July 12, 1932. B. J. THOMPSON 1,867,390

ELECTRIC DISCHARGE APPARATUS

Filed Aug. 2, 1928

Fig. 1.

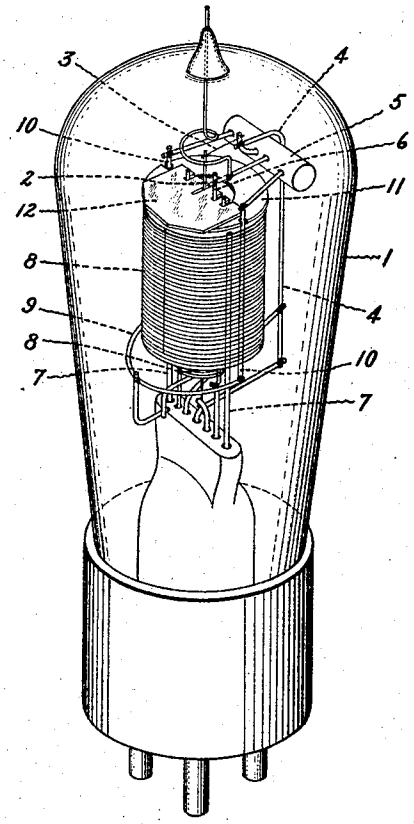
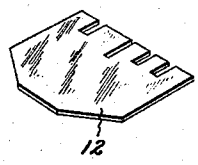


Fig. 2.



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Patented July 12, 1932

1,867,390

UNITED STATES PATENT OFFICE

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ELECTRIC DISCHARGE APPARATUS

Application filed August 2, 1928. Serial No. 296,901.

The present invention relates to electric discharge apparatus and more particularly to thermionic devices which employ electrode construction subject to vibration.

In several of the well-known types of thermionic devices employed as amplifiers, detectors, oscillators and the like, the source of electrons usually takes the form of a filament suspended between rigid supports. The length of the filament is such that when cold, it is fairly taut and centrally disposed of the electrode unit but under operating conditions, this member elongates and the normal tension gives way to slack. When the tube is operating and is subjected to jar or shock, the bowed filament tends to move or sway slightly toward the nearest electrode with the result that the operating characteristics of the device are impaired and considerable noise produced in the loud-speaker load. I have discovered that by providing a plurality of surfaces which bear lightly against the filament, on both sides thereof and near one of the supports, the vibratory energy of the heated member may be substantially dissipated and microphonic noise practically eliminated. This surface conveniently may take the form of a relatively thin flat disk provided with an aperture or slot that engages diametrically opposed surfaces of the filament, thereby producing a particularly effective rubbing or frictional contact of the compressional sort at this point. In order to maintain the centrally aligned position of the expanded filament, thus further reducing the amplitude of vibration, I may employ in connection with the disk, a flexible support which may serve as an energy supply conductor. In addition to the filament, the remaining electrodes are also susceptible to vibration or jar in the event that they are suspended in the envelope between wires of a pliable nature or supported solely from one end, adding their microphonic effect to that of the filament. However, the order of magnitude of the filament vibrational energy is ordinarily so much greater than that of the other electrodes that the latter, tho sometimes appreciable, nevertheless normally is considered negligible. I have found that the disk not only serves the purpose of damping out the vibrations of the filament but in addition rigidly maintains the position of the various other electrodes with which it contacts.

Among the objects of the present invention is to provide a simple and effective device which is readily adaptable to standard forms of receiver tubes and which will serve to dissipate the vibrational energy of the filament, also that of the remaining electrodes. A more general object is to maintain the relative positions of the active members thereby to form a rigid electrode unit. Other objects and features will be apparent as the specification is perused in connection with the accompanying drawing in which Fig. 1 shows in perspective a screened-grid type of amplifier so-called with the improved vibration-reducing means in place, while Fig. 2 is an enlarged view of the attachment which forms the subject matter of the present invention.

Referring to Fig. 1, numeral 1 illustrates an evacuated glass envelope containing a plurality of electrodes shown in concentric arrangement and including the usual axially aligned rectilinear filament 2. The filament is supplied with current serially thru a horizontally disposed flexible conductor 3 and upright support 4 which is connected to one of the external contact plugs in the base. The lower end of the filament is attached preferably to a stout wire secured in the press, which wire serves as the other leading-in conductor. It will be evident that under operating conditions the hair-like wire 3 will take up substantially all the longitudinal expansion of the filament 2 at the same time maintaining the latter generally in the axially aligned position. The control grid member is of the ordinary spiral or helical form and is supported at the top from the glass anchor rod 5 by means of a wire having a vertical portion 6 and a horizontal part, the grid lead being attached to the latter and taken out through the top of the envelope in the well-understood manner. The anode comprises a hollow metal cylinder and is positioned within the envelope by means of two diametrically opposed rods 7 which are affixed in the press; one of the rods may be

