March 20, 1928. 1,663,166

L. L. JONES

VARIABLE GRID LEAK

Filed March 16, 1923

Fig. 1,

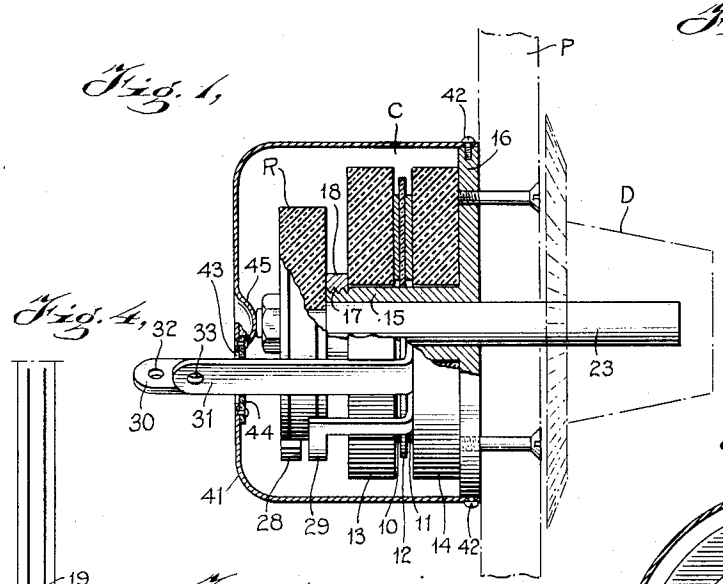


Fig. 6.

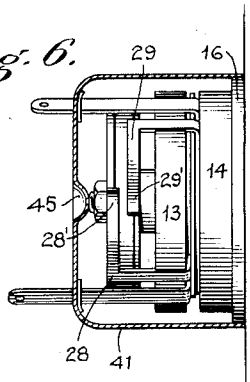


Fig. 4,

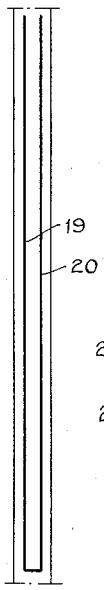


Fig. 3,

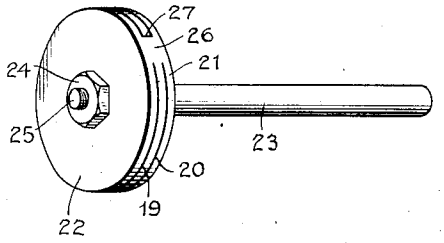


Fig. 2,

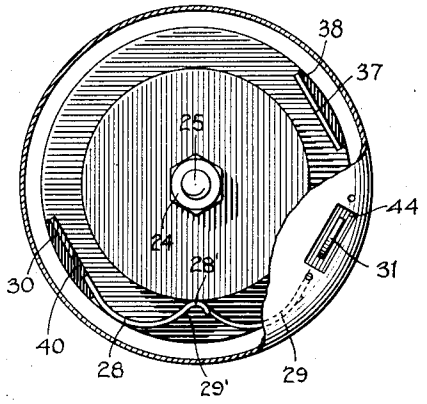
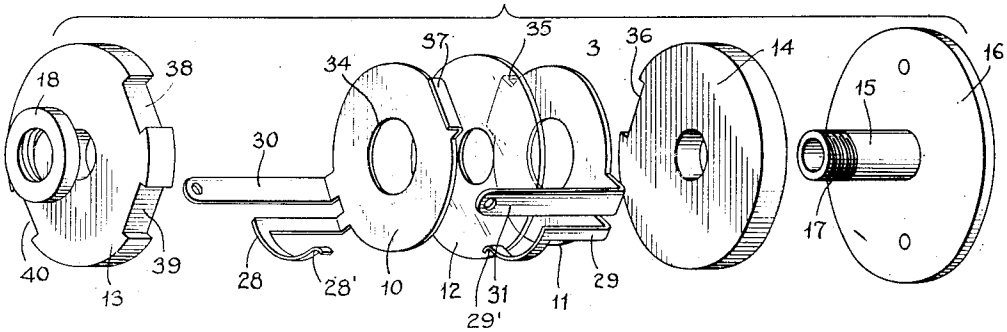


Fig. 5,



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UNITED STATES PATENT OFFICE.

