Aug. 20, 1935. A. W. HULL 2,012,129

NONRESONANT SUPPORTING DEVICE

Filed Dec. 15, 1928

Fig. 1.

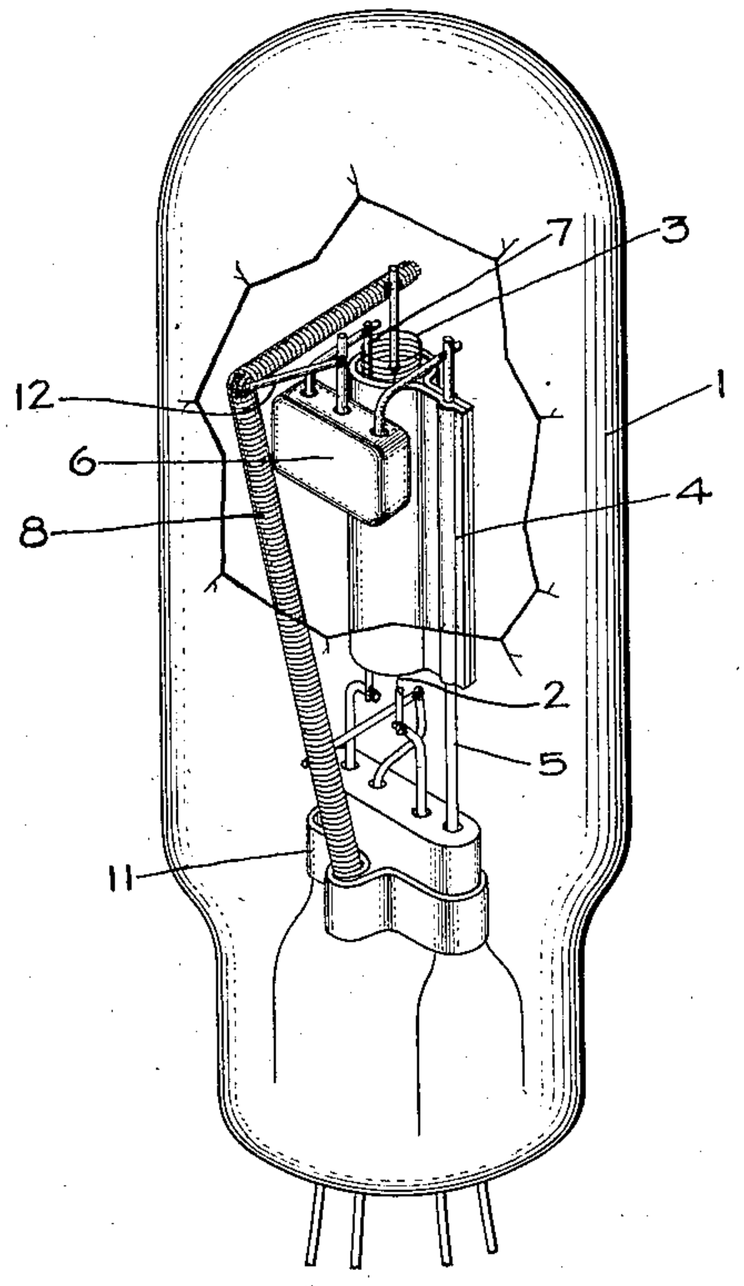



Fig. 2.

