Feb. 24, 1959 R. P. STONE 2,875,361

AUXILIARY HEATERS TO AID IN ACTIVATION OF CATHODE RAY TYPE GUNS

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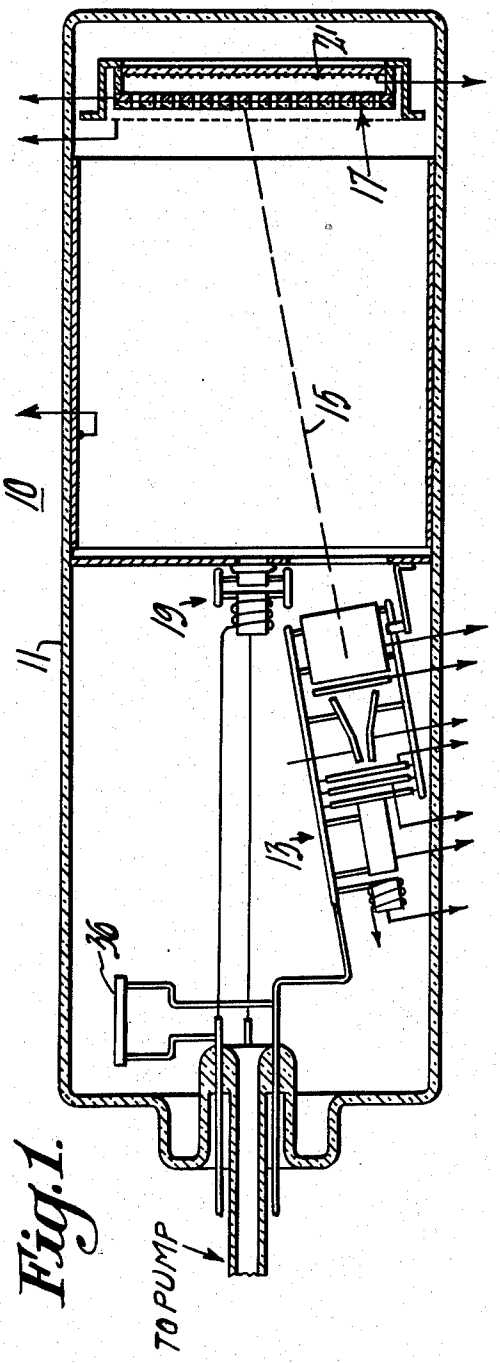



Fig. 1.

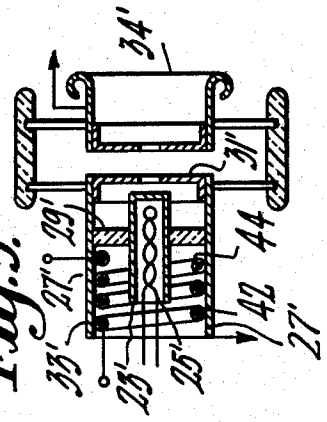



Fig. 3.

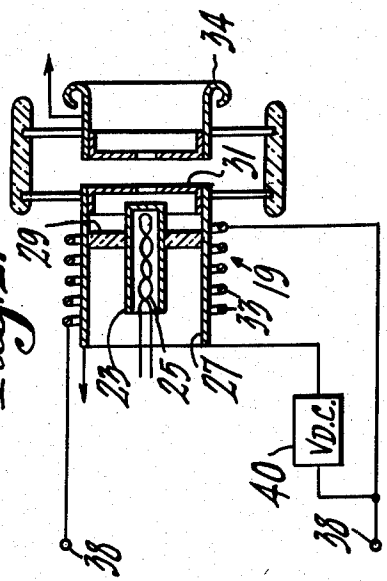



Fig. 2.

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# AUXILIARY HEATERS TO AID IN ACTIVATION OF CATHODE RAY TYPE GUNS

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5 Claims. (Cl. 313—85)

This invention relates to electron guns and particularly to an improved method of and means for constructing electron guns for cathode ray tubes.

During the conventional construction of electron guns for cathode ray tubes, the cathode is sprayed with a layer of material that includes barium carbonate and/or strontium carbonate. After the gun assembly has been placed within the neck portion of an evacuated envelope, the barium carbonate and/or strontium carbonate is converted to the oxide form of the material, as this is the active form, and produces an emission of electrons when heated to a sufficiently high temperature during tube operation. The barium and strontium oxides are unstable and tend to rapidly combine with moisture and carbon dioxide when exposed to the atmosphere. Thus, the cathode is activated after tube evacuation and before it is sealed off.

The normal method of activating the barium carbonate and/or strontium carbonate on the cathode of an electron gun is to heat the cathode by applying potentials to a filament adjacent to the cathode surface. When heating the cathode, the control grid electrode, which is spaced closely adjacent to the cathode, is also heated in order to prevent it from collecting various breakdown products from the cathode. The reason for this is that these breakdown products would re-evaporate back to the cathode when the control electrode is heated during subsequent tube operation and would then cause a decrease in electron emission.

