

- [54] **PRODUCTION OF LEAD MONOXIDE COATED VIDICON TARGET**

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- [52] **U.S. Cl.**..... **148/1.5;** 148/174; 427/86;
357/31; 313/65
- [51] **Int. Cl.²**..... **H01L 7/54**
- [58] **Field of Search**..... 148/1.5, 175, 174;
117/200, 106 A

- [56]
- References Cited**

UNITED STATES PATENTS

- | | | | |
|-----------|---------|--------------------|-----------|
| 3,289,024 | 11/1966 | De Haan et al..... | 357/10 X |
| 3,307,983 | 3/1967 | De Haan et al..... | 117/200 X |

3,372,056	3/1968	De Haan et al.....	117/200
3,444,412	5/1969	De Haan et al.....	117/200 X

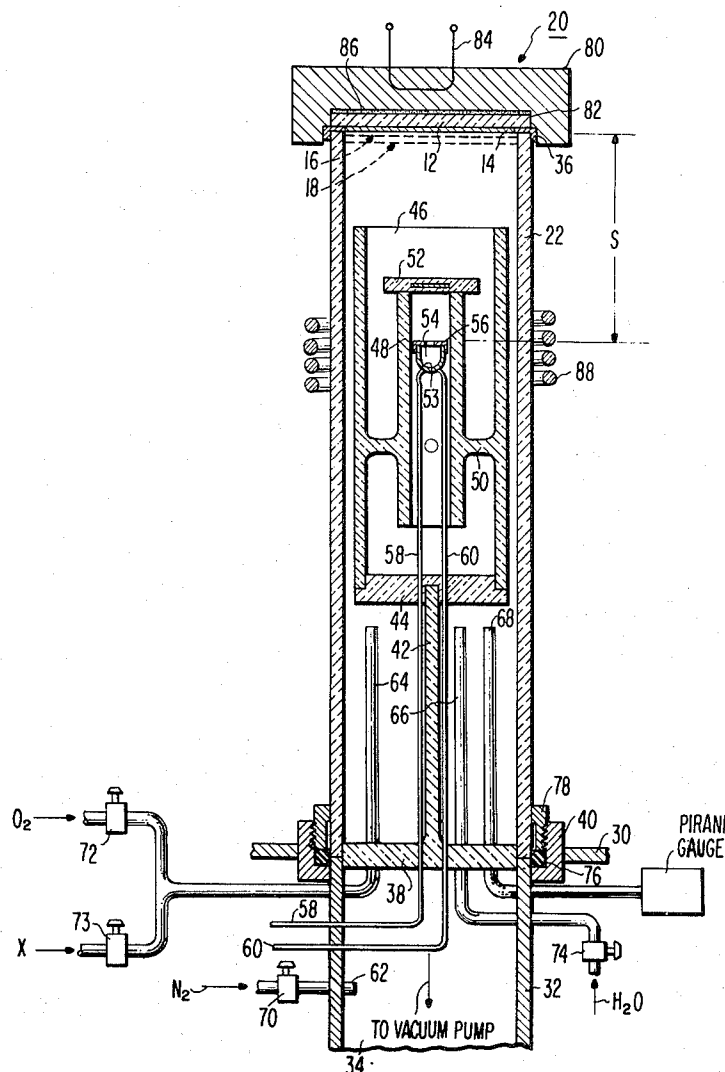
Primary Examiner—G. Ozaki

Attorney, Agent, or Firm—G. H. Bruestle; R. J. Boivin

[57] **ABSTRACT**

A layer of substantially uniform lead monoxide is vapor deposited on a supported signal electrode of a vidicon target. The lead monoxide layer is formed on the signal electrode as a substantially homogeneous compensated intrinsic, or n type, electrically conductive material. An electrical potential is applied to the supported layer of lead monoxide to affect an electrical discharge through a continually renewed atmosphere consisting essentially of one of the inert gases, or nitrogen, whereby ion bombardment of the layer is accomplished.

