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INDIRECTLY HEATED CATHODE FOR VALVES
OPERATING ON DECIMETRIC WAVES
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Fig. 3.

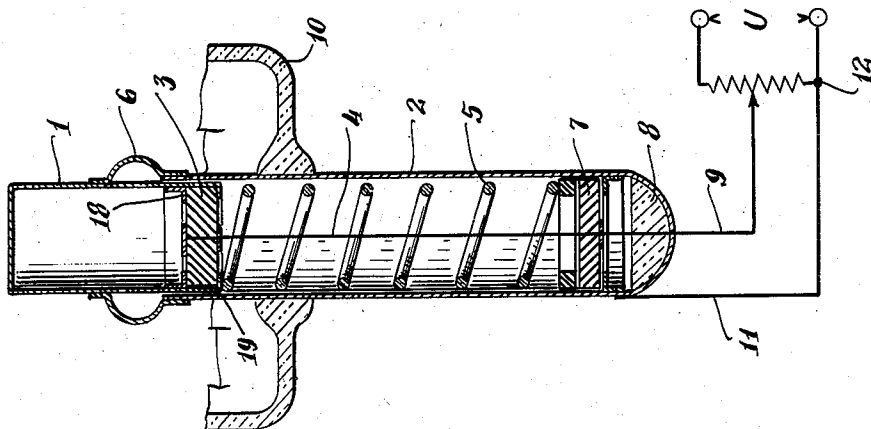


Fig. 2.

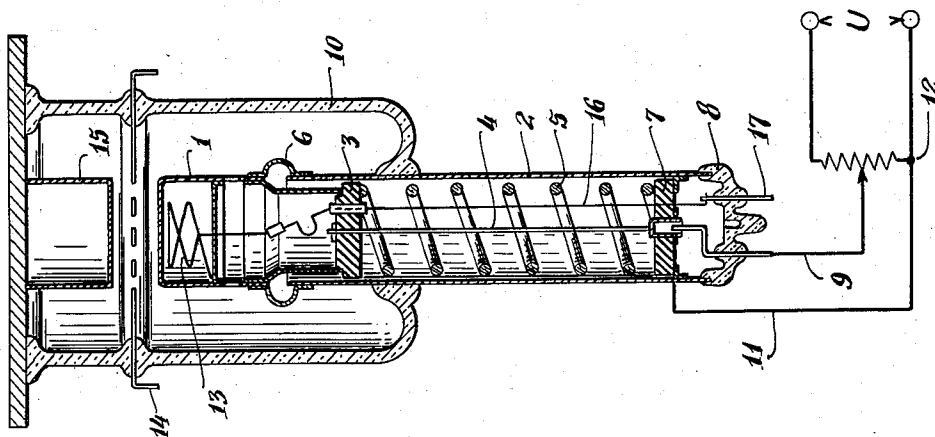
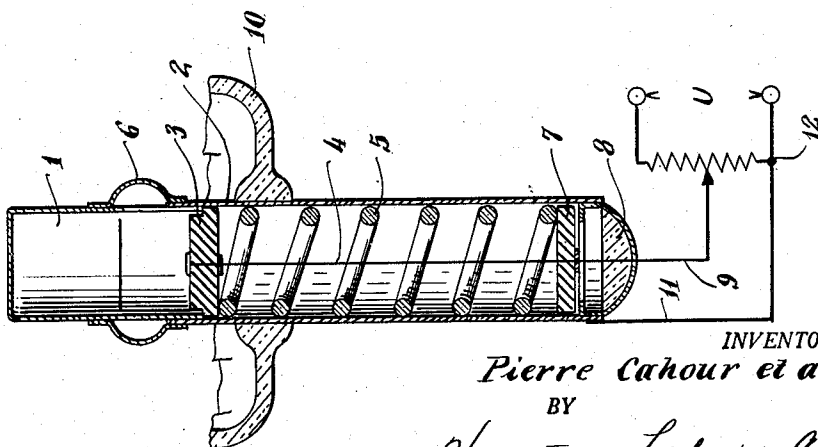


Fig. 1.