extended through the bottom of the envelope to serve as a leading-in conductor. In order to intercept the electrostatic lines of force extending between the grid and anode members and which may give rise to self-sustained oscillations, there are provided two metallic cylindrically-shaped shields or screens 8, 8 in the form of helices arranged on each side of the anode, concentrically therewith, and electrically connected together by wire 9. A connection from the latter wire is led through the stem to one of the external contacts. The screen members are supported from the stem in a vertical position by a pair of wires 10, 10, secured to opposite sides of each member, only the wire nearest the observer on the outer screen being shown in full. The outermost cylinder 8 is preferably open at the bottom but closed at the top by means of a thin metal washer 11 in order to increase the electrostatic shielding effect. The tube as described up to this point constitutes the standard form of shielded or screened-grid amplifier so-called, disclosed and claimed in Patent No. 1,748,026, granted February 18, 1930, to Loris E. Mitchell.

It is evident that in the electrode construction as shown, there is considerable tendency for the upstanding filament, and the various other electrodes, particularly the grid, and their conductors, to vibrate or move in lateral directions, which movements under operating conditions, may cause variable tube characteristics, microphonic and other disturbances. The effect of these vibrations is accentuated in the case of the filament because of its relatively small inertia and by reason of the fact that it is rigidly supported only at the bottom, the upper end being flexibly mounted to allow for thermal expansion as stated hereinbefore. In accordance with the present invention, I provide a simple and effective device for rigidly maintaining the relative positions of the upper end of the various electrodes and their supports. The device takes the form of an insulating plate member or washer 12 preferably of relatively thin sheet mica and shaped in such manner as to encompass either the upper ends of the electrodes of their projecting lead wires. In the case of the screened-grid type of tube shown, I prefer to fashion the vibration-reducing means roughly into a semi-circular form with rectangular notches, slots or apertures positioned along the diameter at distances corresponding to the electrode or lead wire spacing. The number of slots correspond to the number of projecting leads or electrode supports it is desired to encompass and in the specific embodiment illustrated, there are four, one each for the filament and the control grid lead and two for the uprights which are welded to convolutions of the inner screen-grid 8 at diametrically opposite points. The dimensions of these slots, with the exception of that of the filament, are such as to provide a snug fit for the encompassed member. While the sides of the filament slot contact lightly with member 2, the depth preferably is considerably greater and extends well beyond the position of the filament in order not to place an initial strain on the latter in a direction normal to the line of the slots. The construction of member 12 may be simplified and the placing into position expedited by cutting the mica strip off to a length as will readily clear the outer screen-grid supports. It is apparent that the attachment may be quickly inserted into position and is simple to manufacture, also effectively spaces the various electrodes or lead wires at the proper distances apart with the result that the lateral movements of each member are precluded, particularly in a direction along the lines of the slots, hence, microphonic disturbances are substantially avoided. The frictional contact exercised at the sides of the filament slot does not interfere in substantial degree with the increase in length of the heated member due to thermal expansion; moreover, by applying the pressure substantially equally from opposite directions, there is no tendency to place a lateral strain or mechanical bias on the filament. The bearing or contact surface on the various electrodes and conductors is no greater than a heavy line in width because of the thinness of member 12; this narrowness of contact precludes any distortion or bending of the enveloped wire. In the event that there are no horizontally disposed leading-in conductors or supports at the upper portion of the tube, it may be feasible to utilize a circular or other symmetrical form of mica washer with holes drilled along the diametral line thru which the vertical wires may be threaded. The filament aperture obviously would take the form of a slot of elongated length and having width just sufficient to accommodate the filament. While I have described the mica washer as positioned at the upper end of the electrode structure, it will be evident that it may be placed in other portions of the structure, for example, at the lower end or in the middle of the filament if there be excessive vibration at this place. It is also to be understood that the vibration-reducing expedient is adaptable to all types of electrode arrangements provided there is present a convenient surface upon which the member may be supported or may bear.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In thermionic apparatus, a plurality of cooperating electrodes including a filamentary source of electrons, said electrodes terminating in parallelly extending conductors which are subject to vibration, and means comprising a strip of insulating material which individually embraces the extremity of

each of said conductors for damping out vibrations in the respective conductors.

2. In thermionic apparatus, a plurality of cooperating electrodes including a filament, and a common means for reducing the vibration of each of said electrodes including the filament, said means comprising a sheet of insulating material presented edgewise to the electrodes and contacting individually with the same.

3. In thermionic apparatus, a plurality of cooperating electrodes including a filamentary cathode, and means for preventing microphonic movement of the filament, said means comprising a flat disk presented edgewise to an extremity of the filament, said member being cut away so as to provide a frictional contact with a substantial part of the periphery of said filament.

In witness whereof, I have hereunto set my hand this 1st day of August, 1928.

BROWDER J. THOMPSON.