17 Claims, 2 Drawing Figures



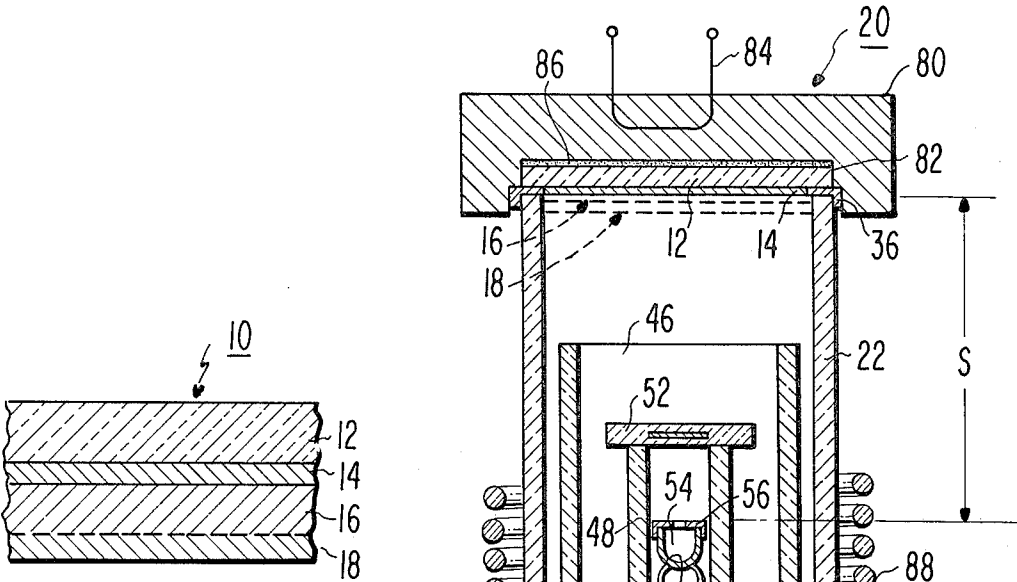


Fig. 1

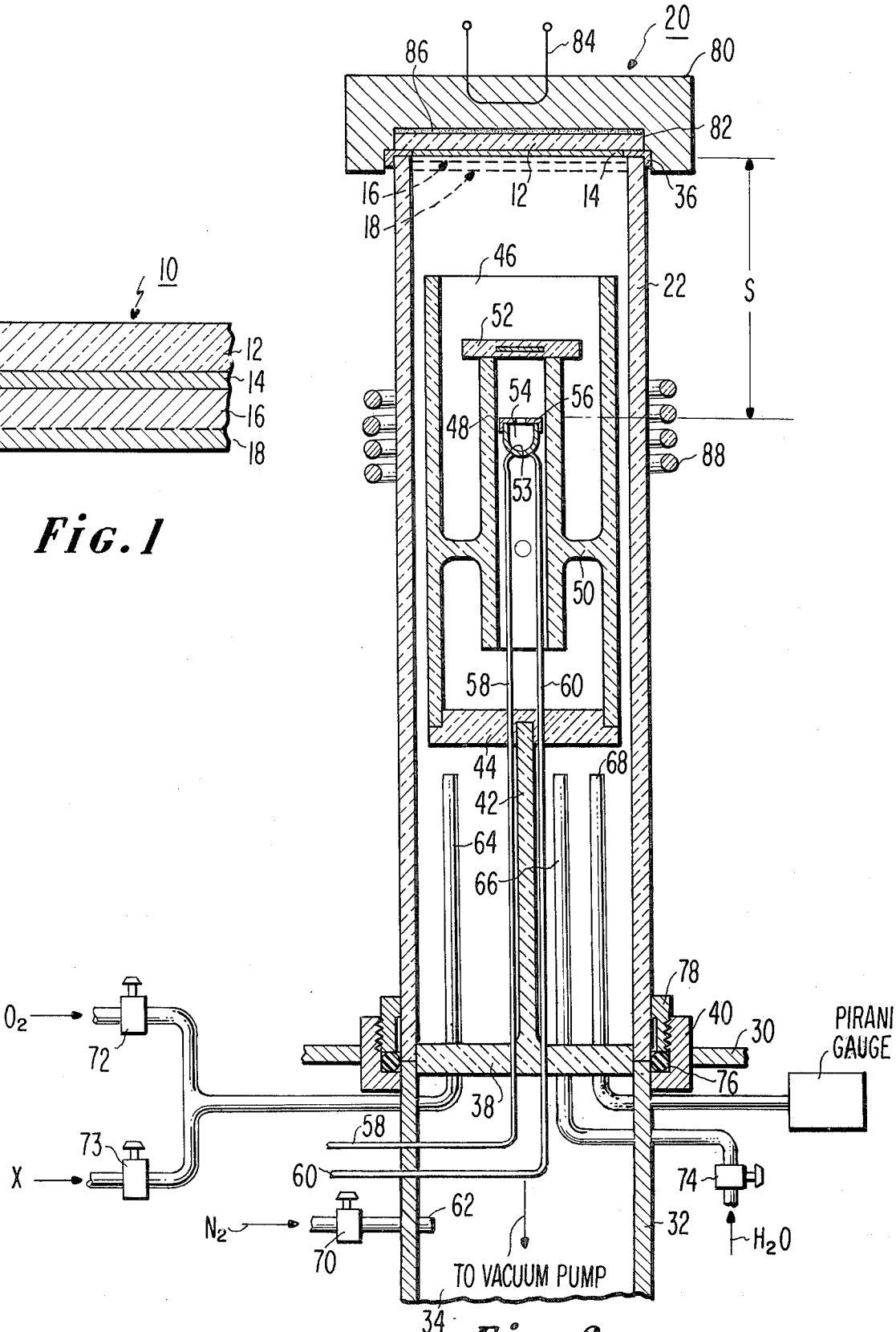


Fig. 2

PRODUCTION OF LEAD MONOXIDE COATED VIDICON TARGET

BACKGROUND OF THE INVENTION

The invention relates generally to methods of forming photoconductive layers of lead monoxide (PbO) and, more particularly, to such layers which display photoconductive properties particularly suited for use as photoconductive targets in image pick-up tubes such as vidicons. In general, photoconductive layers of this type include regions of different conductivity type material lying one behind the other in the direction of thickness of the layer. A p-n barrier or junction is thereby formed at the boundary region between the two adjacent zones of different conductivity.

Certain prior art techniques are known for the manufacture of photoconductive PbO layers. These include, for example the techniques described in the following U.S. Patents issued to E. F. DeHaan et al:

3,289,024 issued on Nov. 29, 1966,
3,307,983 issued on Mar. 7, 1967,
3,372,056 issued on Mar. 5, 1968, and
3,444,412 issued on May 13, 1969.

In the manufacture of devices which incorporate such photosensitive PbO layers, certain deficiencies in the prior art processing methods have resulted in inconsistent and particularly poor yield of devices having desired characteristics.

One desirable characteristic for photoconductive targets used in vidicons is a relative insensitivity of its photosensitive layer to changes in the magnitude of a reverse bias voltage connected across that layer. Devices having an excessive photosensitivity to such voltage changes when light within the blue region of the light spectrum is focused upon that layer may be said to display "blue slump." Generally, photosensitive devices which display, in operation, a blue-slump characteristic, soon thereafter display, by continued operation, other still more serious defects which make them unuseable. Thus, the degree of "blue slump" displayed by such photosensitive devices is used as a leading indication of device failure. It has been found that prior art techniques, for manufacturing PbO layers of the type described, result in a high percentage of defective devices displaying such a "blue slump" characteristic.