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VARIABLE GRID LEAK.

Application filed March 16, 1923. Serial No. 625,484.

This invention relates to the control of thermionic or electron tubes, and more particularly to a grid leak device designed for radio receiving circuits; and has special reference to the provision of a new and improved variable grid leak.

As is well known, to control the current flowing between the plate and the filament of a thermionic or electron tube in a radio circuit, the potential on the grid of the tube relatively to that of a terminal of the filament is controlled by means of the so-called "grid leak," the function of which is to present a leakage path across a grid condenser to maintain the potential of the grid at some desired value. It is also well known that different circuits require grid leaks of different values, the value being dependent upon the operating characteristics of a given tube and its use as a detector, amplifier or oscillator, and upon such factors as the design of the apparatus, the type of antenna used, and the ground system employed; and to meet these varying requirements grid condensers have been combined with variable resistances to produce variable grid leaks which may be adjusted to suit the different needs of service.

To be adaptable for the different circuits and tubes met with in practice, it has been found that the range of resistance change of a variable grid leak should be fairly large, a variation of from about ½ to 10 megohms having been found a desideratum, if not indeed a requirement, to suit the many different conditions presented. The adjustment for many circuits and tubes is moreover highly sensitive, and consequently another desideratum in the design of a serviceable variable grid leak is the capability of permitting small resistance changes when the grid leak is adjusted to produce a setting. Furthermore, in view of the fact that circuits and tubes of widely different characteristics and properties may be equally sensitive at widely different values of leak resistance, it is very desirable to provide a leak resistance which is uniformly changeable when varied, and one preferably which possesses a straight-line calibration curve. To provide a variable grid leak which is characterized by the desired large range of resistance variation and a variation over a long adjustment path to afford sensitive control of tubes along with uniform sensitiveness over the large range of adjustment is a prime object of my present invention.

In the construction of variable grid leaks, the resistance terminals are connected to the condenser electrodes or plates, and according to prior commonly employed designs, the means connecting the condenser and resistor are constructed to provide one or more connecting terminals or binding posts for the grid leak device, the movable contact arm for the resistor being sometimes employed as one of the connecting means. I have found that these prior grid leak structures are open to the common objection of producing loose contacts, especially after some use, either at the connecting terminals or at the dial shaft carrying the contact arm, with the result that the adjusted value of leak resistance is varied, and not only is the adjustment vitiated, but an undesirable loose connection in the set is produced. This disadvantage I have found especially pronounced in that type of grid leak construction wherein the resistance element is made up of graphite streaks or lines produced on an insulating surface with the aid of a pencil, the integrity of the electrical connection between the graphite surface and the connecting terminals and condenser electrodes being difficult to maintain. To obviate these disadvantages and objections, and to produce a variable grid leak device in which the condenser and resistor units are connected so as to minimize liability of loose contacts, while at the same time providing for ready severability between the condenser and stator units, is another prime desideratum of my present invention.

Another important problem in the design of a variable grid leak is that of eliminating the troublesome changeable capacitive effects in the circuit produced by the changing position of the hand or body of the operator in obtaining a setting of the leak. The connection of the grid leak to the high potential side of the grid circuit renders it particularly difficult to obtain the desired setting, the large differences of potential between the circuit and the operator's hand producing relatively large capacitive changes and a consequent unbalancing effect on the circuit. To eliminate this objection my present invention further comprehends the

provision of a grid leak device in which the parts are so electrostatically shielded as to make an adjustment of the same entirely unaffected by the hand of the opeartor.

