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NONMICROPHONIC SUPPORT FOR VACUUM TUBES

Filed Aug. 31, 1928

Fig. 1.

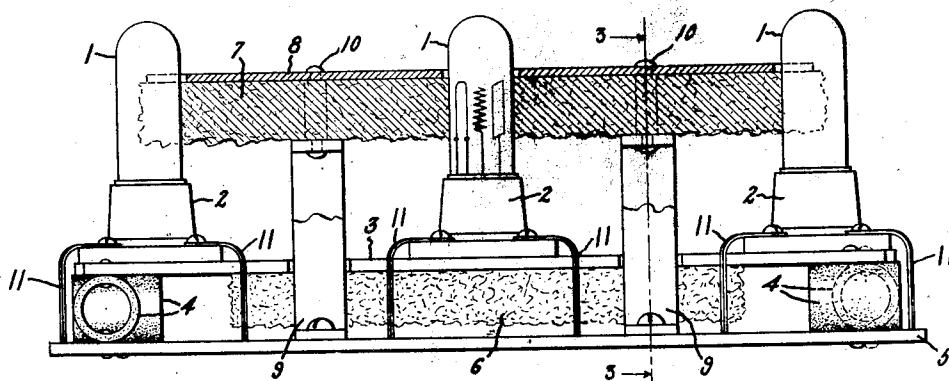


Fig. 2.

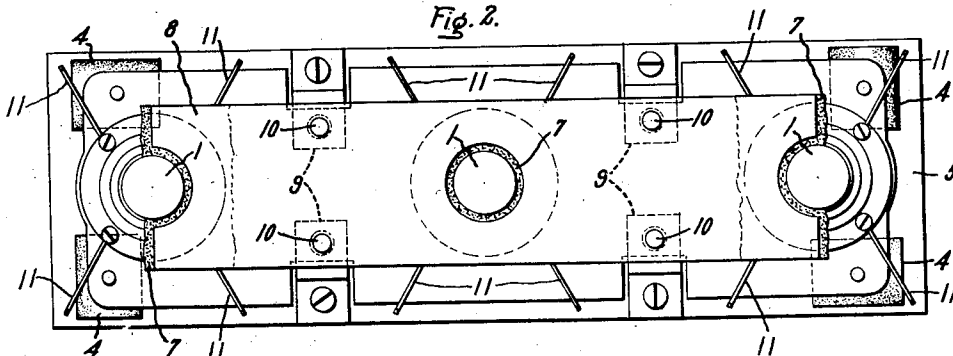
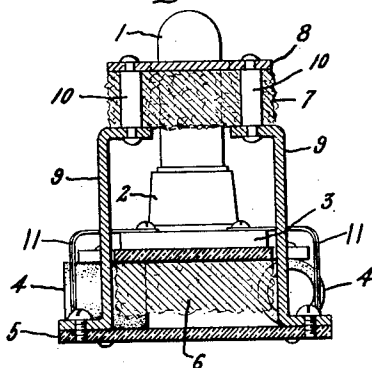


Fig. 3.



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UNITED STATES PATENT OFFICE

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NONMICROPHONIC SUPPORT FOR VACUUM TUBES

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The present invention relates to electric discharge apparatus and more particularly to non-microphonic supports for thermionic devices which are mounted upon vehicles or in other places where they are subject to shocks, jars or vibrations.

It has been found that the electrodes of vacuum tubes, as they are usually constructed, almost always tend to act as vibratory systems with small damping factors. Any relative movement of the electrode or parts thereof varies the output or space current which passes in a circuit including the cathode and anode of such tubes, and hence, it is seen that shocks or vibrations impressed upon the tube so as to cause the electrodes to vibrate in their several respective periods will cause troublesome noises in a telephone bridged across the output circuit of the tube. Especially is this true when several amplifier tubes are connected in tandem, when each tube in addition to amplifying the current variations of the preceding tube will add a series of variations due to the vibrations of its own elements. The trouble due to vibrations of the electrodes is not limited to tubes in cascade but is usually present where vacuum tubes are mounted on a solid structure subject to vibrations, such as aeroplane, boat or other moving vehicle. Moreover, it has been found that not only do the elements within each tube move so as to change the inter-electrode spacing, but the tubes themselves may change their position with respect to one another and also with respect to adjacent conducting surfaces which causes detuning of the radio frequency circuits connected with the various electrodes.

