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S. H. STUPAKOFF

2,057,931

CATHODE

Filed Aug. 7, 1930

Fig. 1.

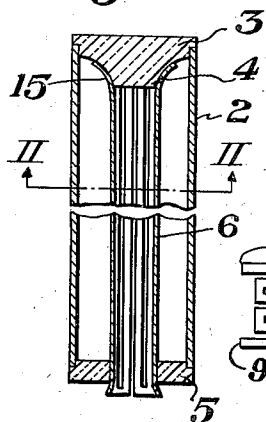


Fig. 2.

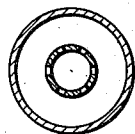


Fig. 3.

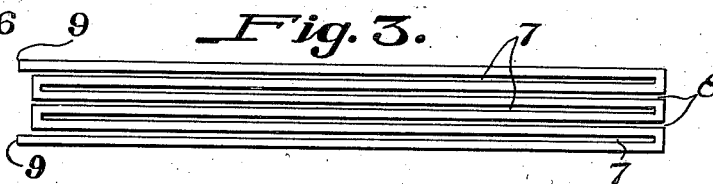


Fig. 4.

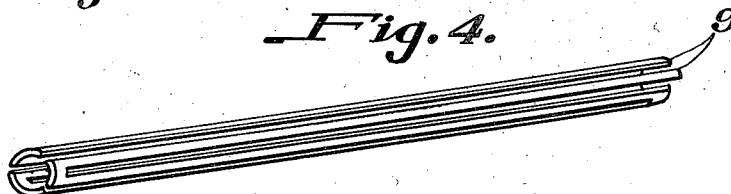


Fig. 5.

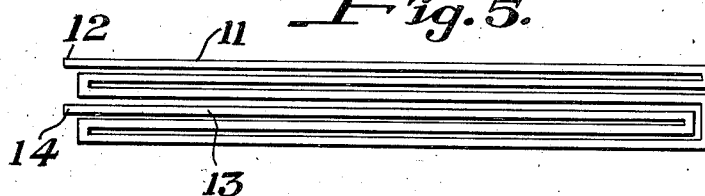


Fig. 6.

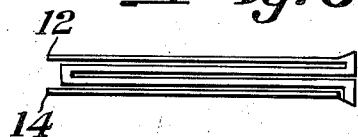
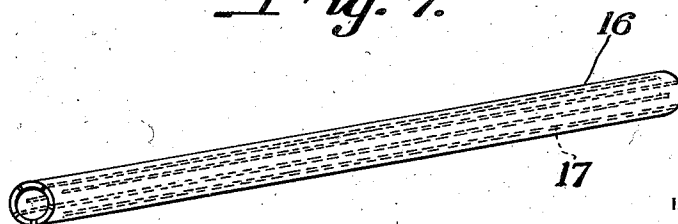


Fig. 7.



INVENTOR

Simon H. Stupakoff
By *Byrne, Stebbins, Parmelee & Blum*
Attys.

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CATHODE

Semon H. Stupakoff, Pittsburgh, Pa.

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2 Claims. (Cl. 250—27.5)

This invention relates to cathode discharge devices and more particularly devices of this nature having an indirectly heated cathode, and is for an improvement in the heating element for such structures.

Indirectly heated cathodes are commonly employed in radio receiving tubes energized from house-lighting circuits. These cathodes commonly comprise a metal cylinder within which is supported a filament, either of the hairpin type, or non-inductively wound coil. In either case the filament is generally supported on a porcelain rod coextensive with the length of the metal cylinder.

The overall permissible length of these filaments is approximately one inch. They are designed to operate on $2\frac{1}{2}$ volts and from $1\frac{1}{2}$ to 2 amperes in the ordinary receiving tube. It is obvious that the diameter of the filament must be very small in order that it may have the requisite resistance, measuring around 1.2 ohms, because of the limited maximum length which it may have.

This very small filament has to maintain the emitting element, which is the nickel cylinder, at an operating temperature, and to do so it must not only heat up the nickel, but the ceramic mass within the nickel cylinder on which the filament is supported. It is therefore necessary to operate the filament at extremely high temperatures, approximately 2000 degrees C., in order to maintain the nickel cylinder, which has a very much larger radiating surface, at the proper emitting temperature.

This very delicate filament must not only be handled very carefully in the manufacture of the tube, but at the high temperature at which it is operated it deteriorates quite rapidly, thus imposing a considerable limitation on the active life of a tube. Another objection to this structure is that a considerable period of time, from 10 to 45 seconds, is required before the entire mass of the cathode becomes heated sufficiently to cause the tube to function.

According to the present invention there is provided a form of heater or filament wherein the mass of the filament is greatly increased over that in the present forms, the mass of the filament in fact approaching that of the nickel cylinder itself. With this filament a smaller mass of ceramic insulation is required so that the total mass to be heated is considerably less. The invention therefore permits the filament to be operated at a considerably lower temperature and at the same time bring the cathode up to an operating temperature almost instantaneously. Being much less

fragile than the present filament, the construction materially simplifies the process of manufacturing and assembling and reduces the cost.

The invention may be readily understood by reference to the accompanying drawing which is provided merely for the purpose of illustration and to the details of construction of which the invention is not confined, the drawing being on a very much enlarged scale as compared with the actual size of the respective elements in an ordinary radio receiving tube.

In the drawing,

Figure 1 is a vertical section through that portion of a cathode with which the present invention is concerned showing the cathode assembly,

Figure 2 is a transverse section in substantially the plane of line II—II of Fig. 1,

Figure 3 is a plan view showing one step in the development of the heater,

Figure 4 is a perspective view showing the heater in a further stage of development,

Figure 5 is a view similar to Fig. 3 of a slightly modified arrangement,

Figure 6 is a side elevation of a heater formed up from the element shown in Fig. 5; and

Figure 7 is a perspective view showing another way of forming the heater.