Yet another deficiency of the prior art techniques, described in the above references, is that these techniques involve costly, complicated, and extremely sensitive steps for the manufacture of such photoconductive layers.

A simplified and less costly method is desired for manufacturing devices having photoconductive PbO layers, with significantly improved yield of devices whose photosensitivity is relatively insensitive to variations in reverse bias voltage.

SUMMARY OF THE INVENTION

A photosensitive layer is formed from a supported layer of substantially homogeneous compensated intrinsic or n type electrical conductivity lead monoxide material. An electrical potential is applied to the layer of lead monoxide material to effect an electrical discharge through an atmosphere containing a gas chemically inert with that layer at a pressure of from about 4×10^{-2} to about 6×10^{-2} torr whereby ion bombardment of the layer is accomplished.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial cross-sectional view of a target for a vidicon camera tube made in accordance with the invention.

FIG. 2 is a cross-sectional view of one embodiment of an apparatus for practicing the method herein disclosed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the preferred embodiment of a lead-monoxide (PbO) target 10 for a vidicon camera tube is shown. Such targets, and their operation, are well known in the art of camera pick-up tubes generally, and include: a faceplate 12, of an evacuated glass envelope; a conductive coating 14, such as tin oxide on a major surface of faceplate 12; and a thin layer of lead monoxide on a major surface of coating 14 not in contact with faceplate 12. Generally the lead monoxide layer in such devices comprises two regions 16 and 18 of PbO of differing electrical conductivity. In manufacture, a layer of compensated intrinsic, or of n type conductivity, PbO material is first deposited upon the tin oxide coating 14. Thereafter, the region 18 of substantially P type conductivity PbO material is formed into the PbO layer substantially continuous with a remaining portion (region 16) of the original layer of substantially compensated intrinsic or n type conductivity PbO material.

