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METHOD OF MAKING TARGETS FOR PICKUP TUBES

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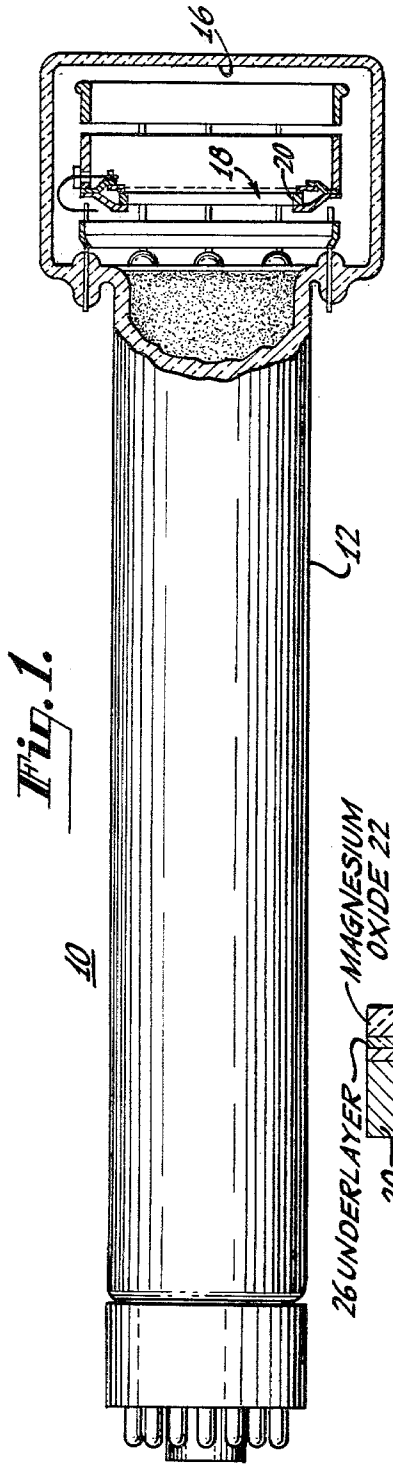

Fig. 1.

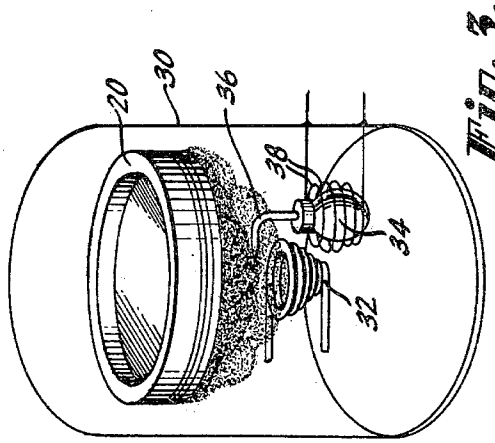

Fig. 3.

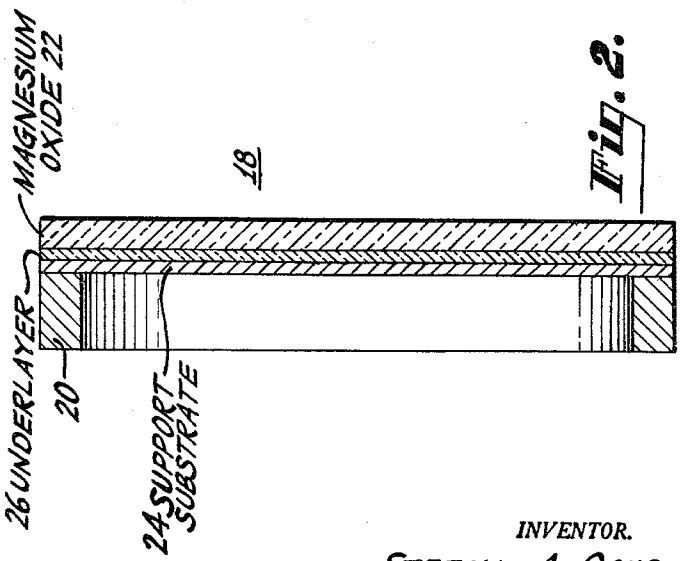

Fig. 2.