An object of this invention is to produce a practical structure to overcome the difficulties mentioned. In the drawings Fig. 1 represents an elevational view partly in cross-section of the improved tube assembly support; Fig. 2 is a plan view, while Fig. 3 shows in cross-section the view taken along line 3-3 of Fig. 1. Numeral 1 indicates a plurality of evacuated envelopes containing various electrodes which may constitute amplifiers, detectors, oscillators or the like in any of the usual combinations, the envelopes

being mounted in the ordinary form of socket 2, which may be secured in suitable manner to a base-board 3 of insulating material, for example, fiber. The base-board rests upon a plurality of hollow members or cushions 4 which may be constituted of highly elastic material, for example, live rubber, the cushion members being supported on a lower base-board 5 also preferably of fiber. While these members may take various shapes, for example, hollow spheres, I prefer to fashion them as hollow cylinders, the manufacture of which is facilitated by forming a rubber tubing of the desired diameter and cutting off pieces of the requisite length. In some cases, rubber bands having a width of material comparable to the length of the cylinder may be wound, layer upon layer, until the proper thickness has been reached and securing the ends to form a unitary ring. The dimensions of the cushions are obviously dependent upon many factors including the weight to be supported and characteristics of the vibrations to be damped; I have obtained satisfactory results by employing live rubber tubing $\frac{3}{4}$ " outside diameter, approximately $\frac{1}{8}$ " thick and $\frac{3}{8}$ " long for supporting radio receiving sets constituting three to five tubes. The pieces of tubing lie lengthwise and may be affixed to the base-boards in any suitable manner, for example, by diametrically disposed rivets which pass through the boards. It is obvious in the event that shock, jar or vibration is transmitted to the tube assembly, as when the set is an accessory to an automobile, aeroplane, boat or other moving body, the resilient members 4 tend to roll slightly but being held in place by the rivets, they simply distort, and the resulting strain dissipates or otherwise drains the vibrational energy from the assembly. It is considered preferable for the more efficacious removal of the shock energy, to mount the tubing so that the longitudinal axes of adjacent members are normal to each other; in this manner, substantially uniform flexibility in all directions of the transverse plane may be obtained, although, it is to be understood that any and all relative positions of the various

members 4 are within the contemplation of my invention. In the event that the shock is severe, as when an aeroplane equipped with the device hereinbefore described is landing on rough terrain, the tubing members may flatten to a considerable extent and it may be desirable to provide a bumper 6, constituted of sponge rubber, to serve as a stop or limit to the relative movement between the base-boards. The thickness of the sponge rubber block should be such as to permit the tubing to distort or flatten to a degree just sufficient for dissipating the shock energy.

Moreover, it has been found that when the receiver is connected to radio frequency circuits, the swinging of the respective tubes about their sockets may cause a slight but readily perceptible detuning of the various circuits. These movements apparently produce a change in the relative positions of each group of electrodes considered as a whole with respect to one another and with respect to adjacent conducting surfaces thereby varying the constants of the associated circuits. In order to prevent these gyrations, I provide a quantity of sponge rubber 7, conveniently in block or plate form, fashioned to fit snugly about the envelope of each thermionic device by means of appropriately shaped apertures; this plate member serves to space the tubes from one another and from nearby conductors. The block may acquire rigidity from a metallic plate 8 preferably of non-magnetic material, for example, aluminum, the combined structure being supported from the lower base-board by means of two sets of oppositely positioned brackets 9, 9 which pass through suitably located notches in the upper base-board 3 and the bumper 6. The brackets may be affixed to the sponge rubber structure by rivets 10, 10 and to the lower base-board by screws or in any other manner. While it is evident that various forms of leading-in conductors 11 may be employed to make connection with the tube contacts, I prefer to utilize flexible metallic braid for this purpose, so as to prevent extraneous vibrations from being communicated to the electrodes which ordinarily would happen if the leads were made of solid metal.

