July 31, 1928. 1,678,870

I. E. MOUROMTSEFF

VACUUM TUBE DEVICE

Filed April 28, 1925

Fig. 1.

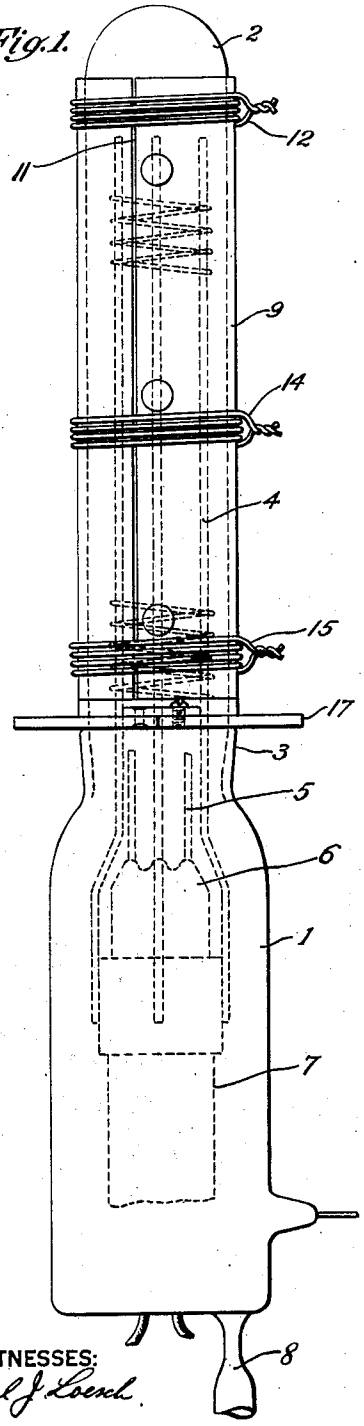


Fig. 2.

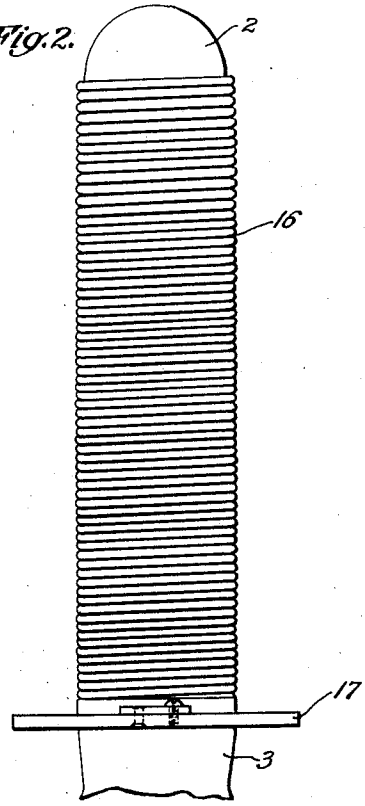
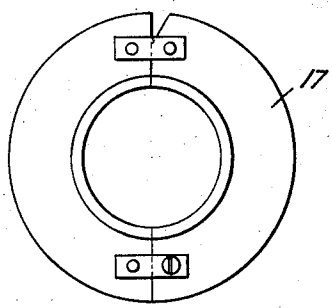


Fig. 3.



WITNESSES:
Carl J. Loesch.
H. P. Hineline.

INVENTOR
Ilia E. Mouromtseff
BY
Wesley G. Carr
ATTORNEY

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UNITED STATES PATENT OFFICE.

ILIA EMMANUEL MOUROMTSEFF, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

VACUUM-TUBE DEVICE.

Application filed April 28, 1925. Serial No. 26,338.

My invention relates to vacuum-tube devices and more particularly to vacuum-tube devices of the exterior anode type.

An object of my invention is to provide a vacuum-tube device, having a light-weight metallic shell.

Another object of my invention is to provide a high-vacuum device with a light metal shell container.

Another object of my invention is to provide a metal shell vacuum-tube device having a pressure therein less than one one-hundredth of a millimeter of mercury.

Another object of my invention is to provide a metal shell vacuum-tube device with reinforcing means cooperating therewith, whereby the device can be "baked out" during the evacuation thereof without danger of collapse of the shell.

It was early practice to construct vacuum tubes having a container entirely of glass. The ability of the glass to pass heat through its body imposed limitations upon the amount of energy which could be translated, and it was desirable, therefore, that a portion of the container be of metal to serve as one of the electrodes. This construction provided means for applying fluid in contact with the outer surface for cooling purposes. It was found necessary, of course, to make a seal between the glass insulating portion and the metal shell portion. This seal was necessarily made between glass and a very thin metal edge making it desirable that the metal shell also be very thin. It was likewise found necessary that such device be very thoroughly "baked out" at an elevated temperature in order to obtain a sufficiently high vacuum.

The temperature at which the copper shell must be "baked out" in order to remove occluded gases is at or above a dull red heat, and at that temperature great difficulty has been experienced in constructing a metal shell portion which would be thin enough to permit of the construction of a glass to metal seal and which would not collapse under the atmospheric pressure surrounding it.

My invention provides means whereby a thin metal shell portion can be reinforced during the exhausting operation whereby its shape is maintained against the atmospheric pressure.

By this means I am enabled to provide a vacuum-tube device having a thin metal shell portion and a very high vacuum therein.

