Feb. 12, 1935. J. N. SCISM 1,991,065

VACUUM TUBE

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Fig. 1.

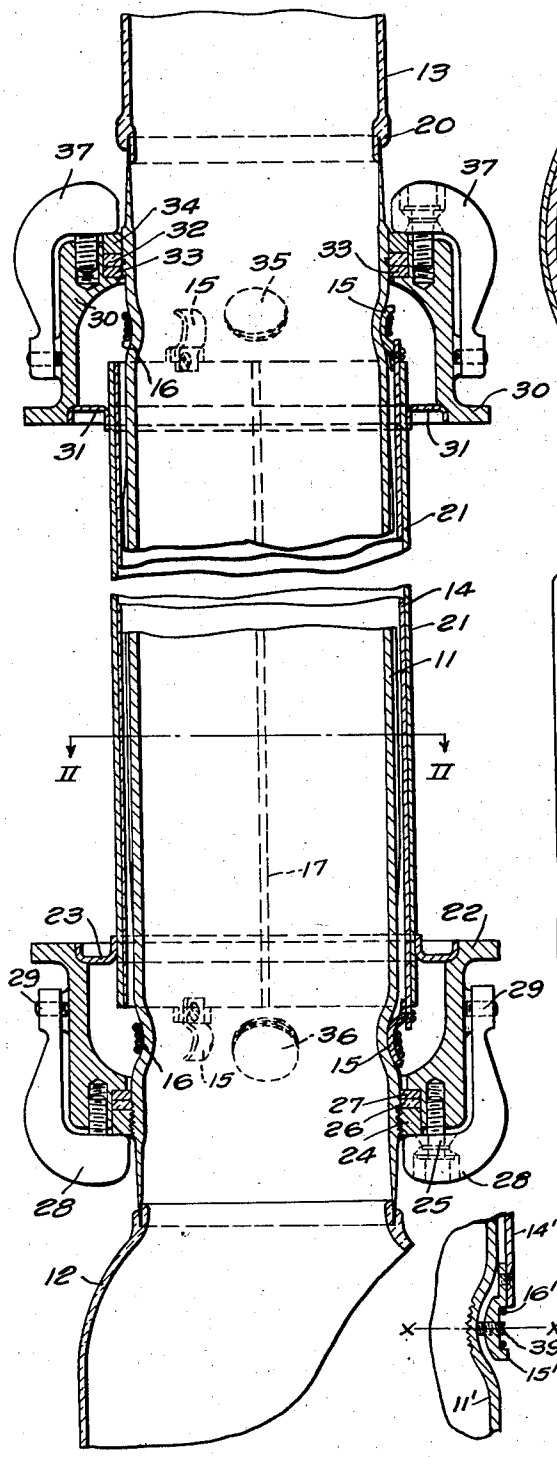

Fig. 2.

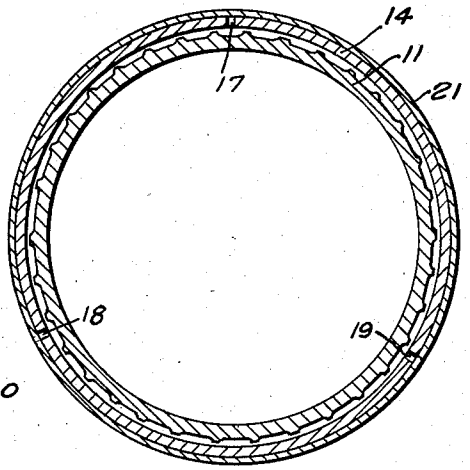

Fig. 3.

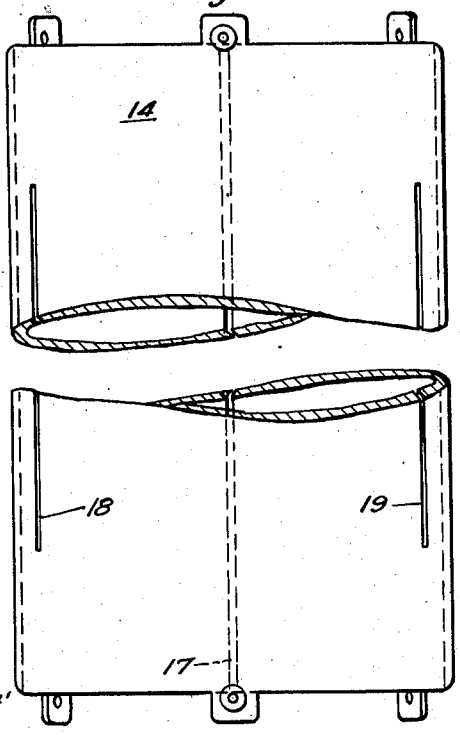

Fig. 4.

