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METHOD AND APPARATUS FOR USE IN CHEMICAL EVAPORATION PROCESSES

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Fig_1

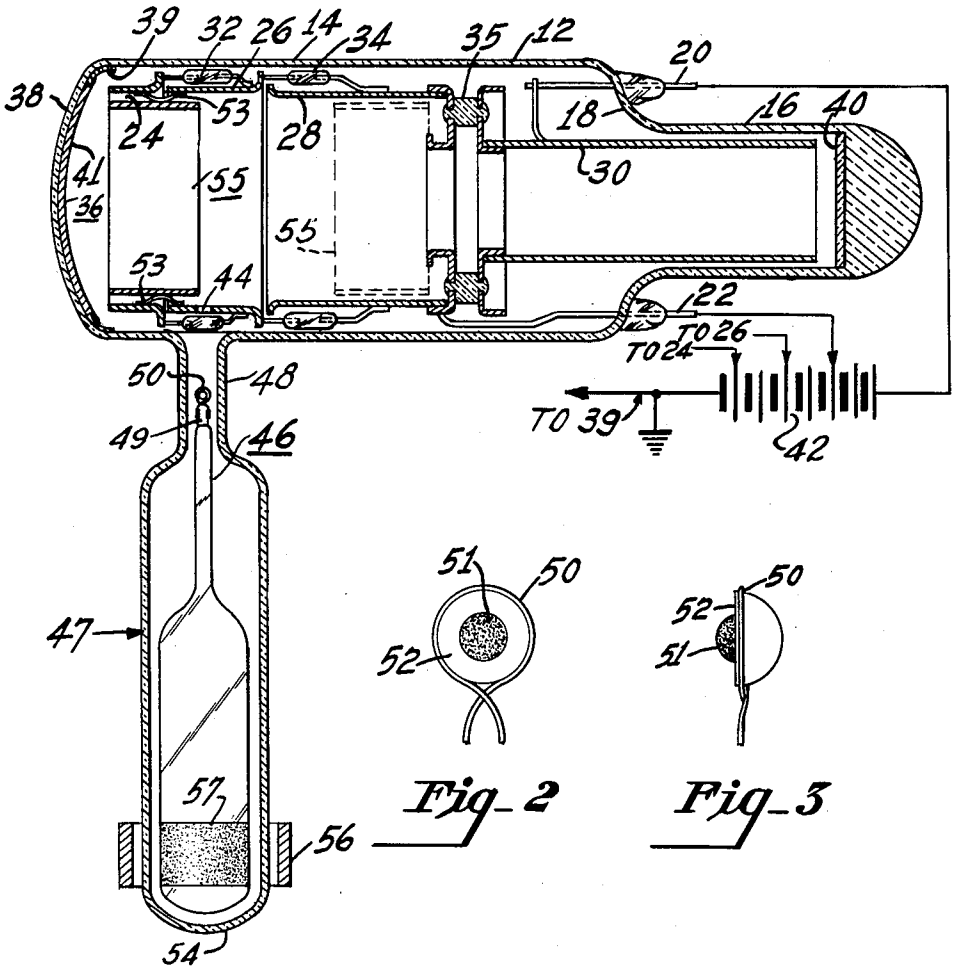


Fig_2

Fig_3

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METHOD AND APPARATUS FOR USE IN CHEMICAL EVAPORATION PROCESSES

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This invention relates to apparatus for use in chemical evaporation processes and particularly to apparatus for shielding predetermined areas within a hollow container while chemicals are evaporated therein.

In the electronic arts many devices such as camera pickup tubes, phototubes and the like, utilize targets, photocathodes or other elements having films of photoelectric material which may be deposited by an evaporation process. Selenium, antimony, antimony trisulfide and caesium are typical examples of photoelectric materials which are often used in such applications. One example of an electron device to which this invention is applicable is the image viewing tube. Such a tube comprises a glass envelope on one end of which is formed a photocathode which is adapted to produce an electron image under the influence of and representative of incident radiation. Within the envelope are mounted a plurality of electrodes which are generally operated at comparatively high potentials and which serve to accelerate the electron image toward the other end of the tube which is provided with a fluorescent viewing screen.