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INDIRECTLY HEATED CATHODE FOR
VALVES OPERATING ON DECIMETRIC
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5 Claims. (Cl. 250—27.5)

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The importance at the present time of valves generating waves of very high frequency and adapted for coupling directly to high output circuits, such as resonant cavities and coaxial conductors, is well known. These types of valves are designated generally under the term "sealed disc valves" and their manufacture involves a number of problems of a mechanical nature. In particular, it is very important to be able to regulate with precision the cathode-grid space, whilst preserving strict parallelism of the electrodes: furthermore, the width of this space, when once determined, should remain permanent. It would, moreover, be very advantageous if the cathode-grid spacing adjustment in such a valve could be effected after sealing-off the envelope and during actual operation of the valve. In valves of the kind referred to, the distances between electrodes are actually of the order of a fraction of a millimetre; thus, with the usual mode of assembly, involving the sealing of electrodes into glass, it is extremely difficult to attain the requisite degree of precision, in the first instance and without subsequent adjustment.

To the problem of adjusting the electrode spacing after the envelope of the valve has been sealed-off various solutions have already been proposed, and, in particular, an arrangement with a deformable plate: in use, however, this system is generally rather precarious; moreover, it tends to increase considerably the diameter of the cathode coaxial and makes it necessary to provide coaxial connections with external anode circuit. This method, therefore, increases both the space occupied and the cost.

The present invention relates to a method of constructing sealed disc valves which method affords great facility of adjustment of the distance between cathode and grid after the valve has been sealed. Said method eliminates the difficulties enumerated above.

The process consists essentially in making the cathode movable within certain limits, its position depending upon the length of a wire enclosed in the evacuated space and adapted to expand under the action of heat due to the passage of an electric current. Furthermore, two forms of embodiment may be provided.

(1) The expansion of the wire may permit only of a single adjustment in the course of which

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the cathode is brought to an optimum position which will be final. Thereafter the expansible wire will remain unused.

(2) The device may permit of varied adjustments. Each time the valve is used, there will be caused to pass through the expansible wire a steady current of a definite value, such as to adjust the size of the cathode-grid space to the value desired. Thus, in each particular case, it is possible to regulate the valve to the best conditions for output.

The invention and all the advantages which it offers will be more clearly understood by reference to the following description which, in conjunction with the annexed drawings, gives some non-restrictive examples of practical embodiments, the features appearing from the text and from the drawings forming part of the said invention.

Figure 1 represents a device according to the first form of embodiment. The cathode proper 1 is connected to the coaxial conductor 2 by small clips or straps 6 which are non-elastic but deformable and are made of a material of high electrical conductivity. A metal thrust washer 3 transmits to the cathode the effort of a spiral spring 5 which is pre-compressed, during assembly, between said washer 3 and an insulating washer 7. The said washer 3 is retained by an expansible wire 4, made of copper or nickel, for example, and fixed to it by any suitable mechanical process; this wire first passes through a washer 7, then through a drop of glass 8 which closes the tube 2 hermetically, and finally it emerges from said tube as at 9. The glass envelope of the vacuum tube or valve, partially represented at 10, is fused to the metallic tube 2 at a suitable zone of the latter. Under these conditions, the interior of the tube 2 forms part of the evacuated space within the envelope of the valve. The expansible wire 4 is electrically connected, through the washer 3, with the body of the tube 2 and constitutes therewith a circuit, the outer terminals of which are: on the one hand, the external portion or extension 9 of the said wire and, on the other hand, a conductor 11 welded to the exterior of 2. Between 9 and 11 there may be applied a potential which is finely adjustable, for instance, by means of a potentiometer device 12 supplied with a potential

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difference U , which may be continuous or alternating. This finely adjustable potential may be obtained by means of any other equivalent device.

The described arrangement operates in the following manner. If, by means of the potentiometer 12, a progressively increasing current is caused to circulate in the wire 4, this wire is heated and increases in length; the spring 5 can then move the thrust washer 3 which, in its turn, pushes up the cylindrical cathode 1. The displacement of this latter is possible since it is held by its lateral surface by means of the deformable straps 6. When the heating current is cut off, the wire 4 cools and contracts, bringing the washer 3 to its original position in which it again compresses the spring 5. Now because the straps 6 are made of an annealed, non-elastic metal, the cathode 1 remains definitely located in the position to which it was brought when the wire 4 was expanded. This final position of 1 obviously depends upon the strength of the current made to circulate in the wire 4. Since the potentiometer 12 is able to produce precise and extremely small variations of this current intensity, it will be understood that the described arrangement allows of exerting a thrust on the cathode by communicating to it very small displacements, for example, displacements of the order of one hundredth of a millimetre.