Referring to Fig. 1, 2 designates a metal cylinder, such as the emitting element commonly provided in radio tubes. At the top of the cylinder is a disc or cap 3 of insulating material, this cap having a projection 4 on the inner surface thereof. At the opposite end of the cathode 2 is a second insulator 5 having a central opening through which the heater is received. The heater itself is designated 6. It is in the form of a cylinder of metal having vertically extending convolutions forming a continuous ribbon of metal and having upwardly and downwardly extending reaches which are separated from each other.

The construction of the heater may be readily seen by reference to Fig. 3 which illustrates a flat development of the heater, or shows the shape of the flat plate from which the cylindrical heater is formed. Figure 3 discloses a flat piece of material from which the filament is formed, preferably metal, in which are cut alternately directed slots 7 and 8, the slots being of equal length and of slightly less length than the length of the metal sheet itself. By reason of this arrangement there is provided a continuous flat ribbon of metal having parallel lengths connected at one end to one adjacent length of metal and connected at the other end to the other adjacent length of metal. This sinusoidally arranged rib-

bon is then bent up into cylindrical form, as shown in Fig. 4. Those portions of the metal which form the opposite ends of the heater construction are preferably longer than the length of the remainder of the structure so as to provide for the connection of lead wires thereto. These extensions are designated 9 in Figs. 3 and 4. It will be noted in Fig. 4 that the extensions 9 lie adjacent to each other. In order that they may be at diametrically opposite points on the cylinder, the flat sheet from which the cylinder is developed may be cut in the manner shown in Fig. 5. In this view it will be seen that one reach of the metal, 11, having the terminal extension 12, is at the outer edge of the strip, whereas the other reach 13 having the terminal extension 14 is at the middle of the strip. The convolutions are so stamped, however, as to provide a continuous ribbon of metal from the extension 12 to the extension 14 without any intermediate point of contact. When the sheet shown in Fig. 5 is rolled into cylindrical form the extensions 12 and 14 are diametrically opposite.

In order to facilitate the assembly of the tube, one end of the heater may be expanded or flared as shown at 15 in Figs. 1 and 6 to embrace the projection 4 and thus provide for the centering of the upper end of the heater on the projection 4 of the insulator 3. The lower end of the roller is centered by the insulator 5. By flaring portions of the lower end of the heater outwardly, as shown in Fig. 1, the insulator 5 can be retained in place. The lead wires, not shown, are connected to the heater and hold the heater against vertical displacement.

Instead of forming the heater from a flat piece of metal stamped as shown in Figs. 3 or 5, a similar construction can be obtained by cutting oppositely extending slots into a small metal tube, as illustrated in Fig. 7 wherein 16 designates a small metal tube and 17 designates the lines along which this tube may be cut to provide a ribbon-like cylindrical member.

It will be appreciated that the drawing is intended to illustrate the principle of my invention and are out of all proportion to the actual size of the parts as provided, for instance, in a small receiving tube.

The structure, by reason of the alternately reversed reaches, is substantially non-inductive due to the fact that the field set up about one reach is opposed to the field set up by the current flowing in the adjacent reaches or parallel stretches of metal. This is a desirable feature in that it minimizes or eliminates any alternating current hum or ripple in the output of the tube. Due to the number of parallel extensions of metal in the structure the actual length of the metal ribbon is many times that procurable in the present structures. Consequently, the requisite amount of heat can be obtained with the filament operating at a lower temperature.

The structure possesses considerable rigidity, being formed from flat sheet metal bent into cylindrical shape. The mass of insulation required in the structure is relatively small, and this insulation is concentrated at the ends of the cathode structure so as not to obstruct the direct radiation of heat from the heater to the cathode. Thus the tube will very quickly heat to an operating temperature as compared with present tubes where there is a relatively large mass of inert material in comparison to the actual diameter of the filament. Due to the fact that the heater is larger in cross-section than the filament and can be operated at a lower temperature, the length of life of a tube employing it will be tremendously increased. The heater furthermore eliminates many of the manufacturing difficulties encountered with the use of the present types of heaters.

The construction herein described and illustrated, while being preferable, is subject to minor modifications, for example, the filament need not necessarily be cylindrical; the tube may be centered without a flare although the flare aids in centering the tube; instead of a flare the lugs may be bent inwardly and a suitable insulator provided whereby the heater may be held in suspension while being centered; and the slotted sheet need not be bent into cylindrical form, but may be bent into U-shape and held in place in a cathode sleeve of oval or rectangular cross-section.

While I have described certain detailed embodiments of my invention and the method of forming the heater, it will be understood that this is by way of illustration, and that changes in modification may be made therein within the contemplation of my invention and under the scope of the following claims.

I claim:

1. A cathode assembly comprising an outer metal shell constituting a cathode, an inner substantially cylindrical member formed of a sinuously extending ribbon of conducting material constituting a heater, and spaced insulators at opposite ends of the cathode for supporting the heater and having the intermediate portion of the heater directly exposed to the interior of the cathode.

2. A cathode assembly comprising an outer metal shell constituting a cathode, an inner substantially cylindrical member formed of a sinuously extending ribbon of conducting material constituting a heater, an insulator at one end of the cathode having an inwardly extending projection about which one end of the heater is centered, and an insulator at the other end of the cathode having a central opening through which the heater passes.

SEMON H. STUPAKOFF.