The principal objects of my invention may be said to include, besides the provision of a variable grid leak structure having the characteristics and capable of producing the results above-mentioned; the further provision of a grid leak structure in which a resistor unit is so combined with a condenser unit as to permit ready detachability of the former for purposes of repair and replacement without interfering with the integrity of the latter; the still further provision of a grid leak device designed so as to be mountable on a support such as a panel; and the provision of a variable grid leak made of a few parts so inter-related as to permit rapid manufacture and ease of assembly to provide a low cost unit.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, my invention consists in the elements and their relation one to the other, as hereinafter particularly set forth and sought to be defined in the claims; reference being had to the accompanying drawings wherein:

Fig. 1 is a side elevational view of my grid leak device showing parts in section and showing the same attached to a support such as a panel,

Fig. 2 is a rear view of the same with parts broken away,

Fig. 3 is a perspective view of the resistance element employed,

Fig. 4 is a development view of the peripheral wall or surface of the resistance element,

Fig. 5 is a view showing the assembly of parts of the grid leak device, and

Fig. 6 is a view of the grid leak on a reduced scale.

Referring now more in detail to the drawings, the variable grid leak of my invention comprises essentially a condenser unit generally designated as C, and a variable resistor unit generally designated as R associated therewith, the said variable grid leak being preferably constructed so as to be mountable on a support such as a panel P and operable by means of a front dial D.

The condenser unit desirably comprises the opposite condenser plates 10 and 11 and an intermediate dielectric plate 12 which may comprise a sheet of mica, locked between the two spaced insulating blocks 13 and 14 carried on a sleeve 15 which may be formed integrally with a front supporting plate 16, the said sleeve being threaded as at 17 for receiving a lock nut 18, the insulating blocks 13 and 14 and the condenser elements therebetween being held between the front plate and the lock nut, the sleeve 15 and the nut 18 forming in effect a tie bolt for holding these elements securely in assembled position.

As hereinbefore mentioned, one of the principal objects of my invention comprehends the provision of a variable grid leak device which is characterized by a large range of resistance variation and a resistance variation over a long adjustment path so as to afford sensitive control of tubes, along with the provision of a uniform sensitiveness over the large range of adjustment. To accomplish these and other ends, as will become clearer hereinafter, the resistor R comprises a resistance element formed by producing two concentric lines 19 and 20 composed of a high resistance material produced on the peripheral wall 21 of a disk-like member 22 made of an insulating material such as hard rubber or bakelite, the said disk-like member being preferably mounted on an operating spindle or shaft 23 and secured thereto as by means of the nut 24 received by the threaded end 25 of the said spindle. The concentric resistance lines 19 and 20 may comprise graphite streaks or lines produced with the aid of a pencil, and may be made by placing the resistance element in a lathe and applying the point of the pencil to spaced parts of the peripheral wall 21 to effect two continuous and circular pencil strokes, after which a portion of the lines so produced may be erased as at 26 and the lines connected at one end by means of the cross stroke 27, two spaced discontinuous lines connected at one end being thereby provided as clearly shown in development in Fig. 4 of the drawings. By the provision of this resistance element, it will be apparent that I am enabled to provide not only a very large resistance range such as a range of from about ½ to 10 megohms, but a resistance range extending over a long path, so that when a contact means is moved over and relatively to the resistance lines 19 and 20, a variation over a long adjustment path to afford the desired sensitive control is obtained, and that moreover I am enabled to obtain uniform sensitiveness over the whole path of adjustment, the resistance element possessing a substantially straight-line calibration curve.