Figure 2 represents the complete assembly of a triode for decimetric waves, according to the invention; the references indicate the same parts as on Figure 1. There will also be seen the heating filament 13 in the interior of the cathode; one extremity of this filament is connected to the body of the whole of the cathode and of the tube 2 while its other extremity is connected to a wire 16 which passes through the washer 3 in an insulating sleeve, and then through the washer 7, and terminates at a lead-in connection 17. The connection 11 thus serves as common return for the filament heater current and for the current used to heat the expansible wire 4. The triode is completed by a grid 14 and an anode 15.

The arrangement is such that the washer 3 can shift without causing the wire 16 to break; for instance, this wire may be allowed to slide in an insulating sleeve which serves to guide and protect it in its passage through the member 3.

One way of applying the method of adjustment according to the present invention involves the construction of triodes, for example, with cathode-grid spaces which, in the first instance, are intentionally oversized. The finished or partly finished valves are then subjected to the operation of a device allowing of precise measurement of these cathode-grid spaces. Such a measurement may, for example, be effected by an optical method if the anode is not yet in position. The finished tube, which has to be adjusted may, however, be introduced into a circuit which permits of determining its electrical characteristics—more especially its coefficient of amplification. The expansible wire 4 of Figures 1 and 2 will then be heated until the cathode-grid space has been reduced to a satisfactory value.

Figure 3 represents a cathode according to the second modification of the invention. The reference numerals still indicate the same elements as in Figure 1. It will be seen that here the thrust washer 3 is imprisoned between two rings 18 and 19 integral with the cathode 1. The

cathode is thus caused to accompany the washer 3 in all its movements, that is to say, both outwards and inwards relatively to the tube 2. Consequently, if the wire 4 be heated, the expansion of this wire will bring the cathode closer to the grid but when the heating is stopped said wire will contract to its initial length, thus retracting the cathode from the grid.

This arrangement permits of continuous adjustment during the actual operation of the triode; it is sufficient to have available an auxiliary current capable of maintaining the expansible wire at the desired temperature; the cathode-grid space can then be increased or diminished at will until a suitable spacing is found in each case.

In addition to an easy and accurate means of adjustment, the invention further presents the following advantages:

(1) The adjustment obtained is very stable, for it can be carried out at the temperature of operation.

(2) The degassing of the electrodes can be carried out with a cathode-grid spacing greater than that required for the normal oscillatory output. Thus, it is possible to establish the best possible conditions for the formation of the cathode and a stable density of electron emission is easily obtained over the whole of the cathodic surface.

(3) The extensible wire may be coated with an appropriate substance enabling it to serve as a getter. Its location outside the bulb proper is favourable for obtaining a good vacuum without causing trouble in the operation of the triode.

It is to be understood that the examples above described constitute only non-restrictive examples and that various modifications of detail can be made therein without departing from the scope of the invention, as claimed hereinafter.

We claim:

1. An electron discharge tube comprising an electron emissive cathode, a metallic tube connected to said cathode by deformable metallic clips, said metallic tube being sealed through the glass envelope of said discharge tube and closed at its end opposite to said cathode by a cap, a thrust washer in mechanical connection with said cathode, a thermally extensible metallic conductor having one end attached to said washer and the other end fixed at a point in the vicinity of that end of said metallic tube which is opposite to said cathode, elastic means urging the thrust washer toward the interior of said discharge tube, and connection means for heating the thermally extensible metallic conductor.

2. An electron discharge tube according to claim 1, wherein the said thrust washer is conductive, the said thermally extensible metallic conductor is electrically insulated from the said metallic tube at the end thereof opposite to said cathode, said cap closing the metallic tube consists of insulating material and has a conductor sealed therethrough in contact with the extremity of the extensible metallic conductor in the vicinity of said cap.

3. An electron discharge tube according to claim 2, including a heating filament and wherein a second sealed-in conductor traverses the said cap, an insulating sleeve is provided in said conductive thrust washer traversed by the extension of said second conductor, said second conductor being connected to one end of the heating filament, and connection from the other end of said heating filament to the cathode itself.

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4. An electron discharge tube according to claim 1, wherein the cathode is cylindrical and of substantially the same diameter as the said metallic tube, and the glass envelope of said discharge tube is also cylindrical and coaxial with said metallic tube and said cathode.

5. An electron discharge tube according to claim 1, wherein the mechanical connection between the thrust washer and the cathode includes projecting means carried by the cathode on opposite sides of the washer to cause the cathode to accompany the washer in its opposite movements.

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