It is well known that conductive surfaces, such as the surfaces of the accelerating electrodes, may emit electrons when present in a high potential field even if these surfaces are cold. This phenomenon is known as cold emission. These cold emitted electrons may be accelerated by the electric field and caused to collide with residual gas atoms or molecules within the tube envelope whereby positive ions are produced. These positive ions in turn may be accelerated by the electric field and may be caused to strike the photocathode and thus interfere with the normal operation of that member. These positive ions may also strike the glass walls of the tube envelope thereby producing phosphorescence. Such phosphorescent light finally may be fed back to the photocathode whereby spurious photoelectric emission may be produced.

In the preparation of an electron tube of the type under consideration, the tube envelope and its components must be processed in conventional fashion by several operations including degassing. Degassing is generally accomplished by baking the tube envelope and the included components. To accomplish effective baking out, the process must be carried out at comparatively high temperatures on the order of 400° C. This tube processing procedure, however, is complicated by the fact that most photoelectric materials are sensitive to such high temperatures and are subject to deleterious changes if so heated. For example, the photoelectric material, if in the form of a film on a supporting surface, may evaporate or transmute into an undesirable crystal structure.

The usual solution to this problem is to mount the tube components within the tube bulb, process the tube and its components completely and then evaporate the photoelectric material onto the supporting surface from a suitably placed evaporator. This procedure is effected

by providing the electron tube envelope with a side tube or appendage which is used in the evaporation process. Some form of evaporator carrying the photoelectric material to be evaporated is inserted through the side tube and into the electron tube envelope so that the photoelectric chemical is in proper position to be evaporated onto the supporting surface. The evaporator is then heated and, as a result the chemical is heated and evaporated onto the supporting surface. The evaporator is then removed and the tube is processed to completion in the usual fashion. However, it often happens, that some of the evaporated chemical deposits and remains on the inner surface of some of the accelerating electrodes. This deposit presents a problem since it is well known that cold emission is increased when the surfaces of electrodes in a high potential field are contaminated by deposits of foreign material.

Accordingly, the principal object of this invention is to provide an improved apparatus for preparing a photoelectric film on a predetermined surface area within a hollow container more specifically the envelope of an electron discharge device.

Another object is to provide an improved method and apparatus for use during the evaporation of chemicals within an electron tube envelope.

A further object is to provide improved apparatus for protecting electron tube components during the evaporation of chemicals within the tube envelope.

In general the purposes and objects of this invention are achieved by the provision, within the electron tube envelope, of a cylindrical shield member which is positioned inside the electrodes whose surfaces are to be protected during the chemical evaporation process. After the evaporation has been completed the shield is moved to a field free area within the envelope whereby the tube, when completed, may be operated in normal fashion.

The invention is described with reference to the drawing which shows an image tube provided with the elements of the invention used during evaporation of chemicals within the tube envelope.

The invention is described in detail with reference to an electron tube employing a target having a photoemissive film. Such an electron tube is shown and described in U. S. patent to Flory et al., 2,506,018. However, the principles of the invention are applicable to the preparation of evaporated films in substantially any type of hollow container having areas to be shielded and protected.

Referring to the drawing, the tube **10** includes an envelope or bulb **12** comprising two sections **14** and **16** of different diameters which are joined at their proximate ends by a conical flange **18**. For convenience in manufacture and to obtain a mechanically strong structure a plurality of leads, of which the two leads **20, 22** appear in the drawing, are sealed into the conical flange. Anodes or focusing electrodes **24, 26, 28** and **30** of the tube **10** are mounted upon and carried by the leads in the flange **18** and are mechanically tied together into a rigid structure by a plurality of insulating beads or spacers **32, 34** and **35**.

