

March 16, 1937.

H. P. PRATT

2,073,804

RADIO TUBE

Original Filed Nov. 23, 1928

2 Sheets-Sheet 1

Fig. 1.

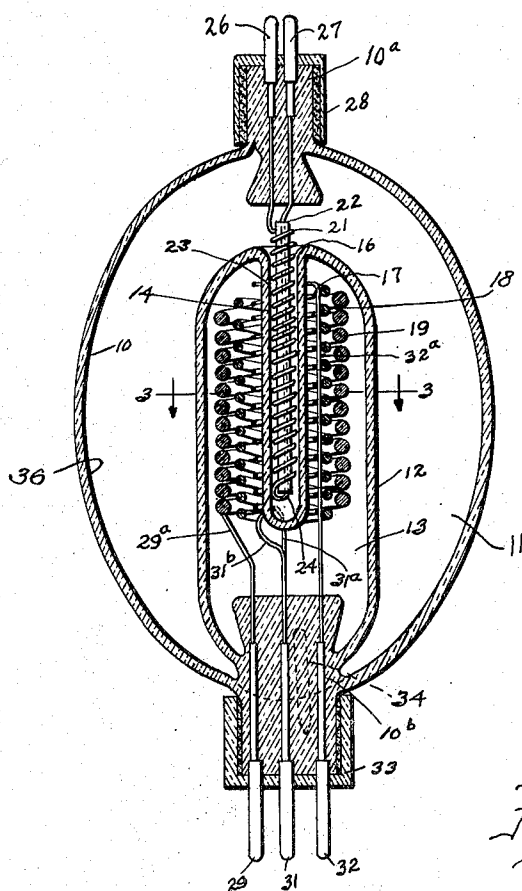


Fig. 2.

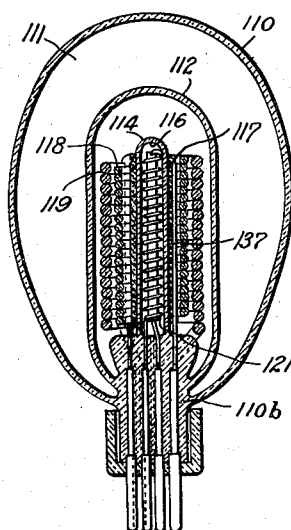


Fig. 4.

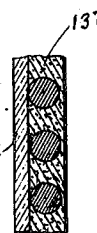
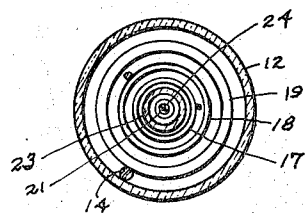


Fig. 3.

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Fig. 5.

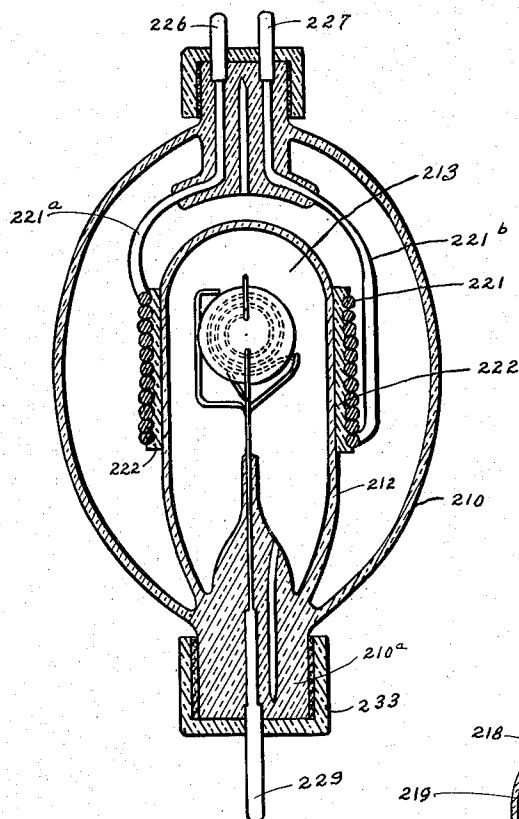


Fig. 6.