Other objects and structural details of my invention will be apparent from the following description, when read in connection with the accompanying drawing, wherein

Figure 1 is a view in vertical elevation of a typical vacuum-tube device of the thermionic discharge type with the reinforcing device of an embodiment of my invention positioned thereon;

Fig. 2 is an alternative embodiment of my invention, and;

Fig. 3 is a plan view of a detail of the embodiment.

Referring to the figures, a vacuum-tube device has a glass portion 1 and a metal portion 2 with an "edge seal" 3 connecting them. Suitable internal structure is provided, such as a grid 4, and a cathode structure 5, which are mounted upon a press 6 and a re-entrant portion 7 of the glass structure. A tubulation 8 for connection to the exhaust pump is connected to the lower portion of the device. A temporary cylindrical metal jacket 9 of substantial thickness is adapted to surround the metal portion 2 in contact therewith. The jacket 9 is split vertically at point 11 and is surrounded by a plurality of binding wires 12, 14 and 15. In the alternative embodiment shown in Fig. 2, a metal spiral 16 surrounds the metal shell 2 and exerts a pressure thereon. In each embodiment, a shielding collar 17 is positioned upon the metal shell 2 and closely adjacent to the seal portion 3.

In the operation of my invention, the vacuum-tube device is assembled in the manner well known in the prior art and prepared for evacuation.

The reinforcing means 9 or 16 of my invention may then be slipped over the metal shell portion of the device and held firmly in contact with the shell. If the split sleeve embodiment is used, it is firmly held by the wrapping wires 12, 14 and 15. If the spiral

wire embodiment is used, the natural elasticity of the wire holds it in firm contact. Other means may also be employed.

The vacuum-tube device is then attached to a pump manifold, (not shown) to which are connected a series of pumps, including a rough pump which may be capable of evacuating a system to a pressure of one or two centimeters of mercury. The rough pump is then followed by a backing pump which is capable of exhausting the system to a pressure of a millimeter or less of mercury. The backing pump is followed in turn by a diffusion pump which is capable of evacuating the device to pressures less than one one-hundredth of a millimeter of mercury.

The vacuum-tube device having been connected to the pump manifold and exhausted by the rough pump, a heating oven is positioned around it and heat is applied to the device. Evacuation by the rough pump may be completed in a very few minutes and it may then be followed by the backing pump which may require a somewhat longer time. During this period, the temperature of the device as a whole may be raised.

When evacuation by the backing pump is complete, the diffusion pump, in turn, is applied to the device and exhaustion continued by its agency. Simultaneously, the temperature of the device is being raised by the oven.

The heating and evacuation are continued for a substantial period of time during which the temperature of the metal shell portion 2 may be raised to a dull red heat which may be attained partially by the heat of the oven and partially by electron bombardment of electrons obtained by the application of current to the filament 5 and between the filament and shell 2.

It has been found necessary to attain a temperature of a dull red heat to drive out of the metal all of the occluded gases. At this temperature a copper shell having a diameter of 1¼″ and a thickness of less than ninety/one-thousandths of an inch will collapse because of the pressure of the atmosphere upon its outer surface. In this collapse, however, there is a spreading of portions of the shell. Such spreading is prevented by the device of my invention when applied to the metal shell and, therefore, the shape of the shell is maintained at the elevated temperature. The presence of the metal shell of my invention permits the shell portion 2 of the vacuum tube device to be made as thin as forty/one-thousandths inch or less and further permits the shell portion to be drawn or spun of soft metal such as copper and to retain its shape during the necessary heating and evacuation.

By this means, I am enabled to produce a vacuum-tube device having a thin copper shell portion as a part of the container thereof and having therein a vacuum showing a pressure less than one one-hundredths of a millimeter of mercury.

While I have shown but two embodiments of my invention, it is capable of other changes and modifications therefrom without departing from the spirit thereof and it is desired, therefore, that only such limitations shall be imposed thereon as are required by the prior art or by the appended claims.

I claim as my invention:

1. A space-current device, comprising a plurality of electrodes, and a container therefor, comprising a metal portion and a glass portion, and means for preventing the collapse of said metal portion thereof during evacuation comprising a metal reinforcing jacket therearound.

2. A vacuum-tube device, comprising a metal shell adapted to be heated, and means adapted to prevent collapse thereof during said heating, comprising a metal jacket adapted to fit over said shell.

3. A vacuum-tube device, comprising a cylindrical metal shell adapted to be heated, and means adapted to prevent collapse thereof during said heating, comprising a metal jacket adapted to fit over said shell and retain its cylindrical shape.

4. In the manufacture of a vacuum electric-discharge device having a wall of insufficient strength to withstand pressure when heated to an elevated temperature, the step which comprises heating the weak portion to an elevated temperature while evacuation is in progress, and simultaneously preventing deformation of said weak portion by applying in intimate contact therewith a reinforcement.

5. In the manufacture of a vacuum electric-discharge device having a wall of insufficient strength to withstand pressure when heated to an elevated temperature, the steps of applying an external reinforcement to the weak portion, heating said weak portion, exhausting the device, and removing the reinforcement.

In testimony whereof, I have hereunto subscribed my name this 22nd day of April, 1925.

ILIA E. MOUROMTSEFF.