A photocathode **36** is formed on the transparent end wall or face plate **38** of the larger section **14** of the envelope **12** remote from the flange **18**. The photocathode includes a conductive ring **39** of metal or the like formed around the periphery of the face plate **38** and a superposed layer **41** of photoelectric material such as caesiated antimony or the like. A fluorescent viewing screen or target **40** is placed at the end of the smaller section **16** remote from the annular flange **18**.

The anode or focusing electrode **30** is preferably within the smaller section **16** of the envelope **12** and extends

beyond the annular flange 18 into the larger section 14. This construction facilitates the assembling of the anodes or focusing electrodes into a unitary mount on a stem consisting of the smaller section of the envelope with the annular flange 18, the edge of the annular flange then being sealed to the walls of the larger section of the envelope. By means of the leads in the conical flange 18, the photocathode 36 and the focusing electrodes may be electrically connected to a source of voltage, such as a battery 42, as shown in Fig. 1. For simplicity, only two leads 20 and 22 are shown, the other connections being shown schematically. For the purposes of this invention, a potential difference appears between electrodes 24 and 26 sufficient to cause cold emission.

For practicing the invention, the electrode 26 is provided with an opening 44 through which an evaporator 46 may be inserted. The evaporator may be like the one shown in a copending Ruedy application, Serial No. 306,601, filed August 27, 1952, and assigned to the assignee of this application. The evaporator includes a glass support member 48 having heating wires 49 extending through one end thereof. The wires terminate in a loop 50 in which the substance to be evaporated is carried. Generally, a pellet 51 of the substance to be evaporated, antimony, selenium or the like, is embedded in a cup-like ceramic matrix 52 held by the loop 50. The tube envelope 12 is provided with a side tubulation or appendage 47 through which the evaporator is inserted into the envelope.

According to one suitable procedure for manufacturing the tube 10, the envelope is completely assembled with all of its components including electrodes 24, 26, 28, 30 and the image viewing screen 40. The face plate 38 is coated with the conductive ring 39 of a metal such as silver or the like. Because of the necessity for baking out the tube and components the photoelectric layer 41 is not deposited on the face plate 38 at this time. According to the invention a cylindrical shield 55, which may be made of metal, is positioned within the envelope and inside the electrode 24 and a portion of the electrode 26. Two or more spring members 53 are fastened to the shield 55 and hold the shield in position within the envelope.

After the aforementioned components are mounted in the envelope 12, the evaporator loop 50 is charged with the material to be evaporated and inserted into the side tubulation 47. The open end 54 of the tubulation is then sealed. The evaporator is retracted as far as possible in the side tubulation and the envelope and its included components are processed in conventional fashion.

In general, processing includes exhausting the envelope and degassing all components by a baking operation. Baking may be effected by any suitable means, for example, in a split oven which comprises two arcuate portions which are placed around the envelope 12. The tube is baked at approximately 350° C. to 400° C. for about one hour. Other processing steps may be included as required.

After the tube has been processed, the evaporator 46 is moved into the bulb 12 and into charge evaporating position. An external magnet 56 may be used in cooperation with magnetic portion 57 of the evaporator to move the evaporator along the side tube 47. In this position of the evaporator, the loop 50 is positioned so that the pellet 51 is directed toward the area to be coated and the substance will evaporate substantially only toward this area. The loop is also positioned substantially in the center of the bulb and aligned with the face plate to be coated. With this arrangement only the electrode 24 and a portion of the electrode 26 need be shielded from chemical being evaporated. The evaporator is then heated and the chemical is evaporated onto the face plate 38. When the evaporation has been completed, the evaporator is withdrawn into the side appendage which is then sealed off at a point close to the main body of the envelope 12. The tube is then processed to completion according to standard procedures. According to the invention, before the tube is put into operation, the tube is tilted and the shield 55 is allowed to fall into position inside the electrode 28 as shown by the dotted lines. In this position, the shield is in a field-free space and does not affect the normal operation of the tube.