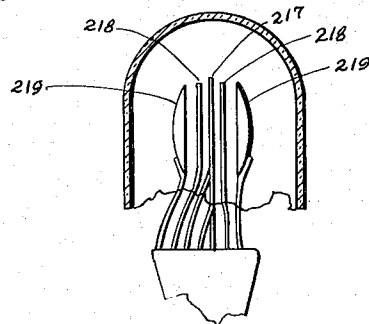
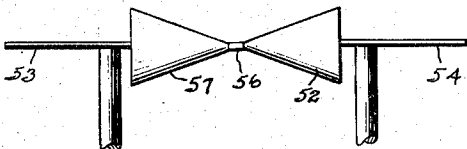


Fig. 7.



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UNITED STATES PATENT OFFICE

2,073,804

RADIO TUBE

Harry P. Pratt, Chicago, Ill., assignor to William Frederick Grower, Henry Asa Allen, George Squires Herrington, and Howard Thompson Ballard, trustees, acting with said Harry P. Pratt, as cotrustees of Pratt Radio Trust

Original application November 23, 1928, Serial No. 321,347. Divided and this application February 26, 1934, Serial No. 712,876

4 Claims. (Cl. 250—27.5)

My invention relates in general to radio tubes, and relates more in particular to a tube designed to be used in place of the present A. C. type of tube, but so designed that it may be used to replace any radio tube as used in the present radio receivers.

The results obtained in the reception of musical programs and the like with the present receivers operating on the A. C. principle, or D. C. receivers utilizing A. C. power packs, is unsatisfactory. There is an unusually large amount of noise usually referred to as static, although I have found that a great deal of this noise is due to interference other than strictly static interference. I have found that the present method of plugging in on the commercial electric circuit for either eliminators or with A. C. tubes is detrimental because it apparently connects the grid circuit within the vacuum tube directly or indirectly with the power circuit, thereby causing a short circuit between all receiving sets plugged in on the same line, and this not only cuts down the distance reception very greatly, but interferes badly with local reception.

I have also found that with present standard methods and equipment, every slight electrical disturbance and every stray electrical vibration picked up by the power line (and there are many of these stray currents impressed on every line) is brought directly to the inside of the tube, thereby causing distortion of the received signal as well as the production of noise in accordance with the amount of interference present.

I know that radio engineers are aware of the existence of at least some of these interfering currents and that various means are resorted to to filter out these false currents, but this is never done with any degree of success.

Accordingly, one of the principal objects of my present invention is the production of a radio tube wherein the introduction of these interfering currents into the receiver is avoided.

Another object is to provide a tube which does not come in direct contact with the power circuit and yet accomplishes practically the same desired results without the many undesirable traits of the present type of tube.

Another object of the invention is the concentration and retention of an even heat in the cathode in order to permit continued use of a tube for a considerable length of time after it is disconnected from a power source.

In accordance with the main features of my invention I provide two, three, or more, vacuum chambers concentrically arranged and having the

effect of shielding the heating electrode from the cathode or filament of the tube and at the same time sealing the greater portion of the heat within the tube to avoid the loss of power through the dissipation of heat. In one modification of my invention, I provide a relatively large amount of emitting material which is capable of absorbing and retaining more heat energy in the active portion of the cathode itself. This increased mass, under varying input conditions, maintains a much more even temperature at the outer surface of the cathode than does the usual arrangement, and thus achieves a more even rate of emission than has heretofore been obtained, and thus stabilizes tube action. Another feature is the introduction of a series of thermo couplings which, when once heated from a primary source, will function and keep up the radiating heat for a period of time which saves energy and also saves the C-battery on account of the thermo-coupling directing the impulses.

Other objects and features of the invention will be apparent from a consideration of the detail description taken with the accompanying drawings, wherein:

Fig. 1 is a vertical central section through a radio tube constructed in accordance with the main features of my invention;

Fig. 2 is a similar view showing the same features employed in a modified construction;

Fig. 3 is a plan sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary enlarged view showing the construction of the element as it may be employed in a radio tube for the emission of material particles, gases, electrons, etc.;

Fig. 5 shows still another modification utilizing in a slightly different way one of the main features of the invention;

Fig. 6 is a fragmentary sectional view showing the arrangement of the elements in the embodiment of Fig. 5; and

Fig. 7 is a greatly enlarged detail showing the construction of one of the elements.

