Jan. 20, 1925.

1,523,430

W. A. KNOOP

MOUNTING FOR VACUUM TUBES

Filed Nov. 30, 1923

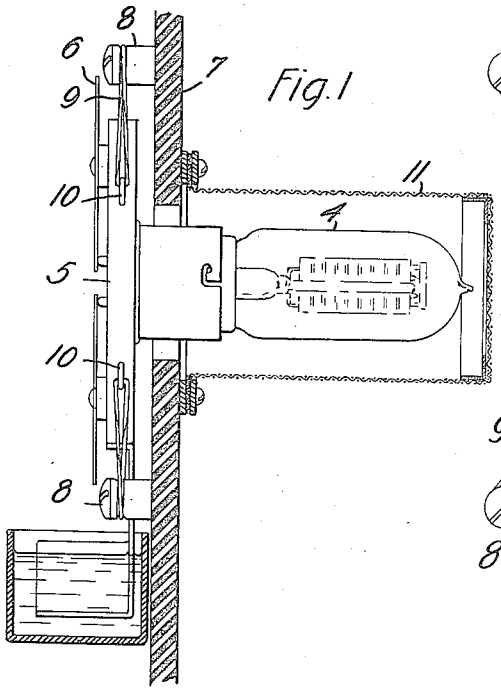


Fig. 1

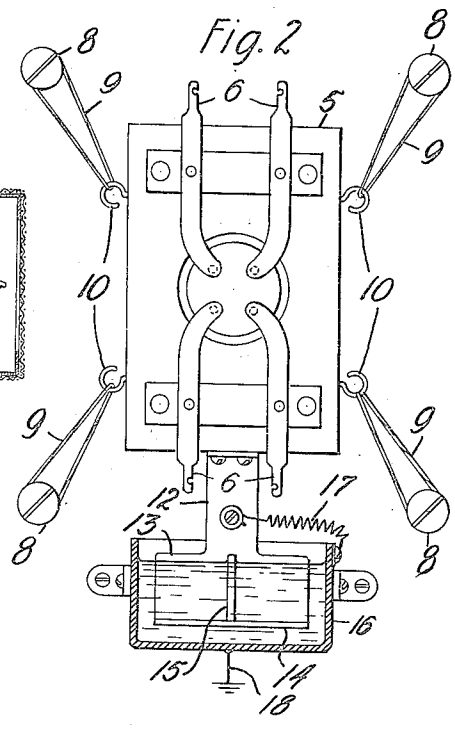


Fig. 2

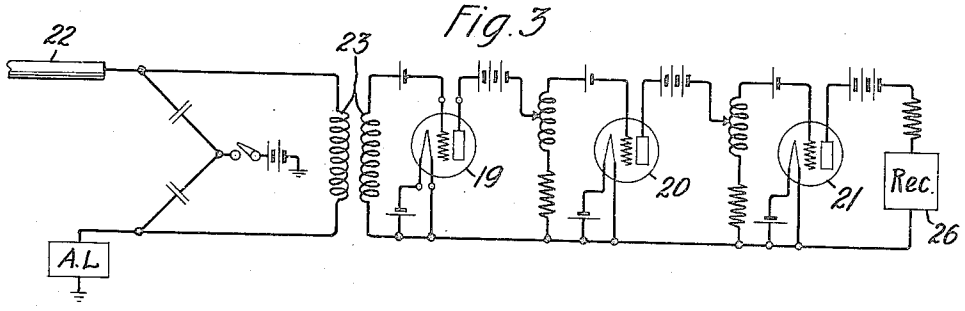


Fig. 3

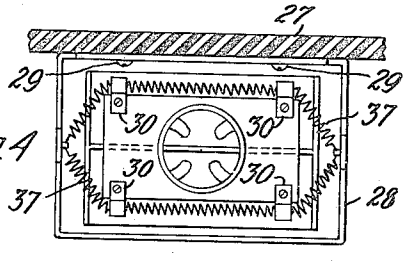


Fig. 4

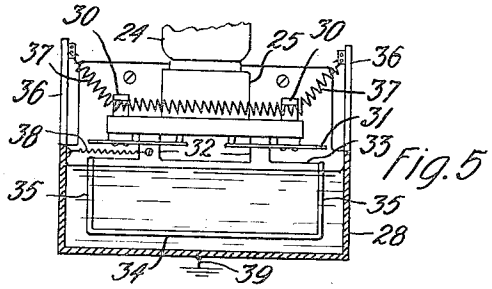


Fig. 5

Inventor:
William A Knoop.
by E. W. Adams Atty

Patented Jan. 20, 1925. 1,523,430

UNITED STATES PATENT OFFICE.