What is claimed is:

1. In the art of manufacturing an electron image tube of the kind containing a cathode structure having a photosensitive surface and plurality of tubular electrodes arranged in spaced apart end-to-end relationship and normally subjected to different potentials to provide a series of focusing fields through which photoelectrons pass in their transit to a viewing screen, the method of forming a photosensitive coating on a surface of said cathode structure without adversely affecting the subsequent operation of said tube, said method comprising mounting a movable tubular shield within the tubular electrodes which lie adjacent to said cathode structure, evaporating a photosensitive material upon said structure and shield, and thereafter moving said coated shield to a position within another of said tubular electrodes remote from said coated cathode structure.

2. The method of preparing a photoelectric structure in an electron tube containing a plurality of electrodes, one of said electrodes defining a field-free space, comprising the steps of positioning a shield adjacent to an electrode to be shielded from evaporated photoelectric material, evaporating a photoelectric material onto said structure, and moving said shield to said field-free space in said tube.

3. The method of forming a photoelectric coating in an electron tube envelope having a cathode structure and a plurality of tubular electrodes coaxial with said cathode structure and with each other, one of said electrodes having an opening communicating with the interior of said envelope, said envelope also having means providing a field-free space therein, comprising the steps of positioning a tubular shield adjacent to said cathode structure and within at least one of said electrodes, inserting a quantity of photoelectric material through said opening in said one electrode, evaporating said material onto said cathode structure, and moving said shield within said field-free space.

4. The method of forming a photoelectric coating on a supporting surface within an electron tube envelope having a plurality of tubular electrodes coaxial with said supporting surface and with each other, one of said electrodes having an opening communicating with the interior of said envelope, one of said electrodes providing a field-free space within said envelope comprising the steps of positioning a tubular metallic shield adjacent to said supporting surface and within at least one of said electrodes, inserting a quantity of photoelectric material through said opening in said one electrode, evaporating said material onto said supporting surface, and moving said shield within said field-free space.

5. An electron tube comprising an envelope containing a cathode surface to be sensitized with chemical by evaporation from a chemical carrier, a plurality of tubular electrodes mounted along a common axis in said envelope and coaxial with said envelope surface and with each other and spaced along said common axis from said surface, one of said electrodes remote from said surface normally containing a field-free space, a movable tubular shield coaxially positioned within said electrodes for shielding said electrodes from said chemical during the process of evaporation, said shield being in sliding contact with one or more of said tubular electrodes, whereby said shield may be held in shielding position during evaporation and thereafter stored within said field-free space after said evaporation process has been completed.

6. An electron tube comprising an envelope containing a cathode structure to be coated with chemical by evapora-

tion from a chemical carrier, a plurality of tubular electrodes mounted along a common axis in said envelope and coaxial with said envelope surface and with each other and spaced along said common axis from said surface, one of said electrodes remote from said cathode structure providing a field-free space, at least one of said electrodes having an opening in the wall thereof and adapted to receive said carrier for said chemical to be evaporated, a movable tubular shield coaxially and slidably positioned within said electrodes for shielding said electrodes from said chemical during the process of evaporation, whereby said shield may be held in shielding position adjacent to said cathode structure during evaporation and within said field-free space after said evaporation process has been completed.

7. An electron tube comprising an envelope containing a cathode structure to be coated with chemical by evaporation from a chemical carrier, a plurality of tubular electrodes mounted along a common axis in said envelope and coaxial with said envelope surface and with each other and spaced along said common axis from said surface, one of said electrodes remote from said surface providing a field-free space, a movable tubular metal shield slidably and coaxially positioned within and in electrical contact with said electrodes for shielding said electrodes from said chemical during the process of evaporation, whereby said shield may be held in shielding position during evaporation and then stored with said field-free space after said evaporation process has been completed.

8. An electron tube comprising an envelope containing a cathode structure to be sensitized with chemical by evaporation from a chemical carrier, a plurality of tubular electrodes mounted along a common axis in said envelope and coaxial with said envelope surface and with each other and spaced along said common axis from said surface, one of said electrodes remote from said surface providing a field-free space, a movable tubular shield coaxially positioned within said electrodes for shielding said electrodes from said chemical during the process of evaporation, said shield having a length smaller than said electrode providing a field-free space, and a plurality of resilient support members connected to said shield and in sliding contact with one or more of said tubular electrodes, whereby said shield means may be held in shielding position during evaporation and then stored within said field-free space after said evaporation process has been completed.

9. An electron tube comprising an envelope containing an electrode structure to be coated with chemical by evaporation from a chemical carrier, a plurality of tubular electrodes mounted in said envelope coaxial with said structure and with each other, at least one of said electrodes defining a field-free space, one of said electrodes having an opening adapted to receive said carrier for said chemical to be evaporated, means connected to said envelope for supporting said carrier, and a movable shield associated with said electrodes for shielding said electrodes from said chemical during the process of evaporation, said shield being movable to said field-free space within said envelope after said evaporation process has been completed.

10. An electron tube comprising an envelope containing a cathode structure to be coated with photosensitive chemical by evaporation from a chemical carrier, a plurality of tubular electrodes mounted in said envelope coaxial with said cathode structure and with each other, one of said electrodes defining a field-free space, one of said electrodes having an opening adapted to receive said carrier for said chemical to be evaporated, a side appendage connected to said envelope for holding said carrier in position, and a movable cylindrical metallic shield slidably mounted within said electrodes for shielding said electrodes from said chemical during the process of evaporation, said shield being movable to said field-free space within said envelope after said evaporation process has been completed.

11. An electron tube comprising an envelope having a photocathode formed by the evaporation of a chemical thereon, a plurality of tubular electrodes mounted in said envelope and coaxial with said photocathode and with each other, at least one of said electrodes having an opening permitting the introduction of a carrier for said evaporated chemical, at least one of said electrodes defining a field-free space, and a movable shield associated with said electrodes for shielding said electrodes from said evaporated chemical and positioned within said field-free space after said evaporation process has been completed.

12. An electron tube comprising an envelope having a cathode structure including a photosensitive coating formed by the evaporation of a chemical thereon, a plurality of tubular electrodes mounted in said envelope and coaxial with said cathode structure and with each other, said electrodes extending rearwardly from said cathode structure, at least one of said electrodes having an opening permitting the introduction of a carrier for said evaporated chemical, at least one of said electrodes defining a field-free space, and a movable metallic shield associated with said electrodes for shielding said electrodes from said evaporated chemical and positioned within said field-free space after said evaporation process has been completed.

13. In the art of manufacturing an electron image tube of the kind containing a cathode structure having a photosensitive surface and plurality of tubular electrodes arranged in spaced apart coaxial relationship and normally subjected to different potentials to provide a series of focusing fields through which photoelectrons pass in their transit to a viewing screen, the method of forming a photosensitive coating on a surface of said cathode structure without adversely affecting the subsequent operation of said tube, said method comprising mounting a movable tubular shield within at least one tubular electrode which lies adjacent to said cathode structure, evaporating a photosensitive material upon said structure from a region between said shield and said viewing screen, and thereafter moving said coated shield to a position within another of said tubular electrodes remote from said coated cathode structure.

14. In the art of manufacturing an electron image tube of the kind containing a cathode structure having a photosensitive surface and plurality of tubular electrodes arranged in spaced apart coaxial relationship and normally subjected to different potentials to provide a series of focusing fields through which photoelectrons pass in their transit to a viewing screen, the method of forming a photosensitive coating on a surface of said cathode structure without adversely affecting the subsequent operation of said tube, said method comprising mounting a movable tubular shield within one of the electrodes which lie adjacent to said cathode structure, evaporating a photosensitive material upon said structure from a region between said shield and said viewing screen substantially on the axis of said tube, and thereafter moving said coated shield to a position within another of said tubular electrodes remote from said coated cathode structure.

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