INVENTOR.
STEFAN A. OCHS
BY L A Larsen
ATTORNEY

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METHOD OF MAKING TARGETS FOR PICKUP TUBES

Stefan Albert Ochs, Princeton, N.J., assignor to Radio Corporation of America, a corporation of Delaware

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This invention relates to television pickup or camera tubes. In particular, this invention relates to a novel method of manufacturing an improved target structure for television pickup tubes.

In the prior art, there are several commercially available tube types known as Image Orthicons. The Image Orthicon tube generally comprises an envelope having an electron gun in one end thereof. In the opposite end of the envelope is a photocathode. Between the electron gun and the photocathode is a semiconducting storage target electrode.

During operation of the Image Orthicon tube, an image of a scene to be reproduced is directed onto the photocathode which produces photoelectron emission which in turn provides a charge pattern on one side of the target electrode. The electron beam scans the opposite side of the storage target to read off the charge pattern thereon and produces electrical output signals corresponding to the original input scene.

In the prior art, the storage targets for the Image Orthicon type of tube have been made of a thin membrane of glass, thin semiconducting materials, or insulating materials with electrically conducting plugs therein. This invention is particularly related to storage targets of the semiconducting type. The semiconducting type storage target generally comprises an annular support ring having a thin membrane of magnesium oxide supported across the aperture in the support ring.

A storage target of the magnesium oxide type is difficult to produce economically. The reasons for this difficulty include the fact that, frequently, the magnesium metal deposit will not properly adhere to an organic film, which temporarily functions as a support membrane, and which is stretched across the support ring during manufacture of the target. Due to this lack of adherence of the magnesium, the resultant target is likely to split during some of the subsequent tube processing.

A further difficulty in manufacturing such a storage target is that the oxidation on the deposited magnesium film requires exposure of the magnesium surface to an oxidizing atmosphere at a relatively high temperature. Such treatment may be undesirably severe for the film, its substrate or other parts of the device. An alternative suggestion is to evaporate directly the desired oxidized material, i.e. magnesium oxide, onto the support membrane. However, with many compounds, particularly the oxides, the evaporation temperatures are too high to be practical. Still further, many materials, such as magnesium oxide, decompose badly when heated to their evaporation temperature.

It is therefore an object of this invention to provide a novel method of manufacturing an improved electrode target structure.

It is another object of this invention to provide a new and improved method of manufacturing magnesium oxide targets for use in Image Orthicon type tubes.

These and other objects are accomplished in accordance with this invention by depositing on the temporary support membrane, an under layer before metallic magnesium is deposited, and then oxidizing the magnesium, or, as an alternative, depositing magnesium metal through a "cloud" of oxidizing material so that a chemical reaction occurs and magnesium oxide is deposited onto the support membrane or on the underlayer directly.

The invention will be more clearly understood by reference to the accompanying single sheet of drawings wherein;

FIG. 1 is a partial sectional view of an Image Orthicon made in accordance with this invention;

FIG. 2 is an annular sectional view of a storage target in the process of being made, in accordance with the invention;

FIG. 3 is a somewhat schematic plan view of apparatus for the novel process of manufacturing a storage type target in accordance with this invention.

Referring now to FIG. 1, there is shown an Image Orthicon tube **10**. The tube **10** comprises an evacuated envelope **12** having an electron gun (not shown) positioned in the stem end thereof (to the left as viewed in FIG. 1). Positioned on the inner surface of the face plate, in the opposite end of the envelope, is a photocathode **16**. The photocathode may be of any conventional materials, examples of which are the S–10 photosurface described in U.S. Patent No. 2,682,479 issued to Johnson, or the multi-alkali photosurface described in U.S. Patent No. 2,770,561 issued to Sommer.

In the envelope **12**, spaced from the photocathode **16** toward the electron gun, is a semiconducting type storage target **18**. The storage target **18** comprises an annular metallic support member **20** having a thin film of magnesium oxide thereon.

During operation of the Image Orthicon **10**, light from a scene to be reproduced is directed through the transparent face plate onto the photocathode **16** producing a photo-electron image corresponding to the light from the scene. The photo-electron image is focused, and accelerated, by known techniques, and lands on one side of the storage target **18** to provide a charge pattern thereon. An electron beam from the electron gun scans the opposite side of the storage target **18** to remove the charge pattern therefrom. The electron beam is reflected back toward the electron gun where it is fed into a conventional electron multiplier which produces electrical output signals from the tube. The output signals correspond to the light from the scene to be reproduced.