Referring first to Fig. 1, the main glass body of the tube comprises an outer wall 10 forming a large chamber 11, an inner wall 12, forming an inner chamber 13, and a third inner wall 14 within the wall 12 and forming a chamber 16 in communication with the chamber 11. Within the chamber 13 and grouped around the inner tubular glass wall 14, I arrange the main elements of the tube, including a filament or material particle emitting element 17, a grid 18 and a plate element 19. In this figure I show all of

these elements as coils of suitable wire concentrically arranged about each other, but they may have other shapes in accordance with the selection of a manufacturer or peculiarities in the design of the two. Instead of passing electrical current directly through the filament element for the purpose of heating it, I prefer, as shown, to supply a heating element 21 arranged within the chamber 16 and designed to be heated from an outside electrical source and furnish its heat to the filament immediately surrounding it so that emission of suitable current carrying particles, usually electrons, will result. In the specific arrangement of this heating element, as shown, I provide a central tube 22 which is of refractory material, and an outside tube 23 formed of suitable electrical current insulating and heat transferring material, such as porcelain. The heating element 21 is arranged to neutralize polarity and decrease interference and directional effect as much as possible consistent with the space it is to occupy. Good results may be secured by bringing one terminal directly through the tube 22 in the manner shown, bending it up at 24 and carrying the wire by a series of helices to the top of the tube for return to its terminal. For forming electrical contact with the element 21 from an outside source, I provide terminals 26 and 27 which are sealed through an enlarged portion 10^a of the outside wall 10 and joined in the usual manner to the ends of the resistance element 21. A suitable protecting cap 28 is provided at the top of the tube for its protection at this point.

At the bottom of the tube the walls 10 and 12 are brought together to form an enlarged body of glass 10^b, through which terminals 29, 31, and 32 are sealed, a protecting cap 33 being supplied in the usual manner. These terminals are connected in a suitable way to the elements of the tube within the chamber 13. In actual practice I show the terminal 32 connected to the filament 17 by a continuation 32^a. The terminal 31 is connected to the grid 18 by a connection 31^a and to the filament 17 by a connection 31^b, while the terminal 29 is connected to the plate element 19 by a connection 29^a. In this way the necessary circuits for the employment of the tube in the usual radio receiver are provided, the plate circuit of the receiver including the terminals 29 and 32, while the usual C-circuit makes use of the grid connection 31. For the evacuation of the tube the usual evacuating passageway 34 is provided through the glass 10^b, and this is arranged so that the entire tube, including all of the chambers, may be evacuated separately or sealed off separately. This, of course, may be modified, but it is quite apparent that with the evacuation of the chamber 11 the chamber 16 will also be evacuated, as it is in connection therewith.

When this tube is in operation the terminals 26 and 27 are connected to a suitable source of electrical power to heat the element 16 and the filamentary element 17. This heating element being entirely separated electrically, and every way except from a heat transfer point of view, from the other elements, none of the usual interference results. The evacuated chamber 11 entirely surrounding the other two chambers in which the elements are contained, acts as a very good heat insulator to avoid the transfer of any heat energy through the outer walls of the tube. To increase this effect, I may provide a deposit 36 on the inside of the wall 10 of the tube to

act as a mirror as used in ordinary Dewar vessels, so that any heat rays striking the outer walls of the tube will be reflected back and there will be little or no transmission of heat. By bringing the tube up to temperature it can then be operated for a considerable length of time without any further energy input as far as electronic emission from the element 17 is concerned. By utilizing a suitable switch operating on a thermostatic principle I may maintain the temperature of the electron emitting element at a high constant. The current may be off the greater portion of the time, but as soon as it drops below a temperature controlled by a thermostatic switch, heating current will be again supplied.