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VACUUM TUBE

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Application July 30, 1930, Serial No. 471,643

5 Claims. (Cl. 250—27.5)

My invention relates to vacuum tubes and particularly to transmitter tubes having water-cooling jackets.

In high-power transmitter tubes, the anode usually forms part of the vacuum tube envelope and is surrounded by a water-cooling jacket, a flow of water being maintained between the anode and the jacket. When this structure is employed, a rapid flow of water is desired in order to dissipate the heat, and, in order that the water may be passed through the cooling jacket at a high velocity without utilizing too great a volume of water, the spacing between the anode and the inner surface of the cooling jacket is made very small.

An object of my invention is to provide a tubular casing around the anode which shall have a small and accurate spacing all around the anode.

A further object of my invention is to provide a structure that may be easily assembled.

In practicing my invention, I surround the anode with a metallic tube which is split in order that it may be slipped over a seal in the envelope. The split tube is supported directly from the anode by means of metallic supports or feet. A solid tube, which forms a portion of a water-tight chamber, is closely fitted over the split tube.

Other features and advantages of my invention will appear from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a longitudinal section of a portion of a vacuum tube envelope and of a cooling jacket constructed in accordance with my invention.

Fig. 2 is an enlarged view taken on the line II—II of Fig. 1.

Fig. 3 is an enlarged view in elevation of the split tube, and

Fig. 4 is a view of a modified form of my invention.

Referring to Fig. 1, the vacuum tube comprises an envelope which consists of a metallic anode 11 having a glass blank 12 sealed to it at one end and a glass blank 13 sealed to the other end. The filament and control electrode are not shown. The complete tube, with the exception of my improved form of cooling jacket, is shown in application Serial No. 344,772, filed March 6, 1929, in the name of Ilia E. Mouromtseff, and application Serial No. 358,608, filed April 27, 1929, in the name of Ilia E. Mouromtseff and Gregory V. Rylsky, both applications being assigned to the Westinghouse Electric and Manufacturing Company.

The anode 11 is preferably ribbed, as shown in Fig. 2, both to make the water flow in straight lines and to prevent the cooling jacket from touching any considerable area of the anode in case the cooling jacket becomes displaced.

In accordance with my invention, a split metallic cylinder 14 is slipped over the anode 11 and is supported directly from the anode 11 by means of metallic feet 15 bolted, or otherwise secured, to the cylinder 14. The split cylinder 14 is held in position by wrapping wire 16 around the anode 11 and feet 15.

The manner in which the cylinder 14 is split will be seen by referring to Fig. 3. On the under side of the cylinder, a saw cut 17 extends the entire length of the cylinder. On the upper side of the cylinder 14, two saw cuts 18 and 19 extend for only a portion of its length. In this manner, the cylinder is made flexible enough, so that its diameter may be increased enough to permit slipping the cylinder over the seal 20. After the cylinder has been slipped over the seal 20 and around the anode 11, it springs back to its original diameter to form a very close spacing between its inner surface and the outer surface of the anode. The split cylinder 14 is entirely surrounded by a water-tight cooling jacket. This jacket comprises a water-tight cylinder 21 which has an internal diameter that is larger than the external diameter of the seal 20. The cylinder 21 fits snugly over the split cylinder 14. At one end, it is secured to an annular member 22 by means of a flexible diaphragm 23. In practice, the diaphragm 23 is made of $\frac{1}{32}$ inch soft copper. The annular member 22 is supported on the anode 11 by means of a one piece ring 24 threaded on the anode.

A gasket 26 is positioned between a split ring 27 and the ring 24 and may be compressed by means of a plurality of pivoted hooks 28. The hooks are pivoted on the head of a screw 25 as indicated by the broken lines. In order to compress the gasket 26, either the screw 25 is turned or the screw 29 is turned to lift the end of the hook away from the annular member 22.