It will be apparent that in providing elastic means for damping out the mechanical vibrations derived from any extraneous source which otherwise may be transmitted to the electrodes of the tubes and further, in providing a resilient spacer between the tubes to prevent detuning of the various circuits, the construction is admirably adapted for supporting audion tubes and produces the maximum degree of quietness in the output of such tubes under difficult operating conditions. The live rubber tubing tends to dispose of at least two forms of acoustic undulations, the sharp, relatively small amplitude, intermittent jar or vibration being effectively dissipated in the body of the rubber, the slow, large amplitude, recurrent shock being disposed of by the flattening process or other strain existing in the tubing. The sponge rubber which is employed for members 6 and 7 serves to eliminate or reduce the effect of heavy thrusts exerted by the upper base-board in moving toward the lower board or by the swinging motion of the various tubes; the air cells of the sponge rubber constitute a multitude of dash pots in draining the vibrational energy from the various parts of the apparatus producing a high damping factor.

It is evident that other caoutchouc-like materials may be substituted for each of the live rubber and sponge rubber having similar resiliency and damping properties. No attempt has been made herein to enumerate or describe all the possible damping materials or means and other equivalent structure and devices which may be used in carrying on the purposes of the invention but the appended claims are intended to include such equivalents except where otherwise specified. For example, in place of hollow cylinders, annular members of damping material in the form of helices may be used.

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

1. A support for preventing external vibrations from changing the space relations of electrodes in space current apparatus, said support comprising a plurality of cylindrically shaped members of elastic material having longitudinal axes angularly disposed with respect to one another, said apparatus resting upon said members, whereby the vibrational energy is dissipated in a plurality of directions.

2. A mounting arrangement for space discharge apparatus, comprising a base-board upon which the apparatus is mounted, a sub-base-board, a nonmicrophonic member interposed between said base-boards, said member comprising tubing of caoutchouc material which lies lengthwise of the base-boards.

3. A mounting for space discharge apparatus which normally is subject to vibrations, said mounting comprising a base-board upon which the apparatus is mounted, a sub-base-board and means interposed between the base-boards for draining the vibrational energy from the apparatus, said means comprising a plurality of cylindrical members of resilient material having the longitudinal axes of adjacent cylinders normal to one another whereby resiliency is procured in a plurality of directions.

4. A support for multi-tube space current apparatus in which the electrodes of the various tubes normally tend to vibrate and in which the tubes normally tend to swing, whereby the electrode spacing is changed within each tube and the constants of the

associated circuits are altered, means for maintaining the normal electrode spacing, said means comprising a plurality of hollow cylindrical elastic members upon the periphery of which the apparatus is supported and a spacer of resilient material positioned between the tubes.

5. A support for a radio frequency amplifier, said amplifier comprising a plurality of thermionic devices which tend normally to vibrate due to extraneous mechanical disturbances thereby changing the inter-electrode spacing within each device also changing the spacing between the electrodes of such devices and adjacent conducting surfaces whereby deleterious effects are produced in the output of the amplifier, means for maintaining the normal electrode spacing, said means comprising hollow cylindrical members of elastic material upon the periphery of which the amplifier is supported, said members being subject to distortion of shape when activated by said disturbances, a block of resilient material to limit the amount of said distortion and a spacer of energy-damp-
ing substance positioned between said devices.

In witness whereof, I have hereunto set my hand this 30th day of August, 1928.

CLARENCE A. GUNTHER.