In the arrangement of Fig. 2, substantially the same features are employed as described in connection with Fig. 1, but I show an additional feature which will be brought out. In general structure I provide an outer wall 110, an intermediate wall 112, and an inner wall 114. The other portions of the tube are numbered in accordance with the reference characters employed in Fig. 1, except with the numeral 1 used as a prefix. In this form all of the terminals are brought through the base of the tube through the member 110^b and the inner chamber 116 is unconnected with the outer chamber 111. The elements are shown as formed of wire helices, but are closer together than in the form of Fig. 1. The filamentary element 117 is heated by the heating element 121, as in the first described form, but I imbed as is distinctly shown in Fig. 4 this element in a relatively large amount of a material 137 which will have the triple property of emitting material particles, holding a considerable amount of heat, and serving as a path for the transfer of electrical energy from the filament to the plate and through the grid, as is done when the tubes are used in radio receivers. Material 137 is preferably, in this form of the invention, a substance which will emit a gas which, at extremely low pressures within the tube, will be ionized for ready transfer of current thereover. A material of this character, for example, is sodium, but any substance which will emit particles of a nature to carry an electric current when ionized may be used in this connection. The arrangement is such that only relatively small amounts of the substance will be emitted on heating of the tube, but when the tube has cooled, the material will again absorb or occlude most of this gas.

In the arrangement of Fig. 5 I depart somewhat from the first two forms and provide an outer wall 210 and an inner wall 212, the elements being disposed entirely within the chamber 213. A heating coil 221 is employed, being wound in a series of helices about a suitable refractory base 222 and having suitable leads 221^a and 221^b connecting to the terminals 226 and 227. The chamber 213 may be filled with a low pressure gas vapor or it may be entirely evacuated so that dependence for the transfer of electrical energy from the filament to the grid rests entirely upon the customary emission of the electrons from the filaments. The elements within the chamber 213 are different in form than shown in the other views but comprise a filament 217, a pair of grids 218 and plates 219. These are connected by suitable connections to terminals 229 sealed through the glass bottom 210^a of the tube. In operation this tube is not substantially different than the others.

In Fig. 7 I show a section of an element wherein I employ two cones 51 and 52 connected at their apices and formed of different material, preferably of electro-positive and electro-negative metals. I show them connected for the purpose of illustration by terminals 53 and 54. I found that if current is passed through these two cones they will be heated locally at their apices where the cross section is small, while remaining relatively cool at all other points. While in this condition, a high frequency alternating current may be connected across the terminals, and it will be found that these two cones act as a radio valve, permitting current to pass only in one direction, the phenomenon being similar to that known to exist with the ordinary "crystal". By heating the common apex 56 in any suitable manner I may employ a series of these cones as an element within a tube and pass the received signal therethrough in order to employ this principle in a detector; or a series of these cones can be used with an amplifying tube, or, in fact, in any way or under any circumstances in which this principle can be utilized. I may employ these cones opposed in this manner, or a series of them in the elements of the tubes shown in Figs. 1, 2, and 5, and so obtain the advantage of the incorporation of these various features together. The cones of Fig. 7 are a great deal larger than cones which I will employ within a tube, although for certain purposes cones of this magnitude might be feasible.

This application is a division of an application filed by me November 23, 1928, Serial Number 321,347, Radio tube, Patent No. 1,949,395.

While I have described many features of my invention and shown detailed modifications thereof to enable those skilled in the art to understand and practice the same, I do not restrict myself to the details shown and described, but the inven-

tion is limited only by the scope of the appended claims.

What I claim is:

1. In a radio tube a pair of evacuated chambers, one within the other, cathode, grid and plate elements within the inner evacuated chamber, a third chamber of narrow tube-like character extending within the inner chamber, and a heating element disposed within the third chamber for supplying heat to the elements within the inner chamber.

2. A radio tube including in combination a chamber with the usual radio elements therein, a heating coil disposed in a position to impart heat to the radio element but arranged out of connection with the element containing chamber, and an outer chamber evacuated to form a heat insulator for the element containing chamber, said heating element lying within said usual radio elements and located within said outer chamber, said outer chamber being out of communication with the inner chamber.

3. A radio tube having three separate vacuum chambers arranged one within another, whereof the innermost chamber is provided with a heating element, the intermediate chamber with cathode, grid and plate elements, and whereof the outer chamber serves as a heating and insulating medium.

4. A thermionic tube comprising three concentrically disposed elongated evacuated chambers, one within the other, a heater filament within the interior chamber, cathode, grid and anode electrodes within the intermediate chamber, the outermost evacuated chamber being effective to maintain a sufficiently high temperature in the intermediate chamber to continue electron emission of the cathode for a substantial period after the filament has been disconnected.

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