In the manufacture of lead oxide vidicons, the first and second regions 16 and 18 of PbO material must be uniformly and carefully formed on a layer of tin oxide 14 which is ordinarily predeposited on the faceplate 12 of a tubular envelope. The degree to which vidicon targets 10 display desired characteristics, is largely a function of the processing methods employed in forming the regions 16 and 18 of PbO, and of the later sealing assembly of the envelope containing the target formed thereby with other necessary components of the vidicon. An improved method of assembling, sealing, and evacuating envelopes incorporating a target such as 10 depicted in FIG. 1 is fully described, for example in U.S. Pat. No. 3,536,462 issued to A. D. Eyster et al. on Oct. 27, 1970.

In FIG. 2 there is shown a processing apparatus 20, with a glass envelope workpiece 22 mounted thereon, that may be used in practicing the herein disclosed method of forming lead monoxide regions 16 and 18 as part of the target 10 (FIG. 1).

The Apparatus

A portion of the apparatus 20 that serves an evacuating and evaporation function comprises a table 30 supporting a tubular metallic manifold 32 having an upper end adapted to support a lower end of a tubular glass envelope workpiece 22 as shown in FIG. 2. A lower end 34 of the manifold 32 is connected to a vacuum pump, not shown. The upper end of the workpiece 22 is closed by the glass faceplate 12 having on its inner surface an electrically conducting coating 14 made of tin oxide, for example, and which serves as a signal electrode for the completely assembled vidicon. The coating 14 is connected along its circular periphery to an annular aluminum sealing ring 36 which is hermetically sealed between the faceplate 12 and workpiece 22. The ring 36 includes a lip which engages the external periphery

of workpiece 22 to provide a means of heat conduction as hereinafter described, and a means of electrical connection to the coating 14. Upon the conducting coating 14, regions 16, and 18 of photoconductive material comprising lead monoxide must be formed.

The upper end of manifold 32 is hermetically brazed or welded to a glass mounting base 38, and clamping member 40, which in turn is secured or anchored to the table 30. The base 38 supports a cylindrical glass pedestal 42 extending upward into workpiece 22. The upper end of the pedestal 42 is secured to a glass mounting base 44. The glass mounting bases 38 and 44 each include a plurality of axial passages (not shown) or apertures through their thickness by which there is provided relatively free axial passage of gas and/or vapor within the cylindrical interior of the tubular envelope workpiece 22 between the manifold 32 end of the workpiece 22 and the upper faceplate 12 end of workpiece 22.

The base 44 includes an annular lip region along its periphery upon which a glass cylindrical shield 46 may be engagingly mounted and retained by gravity in a substantially vertical position approximately in concentric telescopic relation to the sidewall inner cylindrical surface of the tubular envelope workpiece 22. The glass shield 46 extends vertically within the workpiece 22 and is spaced therefrom to form an intermediate cylindrically shaped gap or passage for providing an additional passageway through which gases and/or vapors may freely pass from the region of the faceplate 12 to that of the interior of manifold 32.

A cylindrical glass evaporation chimney 48 is mounted entirely within the interior of cylindrical shield 46 in concentric telescopic relation therewith by means of a plurality of glass spoke-like radial extensions 50. The chimney 48 includes upper and lower end openings which terminate within the cylindrical interior of the larger and longer cylindrical shield 46. The upper end opening of chimney 48 includes a glass cover member 52 which includes a magnetic material embedded within its volume. The cover 52 provides a magnetically removable shutter as hereinafter described.

A platinum bullet-shaped crucible 53 is mounted within the cylindrical interior of the chimney 48 for retaining and evaporating a measured quantity of PbO material disposed within a cavity 54 centrally located therein. An apertured lid 56 is provided to cover the crucible cavity 54. Removal of the lid 56 provides access to cavity 54 whereby a measured amount of PbO material may be introduced within cavity 54. The crucible 53 is fixably mounted within the interior of chimney 48 by means of a pair of supported wires 58,60 of dissimilar metal compositions which extend upward through the bases 38 and 44 and which extend through the manifold 32 external to apparatus 20. The wires 58,60 may comprise, for example, material compositions of platinum and platinum-rhodium alloy, respectively, whereby a thermocouple is provided by which the temperature of the crucible may be electrically determined external to the apparatus 20.