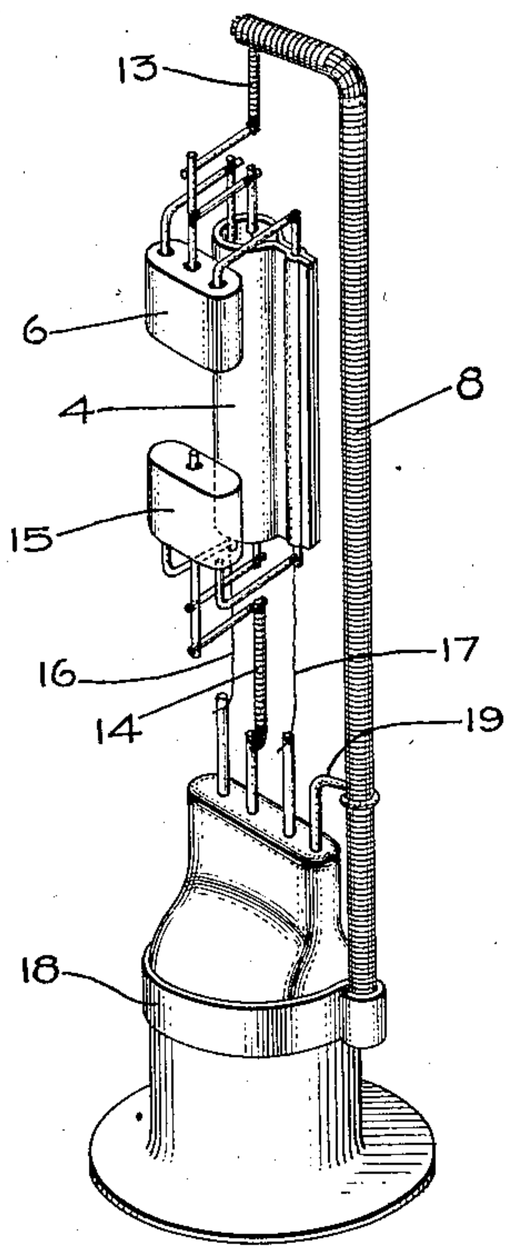
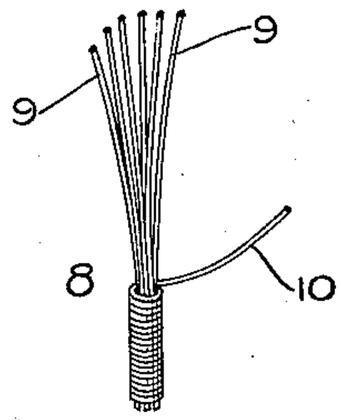



Fig. 3.

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Patented Aug. 20, 1935 2,012,129

# UNITED STATES PATENT OFFICE

2,012,129

## NONRESONANT SUPPORTING DEVICE

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Application December 15, 1928, Serial No. 326,169

9 Claims. (Cl. 250—27.5)

The present invention relates broadly to devices for supporting objects subject to vibration and for draining off the vibratory energy. The invention has particular application to thermionic apparatus wherein the vibratory movement of the electrodes gives rise to microphonic noises in the output circuit.

In three-electrode apparatus which usually comprises a filament, grid and anode, the heated member is suspended in a manner such as to allow for expansion under operating conditions. The filament support may take the form of a coiled spring in the larger apparatus but in the small receiver types of tubes, it has been found sufficient from a practical standpoint to provide rigid supports; however, in the case of the small tubes the filament, when heated, elongates and may tend to vibrate or sway slightly toward the adjacent electrode as the envelop is jarred. The vibratory period of the filament under these conditions is often within the audible range of frequency and the vibrations may give rise to electrical effects which cause howling or other sound phenomena in the loud speaker. While reference has been made more particularly to changes in position of the filament relative to the adjacent electrode, it is also to be understood that when the remaining electrodes, i. e., the grid and anode, are made of relatively light material or in case there is undue flexibility of their supporting means, these electrodes may also add their vibrational effect to that of the filament, resulting in still greater noise; however, the order of magnitude of the filament vibrational energy is usually much greater than that of the other electrodes considered either separately or as a unit.

I have discovered and in accordance with my invention that by providing a special form of support for the electrode structure not only is the vibrational energy of the filament effectively damped, but also such energy of this character as may be contributed by the various other electrodes.

