would be possible where this particular construction is not employed.

There are several specific applications in which the rheostat has marked utility. In Fig. 1, there is illustrated a common type of a receiving circuit in which the rheostat is employed as a grid leak for the detector and amplifier tubes. In the case of a detector tube 50, the rheostat is connected with its resistance circuit in series *b*—*a* in parallel about the condenser 51. In the case of an amplifying tube 52, the rheostat is indicated as connected with its resistance circuits in parallel *a*—*c* and *a*—*b*—*c* and these circuits in parallel with the secondary 53 of the audio-frequency transformer. This particular arrangement of the rheostats with a series connection in the detector circuit and a parallel connection of the resistances in the amplifier circuit, has been found particularly advantageous in receiving circuits of this type, inasmuch as the amplifier is more sensitive to small changes of resistance in the grid circuit than is the detector and the utilization of rheostats permitting easy adjustment of resistance through very small ranges such as is provided by the device here described has been found highly advantageous.

While there has been described and illustrated a single embodiment only of the invention, it should be understood that the invention is not limited thereto, the scope of the invention being determined only by the claims hereto appended.

What is claimed is:

1. In a rheostat, the combination of a base block having a recess therein, a terminal connector on said block, a lead plate within said recess and having its outer surface flush with the surface of said block and electrically connected with the connector, a movable contact arm pivotally mounted on the block, and an abradable resistance material secured to the arm and adapted to contact with the plate and block, and form by deposition a current conducting path thereupon.

2. In a rheostat, the combination of a base block having a recess therein, a stationary terminal connector mounted therein, a movable contact member mounted on said block, an abradable conductor positioned on said movable member adapted to form by deposition on said block a conducting path, and means including a lead plate within said recess and flush with the surface of said block for preventing the rupture of said path.

3. In a rheostat, the combination of a dielectric base having a recess therein, an arm pivotally mounted on the base, a means associated with said arm adapted to form a conducting path on said base, and a lead plate in said connecting path positioned in the recess in said base and flush with the surface thereof in said conducting path.

4. In a rheostat, the combination of a base block having an aperture therethrough, a spindle positioned in said aperture, said spindle having an annular shoulder adapted to engage one face of the block, a resilient cross plate secured to the spindle on the side of the block opposite to that with which the spindle shoulder engages, abradable contacts in the ends of said plate and in engagement with the block; a connection terminal in the path of each contact, and a connection terminal electrically connected to said spindle.

5. In a rheostat, the combination of a dielectric base block, a spindle positioned thereon, a resilient cross plate mounted transversely on said spindle, abradable contacts on said plate in engagement with the block, means for holding said spindle on the block a pair of connection terminals in the path of said contacts and flush with the surface of said block, there being recesses provided in said block to receive said contacts, and a connection terminal electrically connected to said spindle.

6. In a grid leak for radio apparatus, the combination of a base block, a plate pivotally mounted on said block, abradable contacts on said plate, means for electrically connecting said arm to an electrical circuit and connection terminals in the path of said abradable contacts, said terminals comprising metal plates set in recesses formed in said block and having surfaces flush with the surface of said block.

7. In a gridleak, the combination of a base block; a plate pivotally mounted intermediate its end upon said block; abradable contacts secured on opposite ends of said plate, terminals on said block, lead plates in the block forming part of the terminal connectors and flush with the surface of said block, said block having recesses to receive said plates whereby said contacts may slidably engage said plates; and means for electrically connecting the pivot plate on said contacts.

8. In a gridleak, a dielectric base block; a plurality of abradable contacts movable with respect to said block and adapted to bear thereagainst; a terminal electrically connected to both of said contacts; and a plurality of terminals mounted in said base, one terminal in the path of each contact and having portions thereof flush with the surface of said base, said base being provided with recesses to receive said portions.

In testimony whereof, I affix my signature.

CARL P. BROCKWAY.

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CERTIFICATE OF CORRECTION.

Patent No. 1,717,913. Granted June 18, 1929, to

CARL P. BROCKWAY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, lines 27 and 28, claim 3, for the word "connecting" read "conducting", and lines 29 and 30, strike out the words "in said conducting path"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of October, A. D. 1929.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)