In tubes constructed prior to this invention, the usual method of heating the control grid electrode is by use of a radio frequency coil that is placed around a neck portion of the envelope. This method is highly satisfactory for certain types of tubes. However, in other types of tubes the electron gun is inaccessible to the radio frequency field.

Examples of such tubes are: (1) when the electron gun is supported within a large diameter envelope that does not have a neck; (2) when the electron gun is arranged in such a position that heat from the radio frequency coil would harm other tube parts before the control grid is sufficiently heated; (3) when the envelope is metal; and (4) in demountable systems.

It is therefore an object of this invention to provide a new and novel method of and means for heating the control electrode during activation of an electron gun.

It is another object of this invention to provide a new and improved means for heating an electrode which is positioned adjacent to a cathode and in such a position within an envelope as to be inaccessible by conventional heating means.

This and other objects are accomplished in accordance with this invention by providing a heater element, cooperating with a conventional electron gun assembly that comprises a filament, a cathode and a control grid electrode. The heater element, is arranged in heat transfer relationship with respect to the control grid electrode. During tube processing, the cathode of the electron gun is heated, at least partially, by conventional means in that current is passed through the filament to provide heat to the cathode to decompose the carbonate coating. Simultaneously, the grid electrode is heated by passing current through the heater element. Thus, electron guns



manufactured in accordance with this invention may be arranged in any desired position within an envelope since it is not necessary that they be accessible to radio frequency heating.

Other features and advantages of this invention will become more clear from reading the following specification in conjunction with the accompanying single sheet of drawings, wherein:

Figure 1 is a transverse sectional view of a storage tube in which this invention is particularly applicable;

Figure 2 is an enlarged sectional view of parts of a gun structure utilizing an embodiment of this invention;

Figure 3 is an enlarged fragmentary sectional view of another embodiment of this invention.

Referring now to Figure 1 there is shown a transverse sectional view of a storage tube **10** utilizing this invention. It should be understood that this invention is applicable to any general type of tube utilizing an electron gun, and particularly applicable to tubes wherein the electron gun, or guns, are positioned so that they are inaccessible to conventional electron gun activating means. Thus, the particular storage tube **10** in Figure 1 is shown merely to illustrate one of many useful applications of the present invention.

The storage tube **10** generally comprises, within an evacuated envelope **11**, an electron gun **13** which is normally referred to as a writing gun. The electron gun **13** provides an electron beam **15** which is scanned over an apertured insulating storage target **17** to deposit charges on the storage target **17**. A viewing gun **19** is provided which sprays the storage target **17** with electrons. During operation, the electrons from the viewing gun **19** are repelled from the areas of target **17** which are not charged, or "written" on, by beam **15**. In the areas that have information "written" thereon, the electrons of the viewing gun **19** pass through apertures in target **17** to strike a fluorescent screen **21**.

As shown more clearly in Figure 2, the cathode is supported within the control grid electrode **27** by means of an insulating spacer **29**. The control grid electrode, or cylinder, **27** has one end closed by means of an apertured disk member **31**. Surrounding the control grid cylinder **27**, but insulated therefrom, is a heater **33**. Spaced from the closed end of the control grid cylinder **27** is a second grid electrode **34**.

During the manufacturing of the electron gun **19** the cathode **23** is coated with a mixture of material that principally includes barium carbonate and/or strontium carbonate. When the gun is inserted within envelope **11**, and the envelope is being evacuated, the materials on cathode **23** are activated by heating the cathode **23**. The cathode heating means used in this invention is conventional in that the cathode **23** is heated by means of a current flow through filament **25**. When the cathode **23** is heated the barium carbonate and strontium carbonate are converted to barium oxide and strontium oxide respectively. Also, the cathode **23** is de-gassed and certain contaminants with respect to the other electrodes, such as oxygen, carbon monoxide, and carbon dioxide are driven from the hot cathode. The contaminants are preferably taken either out of the envelope by the evacuating pump (not shown), or absorbed by a getter **36**, so that they will not subsequently return to the cathode and decrease electron emission. However, if the control grid cylinder **27** remains cool during this activation process, these contaminants will be deposited upon the control grid cylinder since it is a surface near to the cathode. If the contaminants are deposited on the control grid cylinder, the first time the control grid is heated during normal tube operation, the contaminants on the control grid will be driven back to the cathode and will react with the materials, i. e. the barium oxide

and strontium oxide, so that electron emission from cathode **23** slumps rapidly and thus the tube life is short due to loss of electron emission. It is for this reason that the control grid cylinder is heated during the cathode activation and degassing process.

As can be seen from Figure 1 the writing gun **13** is arranged in an off axis location in the envelope **11** and adjacent to one side thereof. Also, the viewing gun **19** is substantially on the axis of envelope **11** and is spaced from the walls of envelope **11** a substantial distance. Both of the electron guns **13** and **19** are thus in such a position within the envelope **11** that it is extremely difficult to heat the control grid electrode of the electron guns by the conventional means of a radio frequency coil. Specifically, if a radio frequency coil were utilized to heat the control grid electrodes in the electron guns **13** and **19**, other tube elements might be overheated due to conduction paths which exists in the tube's geometry.