Among the objects of my invention are to provide a substantially aperiodic support for members subject to vibration which will effectively drain the vibrational energy from said members, more particularly from the filament and other electrodes of a thermionic device; to provide a frictionally damped cable for suspending objects which tend to vibrate when subjected to jar and in general, to reduce or preferably entirely to remove the effects of vibratory energy from supported members. Other objects and features will be apparent as the specification is perused in connection with the accompanying drawing in which similar reference characters designate corresponding elements throughout the several views.

Fig. 1 is an elevational view in perspective of a thermionic discharge device equipped with the improved electrode support; Fig. 2 illustrates a modified form of electrode unit and supporting member, while Fig. 3 shows the improved supporting cable in the process of making.

Referring to Fig. 1, I have indicated at 1 an evacuated envelop containing a filamentary cathode 2, a helical grid 3, and an anode 4, the two latter members surrounding the filament in concentric fashion. The anode is formed preferably of a curved plate member with terminal flanges between which is clamped an upright support rod 5 secured in the press at the lower end and extended to serve as a leading-in conductor. The upper end of the rod carries a horizontally disposed member, one end of which is affixed in a block 6 of insulating material. The block is also supported by a wire attached to upright 7 which is spot-welded to the convolutions of the grid and which extends through the press to form another leading-in conductor. The position of the lower end of the filament is maintained by a stiff wire, the upper end being suspended from an aperiodic supporting member 8 described hereinafter which may also serve as a lead. This member takes the form of a stranded cable or rod comprising a plurality of parallel wires 9, specifically shown as six and preferably constituted of a metal, such as iron or copper, bound tightly together by a wire 10 preferably of the same material, as seen more clearly in Fig. 3. The length of cable may be finished off by securing together, by welding for example, the last few turns of the wire 10. The composite rod is bent at a suitable place along its length to give, generally speaking, an inverted V shape or cantilever effect for clearing the electrode structure. The lower end of the member 8 is affixed in position by a sheet metal clamp 11 which fits tightly over the press and pinches the upstanding support. In order to assure no turning movement between the aperiodic member and the clamp, a rigid wire 12 is provided, extending from the bend in the rod to the block 6.

It will be evident that when there is set up within or without the envelop mechanical disturbances which normally would displace the relative positions of the various electrodes or swing slightly the entire electrical structure about

the lower rigid wires as a fulcrum, pendulum fashion, resulting in undulations of audible character, the vibrational energy transmitted to the active member will be effectively dissipated in the aperiodic support 8.

While I do not wish to be limited to any particularly theory, it seems that when the rod 8 is subjected to stress with resulting strain as would be the case under the conditions noted, the wires 9 rub against one another and expend the superfluous energy as friction and generated heat, without passing the undulatory motion to the electrodes. The completeness and rapidity with which waves are damped and dissipated depend upon the design of the non-microphonic member. Among the factors which determine these characteristics are the spacing between adjacent turns and the number, size and nature of the wires employed. It has been found that the spacing of the convolutions has somewhat the same effect on the completed cable insofar as the vibrational energy draining function is concerned as a change in the tension accorded to the helix would have.

The number and gage of the wires employed may be determined in large measure from the weight of the unit to be supported. It has been noted that a member fabricated in the manner described, remains substantially anti-resonant or aperiodic to all vibrations of an audible character. The cable also prevents the effect of sharp, localized disturbances, such as a tap on the envelop or other glass portions from being communicated to the electrode structure. In short the rod 8 may be considered mechanically to isolate the electrodes from jar arising within or without the envelop.

Fig. 2 shows an electrode organization suspended entirely between lengths of the improved support. This modification is similar to that described with respect to Fig. 1 except there are provided a short length of cable 13 attached to the overhanging portion of the main stem 8 and another short length 14, which supports the lower insulation block 15. These short pieces preferably are of smaller diameter than the main upright 8 and may be constructed of a fewer number of wires or perhaps of the same number of wires of smaller gage. The block 15 carries the lower end of the electrodes by means of suitable connections. The lead wires 16 and 17 for the grid and anode respectively, are constituted of relatively small wires so as to minimize the amount of material of the microphonic sort necessary, also to provide maximum flexibility so as not to disturb or curtail the damping function of the aperiodic supports. The filament may be energized by current passing through the cables 8 and 14.