In order to manufacture a storage target **18**, shown more clearly in FIG. 2, a thin film of organic material **24** is first deposited on and across an apertured support member or metallic support ring **20** before one attempts to deposit either magnesium metal, or magnesium oxide. The thin organic film **24** may be any of several known materials. Examples of materials which have been found suitable are collodion, nitrocellulose, or isobutylmethacrylate. The organic film **24** functions as a temporary substrate for a magnesium metal layer, or for the magnesium oxide layer. In accordance with this invention, and due to the fact that it is very difficult to evaporate a uniform and reasonably thick layer of magnesium metal onto the organic layer **24**, a thin underlayer **26** of a material which deposits readily on the organic substrate **24** is provided. The underlayer **26** is selected for its properties of readily depositing onto the organic substrate and its property of readily permitting a uniform and sufficiently thick magnesium layer to be deposited thereon. It was found by applicant that magnesium can be evaporated to the required thickness and uniformity onto an organic film if first a thin underlayer **26** has been deposited.

The underlayer **26** should be too thin to be laterally, electrically conducting after the target has passed through the standard manufacturing process. The underlayer **26** may be deposited by evaporation of the selected material in a vacuum of approximately 10^{-5} mm. of mercury. Two materials for the underlayer **26** which have been found to be suitable are aluminum or gold. Many other materials, (metals as well as oxides and salts,) are be-

lieved to be suitable for use as the underlayer **26** prior to the subsequent magnesium metal deposition.

A particular example of the underlayer **26** is a deposit of gold or aluminum which has been evaporated onto a nitrocellulose support membrane **24** and which is of a thickness of approximately 20 to 30 Angstrom units. Onto this underlayer **26** there is deposited, by evaporation in a good vacuum, a film of magnesium metal that is approximately 1,000 Angstrom units thick.

When this has been done, the support membrane **24** is removed, which results in a self-supporting magnesium film attached to the support ring **20**. In the case of many organic support membranes **24**, the temporary support membrane can be removed by heating the target in an oxidizing atmosphere, such as air or oxygen, to approximately 200° C. for a period of time of approximately 10 minutes. An oxidizing atmosphere is chosen in order to avoid the formation of carbon deposits on the magnesium film. Another suitable way of removing the support membrane film **24** comprises exposing the film **24** to the vapor of a liquid in which the film is soluble but which does not attack the magnesium layer. As an example, collodion or isobutyl-methacrylate films can be removed from underneath the magnesium layer, without damaging the magnesium layer, by exposing the film to acetone or amyl-acetate vapor.

The next step in manufacturing the targets involves the oxidation of the thin layer of magnesium metal. This may be accomplished by heating the target in an oxygen atmosphere at a temperature of about 450° C. The oxygen fed into the system should be carefully dried since the secondary electron emission gain of the magnesium film is greatly reduced by exposure of the film to water vapor.

When the support membrane **24** is removed by heating in an oxidized atmosphere, the steps of removing the membrane and oxidizing the metallic magnesium may be combined in a single operation by placing the target in an oxygen atmosphere and heating to a temperature of about 450° C. for a period of time of one hour.

Another advantage which is gained by having the underlayer **26** beneath the magnesium oxide film arises from the fact that the underlayer **26** will become the surface layer on one side of the finished magnesium oxide target. This surface layer can, by proper selection of materials, be made to have a lower scattering coefficient for the electrons of the scanning electron beam than the scattering coefficient of a magnesium oxide surface. Therefore, if the underlayer **26** is positioned on the scanned or gun side of the finished target, in the tube **10**, larger values of beam modulation are to be expected than that found when bare magnesium oxide is used.

Referring now to FIG. 3, the apparatus there shown for manufacturing targets may be used for targets with or without the underlayer **26** previously described. There is illustrated a technique for depositing chemical compounds by evaporating one component of the final material through a cloud of another component of the final material. Thus, magnesium metal is evaporated in a high vacuum system, illustrated by the bell jar **30**, through an oxygen "cloud," from a standard conical tungsten heater or evaporator boat **32**. The target ring **20** having its organic film **24** positioned thereon, with or without the underlayer **26**, is positioned a suitable distance above the evaporator **32** to function as a substrate. A small amount of oxygen is introduced into the system at a point between the evaporator **32** and the substrate. In the particular example of this invention shown, a glass bottle **34** with a thin neck **36**, having a small orifice at its end was used. The oxygen is formed by heating mercuric oxide in the bottle **34**, by means of heating a coil **38** by an electric current from a source not shown, resulting in oxygen gas being forced through the orifice.