As hereinbefore stated, it is a desideratum of the present invention to produce a variable grid leak in which the condenser and resistor unit are so associated and connected as to produce efficient contacts and to minimize the liability of looseness of contacts, while at the same time providing for ready severability between the condenser and resistor units, with the parts so inter-related as to permit of effective capacitive shielding. To these and other ends, the resistance element of the resistor unit is preferably made movable with the contact arms therefor

preferably made stationary, the resistance element comprising to this end the rotatable disk-like member 22 heretofore referred to, the spindle 23 of which is receivable by are journalled within the sleeve 15 of the condenser unit, the said spindle 23 extending through said sleeve and being constructed to receive the operating dial D and the contact means comprising to this end the spaced contact arms 28 and 29 which are formed preferably integrally with the spaced condenser plates 10 and 11 respectively and produced from blanks of sheet material as will be detailed further hereinafter, the said contact arms 28 and 29 being so contoured as to provide the spaced contact fingers 28′ and 29′ arranged in overlapping engagement as clearly shown in Figs. 1, 2 and 6 of the drawings, and in contacting relation with the spaced resistance lines 19 and 20. Also formed integral with the spaced condenser plates 10 and 11, I provide the connecting terminals for the grid leak 30 and 31, which terminals may be provided at their outer ends with the apertures 32 and 33 for the reception of connecting conductors. By the provision of this construction it will be seen that the contact arms are efficiently united to the connecting terminals of the grid leak device so as to eliminate the possibility of any looseness of contact therebetween, these parts being moreover efficiently connected electrically to the condenser plates so as to provide the desired permanent interconnection between the condenser and resistor units. Moreover, it will be evident that with the provision of this arrangement the resistance element may be quickly detached from the condenser unit, as when it is desired to repair or replace the same, by simply withdrawing the disk member 22 and its attached shaft or spindle 23, this being accomplished without affecting the identity or integrity of the contact arms or connecting terminals.

Referring now to Fig. 5 of the drawings, I show the manner of making and assembling the condenser unit and its mounting. For facilitating the process of manufacture, the condenser plates and the integral parts thereof are produced from the same blanks, each of which is apertured as at 34 for receiving the supporting sleeve 15, the integral contact arms 28 and 29 and the connecting terminals 30 and 31 being produced by bending these parts to opposite sides of the respective plates 10 and 11. The plate 11 is further provided with an integral tab 35 which is turned down or bent over to be received by a notch 36 in the insulating block 14, and the plate 10 is also provided with a tab 37 which is bent or turned down in the opposite direction to be received by a notch 38 in the insulating block 13, the condenser plates by this means being locked to the insulating blocks so that all the condenser parts are secured together in a unit. The insulating block 13 is also provided with the recess or notch 39 for receiving the contact arm 29 and connecting terminal 31, and with the recess or notch 40 for receiving in a similar manner the contact arm 28 and the connecting terminal 30. In assembling the condenser, as will be evident, the supporting sleeve 15 is threaded through the condenser parts with the latter locked in position and the whole secured together by means of the lock nut 18. After assembling the condenser, the resistance element is then mounted thereon by inserting the spindle 23 in the supporting sleeve 15.

For housing the condenser and resistor units, and for capacitively shielding the same, I provide a casing 41 which may be connected to ground in a receiving circuit, and which is desirably secured to the front supporting plate 16 as by means of the securing elements 42, the said casing being provided with a plurality of slits 43 at its base through which may project the connecting grid leak terminals 30 and 31. If desired insulating washers or bushings 44 may be provided at the slits 43. For the purpose of holding the resistance element in position, and for the further purpose of electrically connecting the shaft or spindle 23 to the casing, the base of the casing is provided with an inwardly projecting portion 45 which engages the end of the shaft 23 as appears clearly from a consideration of Figs. 1 and 6 of the drawings. By the provision of the casing 40 and its connection to the metallic front plate 16 and to the metallic shaft 23, I provide a complete capacitive or electrostatic shielding for the grid leak parts so as to make an adjustment of the same entirely unaffected by the hand or body of the operator. The casing if desired may be made out of an insulating material, in which event the metallic plate 16 and the spindle 23, being positioned between the operator's hand and the grid leak parts, act as the electrostatic shield for the latter.