The other end of the cylinder 21 is likewise secured to an annular member 30 by means of a flexible diaphragm 31 similar to diaphragm 23. A gasket 32 and a split ring 33 are positioned between the annular member 30 and a split ring 34. Openings 35 and 36 are provided in the annular members to provide an inlet and outlet for the cooling liquid.

The cooling jacket is assembled on the anode 11 by spreading apart the split cylinder 14 and slipping it over the seal 20 as described above. It is then firmly supported on the anode 11 by

attaching the feet 15 thereto and wiring them on the anode.

The cooling jacket structure comprising the members 21, 22, 23, 30 and 31 is clamped on a bench with the member 30 at the bottom. The split ring 27 and gasket 26 are then placed in member 22. The anode 11, with split cylinder 14 and members 12 and 13 attached, is slipped downward to fit in the outer jacket members as shown. The gasket 26 is then compressed to form a water-tight joint.

Next, the above-described complete assembly is turned upside down and clamped on a bench with member 22 at the bottom. The split rings 33 and 34 and the gasket 32 are placed in position and the gasket 32 is compressed in the same manner as the gasket at the opposite end.

It will be noted that this structure has a decided advantage over that in which the cooling jacket cylinder adjacent to the anode is supported from annular rings such as 22 and 30, because it is difficult to so mount the annular rings that the spacing between the cooling jacket cylinder and the anode is small and accurate. The flexible diaphragms 23 and 31 are provided in order to prevent undesirable strains in the tube structure caused either by the unequal expansion of the anode and the water cooling cylinder during the operation of the tube or by the anode and cooling jacket getting out of alinement.

In operation, the tube is set in a vertical position and water is passed into the bottom of the cooling jacket at sufficient pressure to force the water along the anode at a high velocity. The water then flows out of the cooling jacket through the annular member at the top of the jacket.

The modified form illustrated in Fig. 4 may be utilized to provide greater accuracy in assembling the split cylinder 14' with the desired uniform spacing of water channel around anode 11'. In assembling the modified structure, an assembling fixture (not shown) is employed to accurately position member 14' about anode 11' and, while they are so held, set screws 39 threaded in feet 15' are turned to slightly contact on anode 11'. After this, the wire 16' is wound around members 15' and 11'.

In practice, the anode 11' will often vary in diameter at the neck on line x—x (Fig. 4) because of the heat treatments used. It is obvious, therefore, that the split cylinder 14' may be more accurately positioned about anode 11' with the modified structure than with the structure first described.

Various modifications may be made in my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are shown by the prior art and set forth in the appended claims.

I claim as my invention:

1. An electron-discharge device comprising an evacuated envelope, a cylinder which forms a portion of said envelope and which acts as an electrode, a cylinder surrounding and spaced away from said first-named cylinder, a cooling jacket surrounding said second-named cylinder in liquid-tight relation to said first-named cylinder, means for supporting said second-named cylinder from said first-named cylinder independently of said cooling jacket and an electrode cooperating with said first mentioned electrode.

2. An electron-discharge device comprising an evacuated envelope comprising an anode, a cathode and insulating members sealed to each end of said anode, a cylinder surrounding and spaced away from said anode, said cylinder being of smaller internal diameter than the external diameter of either of said seals and being split to permit its passage over one of said seals, a cooling jacket surrounding said cylinder in liquid-tight relation to said anode, and means for supporting said cylinder from said anode independently of said cooling jacket.

3. An electron discharge device comprising an evacuated envelope, an anode which forms a portion of said envelope, a cathode, and a cylinder surrounding and spaced from said anode by spacers at each end which are angularly spaced apart and are immovably fixed to said cylinder and said anode.

4. An electron discharge device comprising an evacuated envelope, an anode which forms a portion of said envelope, a cathode, a cooling jacket surrounding said anode and in liquid-tight relation thereto, and a cylinder surrounding said anode within said cooling jacket and immovably fixed to said anode to produce an annular chamber thereabout, said cylinder being capable of movement relative to said cooling jacket.

5. An electron-discharge device comprising an evacuated envelope, a cylinder which forms a portion of said envelope and which acts as an electrode, a cylinder surrounding and spaced away from said first-named cylinder, a cooling jacket surrounding said second-named cylinder in liquid-tight relation to said first-named cylinder, means for supporting said second-named cylinder from said first-named cylinder independently of said cooling jacket and an electrode cooperating with said first mentioned electrode, said cooling jacket comprising a plurality of portions joined together by flexible metal connections.

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