The electrode structure is preferably positioned in the envelop (not shown) by means of metallic band 18 clamped about the stem to form a holder for the upright member 8. When the cable is long and slender, it may be necessary to provide a transverse support 19 intermediate the ends of the vertical portion, one end of which is affixed in the press and the other end having a hook-like extremity which grasps the upright in the manner shown. It is apparent that the entire electrode structure is supported, top and bottom, by an aperiodic member forming a structure which completely isolates the electrodes, particularly the filament, from vibrations that impinge on the glass envelop. These members operate precisely in the same manner as was explained with respect to the preceding figure. While I have shown the main upright 8 and the secondary supporting members 13 and 14 as constituting non-microphonic material, it is obvious that as few or as great a proportion of the necessary supports may be made of this material with corresponding degrees of vibratory isolation accorded.

It will be evident that the non-resonant cable which forms the subject matter of the present invention is not limited in its use to thermionic apparatus but may find adaptation to any case where vibratory disturbances are to be dissipated particularly where the energy to be drained is of relatively large amplitude. As examples tending to show the extended use of a cable such as described there may be mentioned its employment as an airplane strut, wire rope or cord by which objects in general are suspended or supported the airplane and objects being susceptible to vibration of an excessive character.

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

1. A thermionic device comprising an envelop containing a plurality of cooperative electrodes and means within the envelop for supporting the electrodes, said means comprising a substantially non-microphonic metallic member, said member being constituted of superimposed wires.

2. A thermionic device comprising an envelop containing a plurality of cooperative electrodes and means for supporting the electrodes within the envelop, said means comprising a multistrand cable designed to be substantially non-microphonic at all frequencies.

3. A non-microphonic electrode support comprising a plurality of parallel metallic wires bound together by a helical member.

4. A thermionic device comprising an envelop containing a plurality of cooperative electrodes, including a filament and means for draining vibrational energy from said filament, said means comprising a plurality of wires in contact with one another and having a relative movement therebetween.

5. Electrode structure for a thermionic device comprising an electrode supported at each end within the device by a substantially aperiodic member, said member consisting of a plurality of wires arranged to allow a rubbing contact between one another.

6. An electrode structure for electric discharge devices, said structure including a plurality of electrodes rigidly secured together in spaced relation, and means for supporting the structure as a whole within the device, said means comprising a pair of substantially non-microphonic members secured respectively to opposite ends of the structure, each member consisting of a plurality of wires which contact with one another along their respective lengths and are bound together.

7. A thermionic device comprising an envelop containing an electrode organization, blocks of insulating material positioned at each end of the electrode organization, rigid members connecting said blocks to the electrodes, and means for supporting said blocks within the envelop, said means being substantially aperiodic to all frequencies and comprising a plurality of wires which contact with one another and have a relative movement therebetween.

8. A thermionic device comprising an envelop terminating in a reentrant stem and containing an electrode organization, blocks of insulating material positioned at each end of the electrode

organization and arranged at different distances from said stem, rigid members connecting said blocks to the electrodes, supports between each of said blocks and the reentrant stem, the support for the block positioned remote from the stem being constituted of a plurality of vibration-dampening members of different cross-sectional dimensions, the member of smaller dimension being connected to the remotely positioned block, the support for the block nearer the stem being constituted of a vibration-dampening member having a cross-sectional dimension substantially the same as the vibration-dampening member of smaller dimension which is secured to the other of said blocks.

9. A thermionic device comprising an envelop containing a plurality of cooperative electrodes, including a filament, and means comprising a substantially non-microphonic conductor for carrying current to said filament and for preventing vibrations of substantially all frequencies from being communicated to said filament, said conductor being constituted of superimposed metallic wires.

ALBERT W. HULL.