For example, since it is generally necessary to heat a control grid electrode to a temperature of approximately 700° C. to prevent contaminants from the cathode from settling thereon, an extremely large amount of power must be utilized in order to heat the control grid **27** to such a temperature. This large amount of power is likely to damage other electrodes within the tube, such as those portions of the writing gun **13** that are near the envelope wall, long before the control grid **27** has attained such a temperature by conventional radio frequency heating means.

In accordance with this embodiment of this invention, the control grid cylinder **27** is heated by current flow through the heater **33** that surrounds the control grid cylinder. In the example presently under consideration, the heater **33** is made of 10 mil tungsten wire with approximately four, or more, turns of the wire around the control grid cylinder **27**. A heater similar to heater **33** shown in Figure 2 has also been made of 12½ mil thoriated tungsten wire.

During the activation process of manufacturing gun **19**, the filament **25** is heated to a temperature of approximately 1300° C. to 1400° C. which heats the cathode, by means of radiation and conduction, to a temperature of approximately 1000° C. to 1200° C. Simultaneously the heater **33** is heated to approximately 2200° C. This temperature for heater **33** generates sufficient heat to raise the temperature of the control grid cylinder **27** to a temperature of approximately 700° C. to 800° C. by radiation. These temperatures may be obtained by passing approximately 6 amperes through the heater **33** at a potential of approximately 16 volts. The cathode temperature is obtained by passing approximately 8/10 amperes through the filament **25** at a potential of approximately 10½ volts. In the method just described, the potentials for the heater **33** are applied across input terminals **38** and the control grid cylinder **27** is heated solely by heat radiated from the heater **33**, neglecting the small amount of heat radiated to the grid cylinder by the cathode.

Another method of operating the device shown in Figure 2 is to raise the temperature of heater **33** until it becomes electron-emissive. When using this method, the control grid cylinder **27** is made electrically positive with respect to the heater **33** by means of direct current source **40**. When this method is utilized the control grid cylinder **27** is heated by both electron bombardment and by heat radiation, and thus the heater **33** should be at a temperature that is highly electron-emissive. For example, the heater **33** is electron emissive when raised to a temperature of approximately 2200° C. for a tungsten heater, and approximately 1800° C. for a thoriated tungsten heater.

Referring now to Figure 3 there is shown an embodiment of this invention wherein a heater coil **42** is enclosed within the control grid cylinder **27'** and is insulated therefrom by an insulating coating **44** on the heater, or auxiliary filament, wires **42**. When using this embodiment, a tungsten or thoriated tungsten wire may be utilized, as was previously described, and may be connected to a potential of approximately 6 volts with a current of approximately 4 amperes which is sufficient to raise the temperature of the heater to approximately 1100° C. The particular example given above as illustrative of this invention causes the control grid cylinder **27'** to be heated to a temperature of approximately 700° C. to 800° C.

In the embodiment shown in Figure 3, the heat generated by the heater **42** is transferred to the control grid cylinder **27'** both by radiation and by conduction. Furthermore, some heat will also be transferred to the cathode by radiation, and therefore it is not necessary to apply as much power to filament **25'** for heating cathode **23'** to the same temperatures as previously described.

Although the invention was decribed with particular reference to the viewing electron gun, it should be understood that it is also applicable to the writing gun **13**. Also, the invention was described with particular reference to a storage tube **10** and it should be understood that this type of tube was shown merely as an example of a particular type of tube wherein this invention is particularly useful.

What is claimed is:

1. An electron gun assembly including a filament, a hollow tubular cathode electrode enclosing said cathode, said hollow tubular grid electrode having an apertured member spanning one end thereof, and means including a heater element arranged adjacent to said grid electrode and in heat exchange relationship with respect to said grid electrode for heating said grid electrode during cathode activation.

2. An electron gun as in claim 1 wherein said heater is between said cathode and said grid electrode.

3. An electron gun as in claim 1 wherein said heater surrounds said grid electrode.

4. An electron gun assembly comprising a filament, a cylindrical cathode enclosing said filament and having one end closed, an electrically insulated heater element around said cathode, a control grid cylinder enclosing said cathode and said heater, said heater being adjacent to sai control grid cylinder whereby said control grid is heated by passing current through said heater element.

5. An electron gun assembly comprising a filament a cylindrical cathode enclosing said filament and having one end closed, a coating of barium carbonate and strontium carbonate on said cathode, a control grid cylinder enclosing said cathode and spaced therefrom, an auxiliary heater spaced around said control grid cylinder, said filament being in heat exchange relationship with said cathode whereby said barium carbonate and strontium carbonate may be heated by passing current through said filament, said control grid being in heat exchange relationship with respect to said auxiliary heater whereby said control grid cylinder may be heated by passing current through said auxiliary heater, and means for applying potentials between said auxiliary heater and said control grid cylinder whereby said control grid cylinder may also be heated by electron bombardment by electrons from said auxiliary heater.

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# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 2,875,361 February 24, 1959

Robert P. Stone

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 28, after "enclosing said" insert -- filament, a hollow tubular grid electrode enclosing said --; line 44, for "sai" read -- said --.

Signed and sealed this 7th day of July 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents