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MEANS FOR OBTAINING A UNIFORM EVAPORATED DEPOSIT

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Fig. 1.

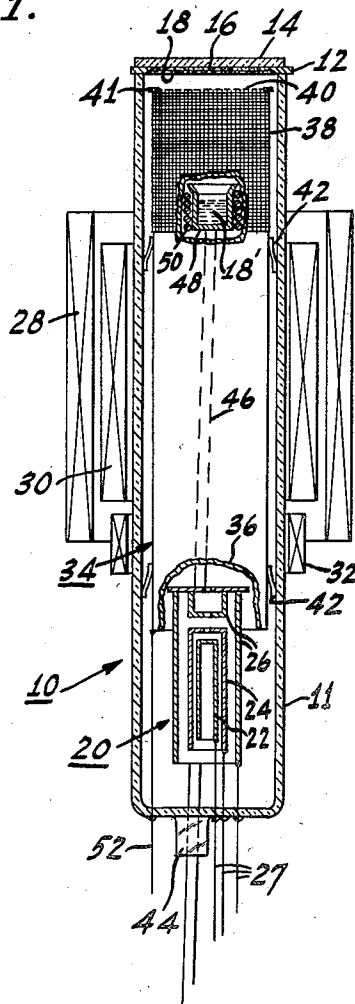


Fig. 3.

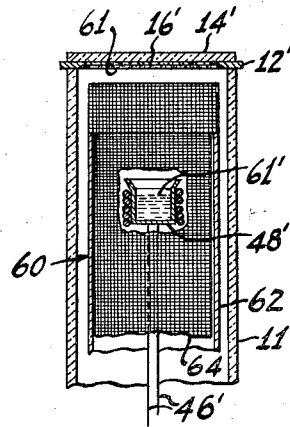
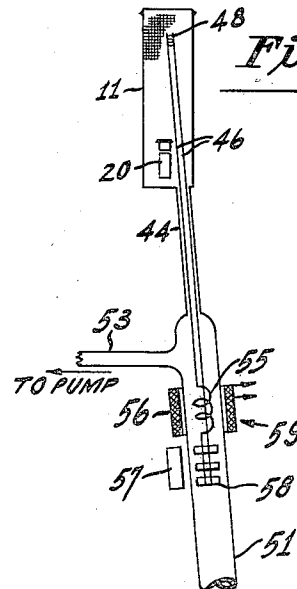


Fig. 2.



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MEANS FOR OBTAINING A UNIFORM EVAPORATED DEPOSIT

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7 Claims. (Cl. 118-49)

This invention relates to television pickup, or camera tubes and particularly to a method of and means for obtaining a uniform photosensitive layer in television pickup tubes.

The type of television pickup, or camera, tube with which this invention is particularly concerned is a tube that is known commercially as a vidicon. This type of tube is manufactured in two sizes, i. e. tubes having an envelope one inch in diameter and tubes having an envelope two inches in diameter. Tubes of this type briefly comprise an electron gun in one end of an evacuated envelope. In the other end of the envelope is a target which includes a transparent conductive signal electrode substantially covered by a photoconductive layer.

During the manufacturing processes of such pickup tubes, there has been a problem of obtaining a uniform photoconductive layer. More specifically the problem has been that of obtaining a porous, uniform photoconductive layer of antimony tri-sulphide, as distinguished from the non-uniform thicknesses of photoconductive material found at times in the prior art.

One solution to the above mentioned problem which is reasonably satisfactory in tubes 1 inch in diameter, is to deposit the photoconductive layer by evaporation, with the evaporator crucible about $\frac{3}{4}$ of an inch from the signal electrode, in an inert gas atmosphere at a pressure of the order of 1 mm. of mercury. However, when an attempt is made to utilize this solution with the evaporator crucible at a distance greater than $\frac{3}{4}$ of an inch from the surface onto which the photoconductive material is to be deposited, which is desired when utilizing certain manufacturing techniques, the evaporated material does not deposit uniformly in a radial direction. Also, this solution does not provide satisfactory results in tubes of larger diameter. For example, when attempting to use this solution in a 2 inch tube, a concentric ring deposit of a diameter of about half that of the tube is usually formed. The reasons for this concentric ring deposit photoconductive material are not clearly understood.

It is therefore a principal object of this invention to provide a new and improved means for, and method of, obtaining a uniform photoconductive layer in a pickup tube.

The above object, as well as various other aspects and advantages, are accomplished in accordance with this invention by providing an evaporator shield in a pickup tube which includes an apertured tubular mesh member. In an embodiment of the invention the evaporator shield may remain in the tube and be utilized as a grid electrode in the completed tube. An improved method of manufacture in accordance with this invention is to deposit a porous layer of photoconductive material while shielding the evaporator crucible with the evaporator shield.

The novel features which are believed to be characteristic of this invention are set forth in the appended claims. The invention itself will best be understood by reference to the following specification when read in con-

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nection with the accompanying single sheet of drawings, wherein:

Figure 1 is a transverse sectional view of a pickup tube in accordance with an embodiment of this invention;

5 Figure 2 is a schematic representation of a means for inserting and withdrawing an evaporator crucible into and out of the tube shown in Figure 1; and

Figure 3 is a fragmentary transverse sectional view of an embodiment of this invention.

10 Referring specifically now to Figure 1 there is shown a transverse sectional view of a pickup tube 10 in the process of having a photoconductive layer deposited therein. The pickup tube 10 comprises a sealed envelope 11 having an annular conductive ring 12 sealed to one end thereof. Sealed to the other face of the annular conductive ring 12 is a transparent face plate 14. The envelope 11 may be glass while the conductive ring 12 may be of some material which will readily seal to glass such as a cobalt nickel-iron alloy. The face plate 14 is preferably of some type of highly transparent, optically clear glass.

Deposited on the inner surface of the face plate 14, and in contact with the conductive ring 12, is a transparent conductive layer 16 which may be of a material such as tin oxide. On the exposed surface of the transparent conductive layer 16 is a photo-conductive layer 18 which may be a material such as antimony trisulphide. Specific details concerning the means for depositing the photoconductive layer 18 onto the transparent conductive layer 16, will be explained hereinafter.

Supported in the other end of the envelope 11 is an electron gun 20 which comprises the usual thermionic cathode 22, a control electrode 24 and one or more accelerating electrodes 26. Since the structure of gun 20 is well known, and also since it is not a part of this invention, further description thereof is not deemed necessary. Lead-in wires 27 for the electron gun 20 extend through the end of envelope 11 in the usual manner. Surrounding the envelope 11 there is provided beam controlling means for controlling an electron beam developed by gun 20. The beam controlling means forms no part of this invention but is shown merely to show the position of the means with respect to this invention. The beam controlling means focusses the electron beam, and scans the beam over the photoconductor 18 to form a raster, and may include a focus coil 28, a deflection yoke 30, and an alignment coil 32.

Extending from closely adjacent to the photoconductive layer 18 to beyond one end of the electron gun 20 is an evaporator shield 34. In accordance with this embodiment of the invention, the evaporator shield 34 comprises a hollow tubular member 36, a hollow tubular mesh screen member 38, and a flat mesh screen 40. The flat mesh screen 40 is connected to the hollow tubular mesh screen member 32 by being spot welded to a ring 41 which is welded to tubular screen member 38. Tubular screen member 38 may be spot welded to hollow tubular member 36. Other conventional means of joining metallic members may also be utilized. The evaporator shield is centrally supported within envelope 11 by means of spacer clips 42. The cylinder 36 may be made of a nickel-chrome alloy, while the mesh member 38 may be made of stainless steel which may be gold plated to improve corrosion resistance. The number of wires per inch in mesh member 38 is not critical and mesh screens having 30 to 150 wires per inch have been successfully utilized. The flat mesh member 40 may also be made of stainless steel and preferably has a minimum of approximately 500 wires per inch so that mesh member 40 may function as an electrode in the completed tube. Other types of apertured tubular members having one

end closed with a flat apertured member may also be utilized.

Entering the envelope 11 through an exhaust tubulation 44, which is offset from the axis of tube 10, is an evaporator. The evaporator comprises a crucible 48 which is supported within a heating element 50 which in turn is supported by its own leads 46. The crucible 48, which is shown greatly enlarged for purposes of illustration, passes between the electron gun 20 and the evaporator shield 36 when inserted within envelope 11. The crucible 48 may be made of a hard glass and in actual practice may be approximately $\frac{1}{4}$ inch in diameter and $\frac{1}{4}$ inch deep. The heating element 50 may be a coil wire which may be energized by several conventional means one of which will be explained in connection with Figure 2.

Referring now to Figure 2 there is shown one method of, and means for, inserting and withdrawing the crucible 48 into and out of an envelope 11. The envelope 11 is connected to a hollow glass manifold tube 51 which encloses the evaporator prior to its insertion into the envelope 11. The manifold tube 51, which includes an exhaust tubulation 53 for connecting to an evacuating pump (not shown), is sealed to the exhaust tubulation 44 of envelope 11. With the gun assembly 20 within the envelope, the manifold 51 is connected at an off center location on envelope 11. The evaporator assembly may be moved into, and out of, envelope 11 by means of a magnet 57 acting on an iron armature 58 attached to the evaporator.

One means for heating the heating element 50, which surrounds crucible 48, comprises utilizing a portion of the support wires 46 within tube 51 as a secondary of a transformer having a primary 56 outside of manifold tube 51. The primary 56 is connected to a source of electrical energy (not shown). Of course, other means (not shown) for energizing the heater element 50 are within the contemplation of this invention such as contacts which engage fixed lead-in wires through the walls of the glass manifold tube 51.

To deposit a surface of photoconductive material 18, the tubulation 44 is sealed to the manifold 51, the envelope 11 is evacuated and filled with an inert atmosphere, e. g. argon at a pressure of approximately 1 mm. of mercury, and the evaporator assembly 46 is inserted into the envelope and with the evaporator crucible 48 approximately $\frac{1}{32}$ inches from the transparent conductive coating 16. When these steps have been accomplished, the evaporator crucible 48 is heated to a temperature above the melting point of the antimony tri-sulphide, i. e. above 550° C. In actual practice, the evaporator crucible 48 is probably heated to a temperature of 600 to 700° C. Due to the presence of the tubular mesh screen 38, the deposit of the material 18 is substantially uniform. The reasons for the uniform deposit are not clearly understood. Perhaps the heat of the evaporator causes convection currents in the gas atmosphere of the prior art methods which carry the evaporated particles into a non-uniform pattern. Assuming that convection currents are the cause of the non-uniform deposits in devices prior to this invention, the mesh screen of this invention breaks up the convection currents resulting in a uniform deposit.

Another possibility for the cause of the unevenness in previous devices, for which there is some evidence, is that particles of photoconductive material radiating from the evaporator strike a solid wall cylinder and are specularly reflected to form the observed patterns on the face plate. If this is the cause of the non-uniform deposits in previous practices the present invention provides a uniform deposit by deflecting the evaporated particles in many directions thus providing a uniform deposit of any deflected particles. Although the reasons as to why a uniform deposit is obtained by following the teachings of this invention are not clearly understood, it has been

proved by many experiments that the results obtained by practicing this invention provide a uniform deposit of photoconductive material.

After the step of depositing the photoconductive material 18 by evaporation, the evaporator crucible 48 is removed from the envelope 11 by being drawn back into manifold 51, by means of magnet 57. The envelope 11 is then evacuated, and tubulation 44 is sealed off. The approximate sizes of the elements, to permit this insertion and withdrawing of evaporator crucible 48 are that the evaporator crucible is approximately $\frac{1}{4}$ inch in diameter, the gun is approximately $\frac{1}{2}$ inch in diameter while the envelope 11 is approximately 2 inches in diameter.

In this embodiment of the invention the evaporator shield 38 is left within the envelope 11 to function as the final accelerating electrode for an electron beam. As can be seen from Figure 1 the flat mesh screen 40 is supported closely adjacent to the evaporated photoconductive material 18 and, when a potential is applied to mesh screen 40, the mesh screen functions as a grid electrode. A screen having a minimum of approximately 500 wires per inch, when used as in mesh 40, does not show in the televised picture. Potentials are applied to the evaporator shield 34 by means of a lead-in 52.