WILLIAM A. KNOOP, OF BROOKLYN, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

MOUNTING FOR VACUUM TUBES.

Application filed November 30, 1923. Serial No. 677,825.

To all whom it may concern:

Be it known that I, WILLIAM A. KNOOP, a citizen of the United States of America, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Mountings for Vacuum Tubes, of which the following is a full, clear, concise, and exact description.

This invention relates to a mounting for vacuum tubes, and has for an object the reduction of noise in a vacuum tube circuit caused by external disturbances.

It is common practice to use vacuum tubes for amplifying or repeating weak signal currents which have been transmitted over long lines. These currents are often so weak that very small variations in the space current of the vacuum tube amplifier will produce fluctuations in the output current comparable with the fluctuations produced by the signals themselves. This is especially true at the receiving end of long submarine cable circuits where the input currents in the first stage of amplification are exceedingly small.

Any variation in the space relation of the electrodes of a vacuum tube will produce variations in the space current, so that when such a tube is used to amplify weak signals, the effects due to the variation of the space relation of the electrodes may produce output currents of the same order of magnitude as the amplified signals. This variation in the space relation of the electrodes may be caused by mechanical vibrations of the tube produced by some external source. These vibrations may be transmitted to the tube either through its support or through the air. In the latter case, of course, the vibrations cannot be transmitted directly to the electrodes, as they are inclosed in an evacuated tube, but must reach them through the socket. Some of the energy of these vibrations may be absorbed by a resilient support for the tube but it has been found that this is not sufficient to absorb all the energy of the vibrations.

External vibrations impressed on the vacuum tube appreciably disturb the space relation of the electrodes, only when they have a frequency or frequencies in the neighborhood of a natural frequency of vibration of the electrodes. It has been found, however, that vibrations of frequencies much lower than could possibly produce vibration of the electrodes, cause a detrimental variation in the space current of the tube. This is due to the slow swaying of the tube in the surrounding electrical field which produces variations in the electrostatic field between the electrodes, thus causing harmful disturbances in the space current. Since these disturbances are of a low frequency, they are particularly objectionable in telegraph signaling.

This invention, in one form, comprises means for resiliently supporting a vacuum tube together with means for properly damping any vibration which might be produced in the tube and for protecting the tube against external electrical fields. The embodiment of the invention described herein comprises an elastically supported vacuum tube socket having projections immersed in a damping fluid.

Referring to the drawings, Fig. 1 shows a side elevation and Fig. 2, a front elevation of one form of this invention; Fig. 3 illustrates a telegraph circuit in which this invention may be used; and Fig. 4 shows a plan view and Fig. 5, a front elevation of another form of this invention.

Referring to Figs. 1 and 2, a vacuum tube 4, which may be of the three-electrode type, is shown mounted in a horizontal position in a socket 5. The socket is of the usual type provided with four contacts 6 for connecting the tube to the circuit in which it is to be used. A vertical panel 7 is shown to which the socket 5 is attached by means of four rubber bands 9. These bands are fastened to the socket by means of four screw-hooks 10 and to the panel by four screws 8. A metal screen 11 fastened to the panel is provided for protecting the tube against mechanical injury.

The bands 9 are not always effective in prohibiting all vibrations being transmitted to the tube from the panel or through the air. An arm 12 is therefore mounted on the socket and attached to it are three mutually perpendicular vanes 13, 14 and 15. These

vanes are immersed in a bath of oil, or other liquid having a relatively high viscosity, contained in a pot 16. This pot is mounted on panel 7 in such a position that during normal operation the vanes will not come in contact with its sides. By suspending the tube in this manner, not only are all the vibrations of frequencies liable to produce vibrations of the individual electrodes prohibited from being transmitted to the tube, but also the energy of those low frequency vibrations which would otherwise produce swaying of the tube is absorbed. As explained above, this swaying of the entire tube produces harmful disturbances due to the effect on the space current of the movement of the tube through the external electrical field.