Due to the relatively fast pumping speed of the vacuum system and the slow rate of efflux of the oxygen from the bottle **34**, an appreciable pressure of oxygen was generated only in the immediate vicinity of the orifice. The pressure in the vacuum system at some distance from the oxygen source did not show any significant increase due to the gas influx. Thus, a fairly well localized oxygen "cloud" was formed above the magnesium evaporator.

As a result of the process illustrated in FIG. 3 a magnesium oxide film is formed in the space above the evaporator **32**, and a magnesium oxide film is deposited on the substrate. It is important to note that, when utilizing the apparatus shown in FIG. 3, the evaporator **32** and the oxygen source **34** do not need to be heated above approximately 700° C. to provide the magnesium oxide layer; whereas, to evaporate magnesium oxide directly, temperatures of about 3,000° C. are needed which prohibits the use of standard evaporating techniques. The technique illustrated in FIG. 3 can, of course, be used for compounds other than the magnesium oxide, for example, other oxides, such as aluminum oxide, may be deposited in the same manner.

The technique disclosed in FIG. 3 is also suitable for depositing layers of varying composition by changing the conditions of the process while the process is being accomplished. As an example, the rate of oxygen outflow, or the rate the metal is supplied from the evaporator **32** may be altered during progress of deposition of the composition.

Thus, the apparatus shown in FIG. 3 provides a film of magnesium oxide either directly on the support membrane **24** or onto the underlayer **26** as described in connection with FIG. 2. In either instance, the organic film **24** may be removed by an air brake at approximately 200° C. leaving a self-supporting magnesium oxide film.

What is claimed is:

1. The method of manufacturing a target electrode assembly for use in a television pickup tube comprising the steps of:

(a) positioning a supporting membrane made of an organic material across an opening in an apertured support member,

(b) then evaporating an underlayer of film made of a material selected from the group consisting of gold and aluminum to a thickness of approximately 30 Angstrom units, onto said supporting membrane, while said film is supported by said membrane,

(c) thereafter evaporating magnesium oxide onto said underlayer film, and

(d) then removing said supporting membrane by changing the material of said membrane to a form that is automatically separable from said underlayer film.

2. The method of manufacturing a target electrode assembly for use in a television pickup tube, comprising the steps of:

(a) positioning a removable supporting membrane made of an organic material across an opening in an apertured support member,

(b) then evaporating an underlayer film of a metal selected from the group consisting of gold and aluminum, to a thinness of approximately 30 Angstrom units,

(c) then evaporating a relatively thick layer of magnesium metal onto said underlayer film,

(d) oxidizing said magnesium metal and converting said magnesium metal to magnesium oxide, and

(e) oxidizing said membrane and finally removing the same.

3. The method of making a target assembly for use in a television pickup tube comprising an electron gun, a target assembly and a photocathode spaced in that order in an evacuated envelope, said method comprising the steps of:

(e) positioning across a support ring a membrane

made of a material selected from the group consisting of collodion, nitrocellulose and isobutyl methacrylate, said member being sufficiently thick to serve as a support,

(b) evaporating in an evacuated ambient a layer of metal selected from the group consisting of aluminum and gold, on said support membrane, wherein said layer has a thickness of from about 20 to about 30 Angstrom units,

(c) evaporating in an evacuated ambient a layer of magnesium metal on said layer of material to a thickness of about 1000 Angstrom units,

(d) heating said magnesium metal layer in an oxygen atmosphere at a temperature of about 450° C. to convert said magnesium metal into magnesium oxide, and

(e) finally chemically removing said temporary support member.

4. The method of making a target electrode assembly as claimed in claim 3, wherein the step of heating said magnesium to convert it into magnesium oxide and the step of chemically removing said temporary support membrane, are performed simultaneously by heating said target electrode in an oxiding atmosphere.

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RICHARD D. NEVIUS, *Primary Examiner.*

WILLIAM D. MARTIN, JOSEPH REBOLD, *Examiners.*