Referring now to Figure 3 there is shown an embodiment of this invention for a pickup tube of the type described above, for use when it is desired to replace the evaporator shield with conventional electrodes. The assembly comprises an evaporator crucible 48' which is supported within envelope 11' by support rods, or lead-ins 46'. The evaporator shield 60 comprises a hollow tubular metallic member 62 having both ends open. Contiguous with the inner surface of the tubular cylinder 62 is a mesh screen 64. The mesh screen 64 extends beyond an open end of cylinder 62 to a point closely adjacent to the transparent signal electrode 16'.

In the embodiment of the invention shown in Figure 3 the mesh screen 64, which is mesh screen of approximately 30×30 wires per inch, extends within the tubular member 62 and is connected thereto by any well-known means such as by spot welding. In this embodiment the evaporator shield 60 is preferably removed from the envelope 11' when the operation is completed and conventional electrodes inserted within envelope 11'. Therefore, a flat mesh screen across the open end of shield 60, similar to that shown in Figure 1, is optional. Here again the cylinder 62 may be a nickel-chromium alloy while the mesh 64 may be stainless steel. During the evaporation process the evaporator is preferably supported approximately $\frac{1}{8}$ inch to 2 inches from the transparent conductive coating 16'. The distance between the shield 64 and the signal plate 16' may be within the approximate range of $\frac{1}{2}$ to 3 millimeters. Also, as was the case in connection with the embodiment shown in Figure 1, no particular mesh size is required; and meshes of 30 wires per inch up to 150 wires per inch have been satisfactorily used.

The purpose of the solid Nichrome shield 62 is to guide material 61', which is to be evaporated, onto the signal electrode 16'. The purpose of the mesh 64, inside of cylinder 62 is to break up the streamline flow thereby creating turbulence in the gases and increasing surface uniformity at the edges of photoconductive layer 61. The diameter of the crucible 48' is not critical. A small crucible opening tends to trap gases and cause splash and bubbling, while a large opening, i. e. one of about .4 inch inside diameter, tends to non-uniformity with the edges tending to be void of evaporated material.

As has been described, in both embodiments of this invention, the evaporation of the photoconductive material, e. g. antimony trisulphide, is preferably done in an inert atmosphere of approximately $\frac{1}{2}$ mm. to 3 mm. of mercury pressure to provide a porous film of photoconductive material.

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What is claimed is:

1. An evaporator shield for evaporating photoconductive material comprising a hollow tubular metallic member, a hollow tubular mesh screen having one open end connected to one open end of said member, an annular conductive ring connected to the other open end of said screen, and a flat mesh screen member connected to said ring and closing the aperture therein.

2. An evaporator shield for evaporating photoconductive material in a pickup tube comprising, a hollow tubular metallic member open at one end and having the other end bonded to a hollow mesh screen member, and the other end of said hollow mesh screen member being connected to a flat mesh member.

3. An evaporator shield for evaporating photosensitive material in a pickup tube comprising a hollow tubular mesh screen member having one end closed by a flat mesh screen.

4. An evaporator assembly comprising an evaporator cup, means to heat said evaporator cup, an evaporator shield including a hollow tubular mesh screen member, means to support said evaporator cup in spaced relation within said evaporator shield, and a flat screen member closing one end of said shield.

5. An evaporator assembly for evaporating material onto a surface comprising, an evaporator crucible and a hollow evaporator shield, means to support said crucible in spaced relation within said shield, said shield being adapted to have a portion thereof positioned a predetermined distance from said surface, said shield compris-

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ing a tubular mesh member and a substantially flat mesh screen closing said portion of said shield.

6. An evaporator assembly comprising an evaporator crucible, a hollow evaporator shield, means to heat and to support said crucible in spaced relation within said shield, said evaporator shield including a hollow tubular mesh screen portion and a hollow tubular metallic portion, one end of said mesh portion extending into said metallic portion, and a substantially flat mesh screen closing the other end of said mesh portion.

7. An evaporator assembly comprising an evaporator shield, said evaporator shield comprising a hollow tubular member having a plurality of apertures through the walls thereof, an evaporator, means to heat said evaporator and to support said evaporator in spaced relation within said evaporator shield.

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