It was found that slight movements of the vanes caused large changes in the distribution of the electrical charges which accumulated on them. This electrostatic disturbance was also effective in producing variations in the space current of the tube. Means is therefore provided for preventing the accumulation of electrical charges on the vanes and oil pot. As shown, this means comprises flexible wire 17 connecting the vanes to the pot 16 which is in turn connected to ground, as shown by the connection 18.

Referring to Figs. 4 and 5, panel 27 is shown to which is attached by two screws 29 an oil pot 28. Integral with the pot are two supporting members 26 to which are attached two helical springs 37. From these springs is suspended by means of four Z-shaped brackets 30 a vacuum tube socket 25, these brackets being attached to the base of the socket, as shown. A vacuum tube 24 which may be of the three-electrode type is supported in an upright position in the socket. Contact terminals 31 are provided for connecting the tube to the circuit with which it is associated. Attached to the socket base are two arms 32 to which are joined mutually perpendicular vanes 33, 34 and 35 which are immersed in the body of oil in such position that during normal operation they will not come into contact with the walls of the oil pot. These vanes are conected to the oil pot by means of a flexible wire 38. The pot is in turn connected to ground through a wire 39.

Fig. 3 shows a system in which it was found desirable to use this type of mounting. Three tandem connected vacuum tubes 19, 20 and 21 are shown in a submarine cable amplifier circuit. The submarine cable 22 is connected to the input circuit of the first tube 19 through a transformer 23, the connections being arranged in the usual manner to provide two-way operation. The output circuit of the last tube 21 is connected to a telegraph recording instrument 26. Telegraph signals coming over the long cable 22 are often very weak and produce variations in the space current of the first amplifier 19 which are of the same order of magnitude as the variations which may be produced by the slow swaying of the tube as heretofore described. The amplified low frequency telegraph signals would therefore be unrecognizable from the low frequency output current produced by the swaying of the tube. These disturbances can be prevented by providing the first stage tube 19 with the protecting mounting herein described. This is usually sufficient to eliminate disturbances due to vibration of the tubes as the input current in the succeeding stages is greater than any current that could be produced by mechanical vibrations of the tube. In some installations, however, it might be found necessary to provide the mounting for one or more of the succeeding stages.

It is to be understood that this invention is not limited to the particular arrangements above described, but that the structure may be variously modified, without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In combination, a vacuum tube having electrodes in fixed space relation to each other, a resilient support for said tube, and means for damping vibrations of the tube, said means comprising a body attached to the tube and immersed in a body of damping fluid.

2. A support for a vacuum tube comprising a base, resilient means for supporting said tube on said base, a pot containing a damping fluid, a body attached to the tube and immersed in said fluid, and means for grounding said body and said pot.

3. A support for a vacuum tube comprising a socket for said tube, a base, resilient means for attaching said socket to said base, a pot containing oil, three mutually perpendicular vanes attached to said socket and immersed in said oil, and means for connecting to ground said vanes and said pot.

4. The combination of a vacuum tube having a cathode, an anode and a control electrode in fixed space relation to each other, means for preventing variation in the space relation of the electrodes due to vibrations transmitted from external sources and for preventing any motion of the tube with respect to the surrounding electric field, said means comprising a resilient support for said tube and a stationary oil bath in which a plurality of vanes attached to said tube are immersed.

5. A support for a vacuum tube comprising a socket for said tube, a plurality of springs for supporting said socket, a bath of damping fluid, a plurality of vanes at-

tached to said socket and immersed in said bath.

6. A support for a vacuum tube comprising a socket for said tube, a plurality of helical springs for suspending said socket, a pot containing damping fluid, a plurality of vanes attached to said socket and immersed in said fluid, and means for connecting to ground said vanes and said pot.

In witness whereof, I hereunto subscribe my name this 27th day of November A. D., 1923.

WILLIAM A. KNOOP.