The method of making and using my variable grid leak will in the main be apparent from the above detailed description thereof. It will be further apparent that I have provided a variable grid leak in which the resistor and condenser elements are efficiently interrelated with the former capable of being removed or replaced for repairing the graphite streaks as for making any other repairs found necessary in practice without necessitating removal of the condenser parts. It will be further seen that the variable grid leak provided is adaptable for the different circuits and tubes met with in practice, sensitive adjustments being possible over a long range of resistance variation. The resistance and condenser elements, moreover, may be

cheaply produced and assembled with ease, and are so inter-related as to permit of the desired electrostatic shield.

While I have shown my device in the preferred form, it will be obvious that many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. A new article of manufacture comprising a fixed condenser, connecting terminals integral with opposite plates of said condenser, a resistance element and contact means for said resistance element formed integrally with said condenser plates.

2. A variable grid leak comprising a fixed condenser including opposite condenser plates and a grid leak resistor including a movable resistance element and stationary contact means in electrical engagement with the movable resistance element, said stationary contact means being made integral with the plates of the condenser by forming a contact means and a condenser plate in the same blank of sheet material.

3. A variable grid leak comprising a condenser and a grid leak resistor including a movable resistance element having concentrically connected lines of a high resistance material, and stationary contact means associated therewith, said stationary contact means being integral with the plates of the condenser by forming a contact means and a condenser plate from the same blank of sheet material.

4. A variable grid leak comprising a condenser including opposite plates, a grid leak resistor including a movable resistance element having concentrically connected lines of a high resistance material, and a plurality of stationary contact arms associated therewith, said contact arms being integral with the opposite plates of the condenser, and grid leak terminals also integral with the plates of the condenser, a condenser plate, a grid leak terminal and a contact arm being formed from the same blank of sheet material.

5. A variable grid leak comprising a condenser unit, and a variable resistor including stationary contact means connected to the condenser unit and a movable resistance unit movable relatively to and in engagement with the contact means the resistance unit being removably mountable on the condenser unit.

6. A variable grid leak comprising a condenser unit including end plates each provided with an integral contact arm and a variable resistance unit detachably mounted on the condenser unit and movable relatively to and in contact with said contact arms.

7. A variable grid leak comprising a condenser unit including end plates each provided with an integral contact arm and a connecting terminal, and a rotatable resistance unit detachably mounted on the condenser unit and movable relatively to and in contact with said contact arms.

8. A new article of manufacture comprising a condenser including opposite condenser plates, a resistance element, contact arms for the resistance element integral with the condenser plates, and terminal connecting means integral with the condenser plates, a plate, a contact arm and a terminal being formed from a single blank of sheet material.

9. A device of the class described, comprising a supporting plate, a condenser mounted thereon having opposed apertured plates, and a variable resistor in circuit with the condenser and provided with an operating spindle extending through the apertures of the condenser plates and through the supporting plate.

10. A device of the class described, comprising a supporting plate mountable on a panel, a condenser mounted thereon having opposed centrally apertured plates, and a variable resistor in circuit with the condenser and provided with an operating spindle extending through the apertures of the condenser plates and through the supporting plate, the said plate forming an electrostatic shield for the condenser and resistor.

11. A device of the class described, comprising a supporting plate, a sleeve thereon, spaced insulating blocks on the sleeve, a condenser including condenser plates between the blocks and locked thereto, means for retaining the blocks and condenser on the sleeve, and a variable resistor comprising a rotatable resistance element having a shaft received by said sleeve.

12. A device of the class described, comprising a plate, a sleeve thereon, spaced insulating blocks on the sleeve, a condenser including condenser plates between the blocks and locked thereto, means for retaining the blocks and condenser on the sleeve, a resistance element comprising an insulating block provided with graphite lines on its peripheral wall, the said resistance element being provided with an operating shaft received by the said sleeve, contact arms for the resistance element integral with the condenser plates, grid leak terminals also integral with the condenser plates, and a casing enclosing the condenser and resistor parts.

Signed at New York city in the county of New York and State of New York, this 8th day of March A. D. 1923.

LESTER L. JONES.