A plurality of glass tubulations 62, 64, 66, 68 extend through and are hermetically sealed to the manifold 32. Tubulation 62 terminates within the manifold's interior and is externally connected to a source of nitrogen buffer gas N₂, for example, through an adjustable dosing valve 70 by which the rate of introduction of this gas subsequent to processing may be accurately con-

trolled, as hereinafter disclosed. Tubulations 64, 66, 68 additionally extend through the base 38 and terminate within the interior of workpiece 22 closely proximate to the gas passages through base 44. Tubulation 64 is externally connected by a "T" tubulation arrangement to a source of either oxygen or gas "X". Tubulation 66 is externally connected to a source of water vapor. The rate of admission of gas or water vapor within the interior of workpiece 22 by tubulations 64, and 66 is accurately controlled by adjustable "dosing" valves 72 and 73, and 74, respectively. Tubulation 68 is externally connected to a Pirani gauge for measuring the internal gas or water vapor pressure within the interior workpiece 22.

The distance "S" of the apertured lid 56 of crucible 53 from the inner surface of the faceplate 12 is adjusted to be 40 mm. $\pm \frac{1}{2}$ mm. when the workpiece 22 is vertically mounted to engage the upper annular end of manifold 32. The workpiece 22, once so positioned may be hermetically sealed to apparatus 20 by means of "O" ring 76 comprised of, for example, a silicon rubber material which may be compressed to hermetically seal the mating annular end surfaces of the manifold 32 with that of workpiece 22 by means of a threaded collar 78 which mechanically engages mating threads in the clamping member 40. Sealing compression of the "O" ring, and release of the workpiece 22 from the apparatus 20, may be easily accomplished by, respectively, screwing or unscrewing the threaded collar 78 within the clamping member 40.

During processing the faceplate 12 is maintained at a constant temperature by means of a removable temperature controlled heating block 80 comprising, for example, a copper block including an annular disc shaped receiving cavity 82 so dimensioned as to receivingly engage the external major surface of faceplate 12 and the aluminum lip 36 which is electrically connected to the conductive coating 14 or signal electrode. A thermocouple 84 is embedded within the block 80 to control the temperature thereof with an accuracy approximately $\pm 1^\circ\text{C}$. of the controlled temperature by means of external control apparatus (not shown). A removable silicon grease 86, or other suitable heat conducting media, is provided within receiving cavity 82 between the block 80 and faceplate 12 to provide increased heat conduction therebetween. During processing the crucible 53 is heated by RF induction by means of the removable coil 88 which may be positioned telescopically about the periphery of workpiece 22 at the axial location of the crucible 53.

The Method

Preliminary to forming PbO regions 16 and 18 on the interior surface of faceplate 12 the apparatus 20 is cleaned of all residual impurities which might later contaminate these layers. Cleaning may be, for example, accomplished by providing an auxiliary cover bulb or envelope, in lieu of the envelope 22 on the apparatus 20. The cover bulb may be sealed to the base 38, in the same manner as previously described for envelope workpiece 22, to include telescopically within its interior all the internal components of apparatus 20 which are ordinarily included within the workpiece 22. Once the cover bulb has been hermetically sealed about the base 38, the bulb may be evacuated by vacuum pump(s) interconnected to the manifold 34. Dosing valves 70-74 are all maintained in an off position

thereby preventing the entry of gases or vapor into the cover bulb. Once the cover bulb has been evacuated, the interior components of apparatus 20 may be cleaned, by a high temperature bake out, comprising for example, maintaining the internal components of apparatus 20 within the cover bulb, at a temperature of 450°C. for a period of 30 minutes. Crucible 53 may also be simultaneously heated by means of coil 88 to remove by evaporation all residual PbO material which remains from a prior use of the apparatus 20.

If the prior cleaning operation is utilized, the cover bulb is thereafter removed by unscrewing the collar 78, and coaxially lifting the cover bulb from the internal components of apparatus 20. The glass shield 46 and chimney 48 are also removed to provide access to the crucible 53. The apertured lid 56 is then removed to provide access to the cavity 54 of crucible 53. A suitable charge of substantially pure PbO material is carefully placed within the cavity 53. The volume of PbO material introduced into cavity 54 must relate closely to the cross-sectional area and thickness of the PbO layer which is later to be formed on the coating 14 of workpiece 22. The apertured lid 56 is then placed across the crucible cavity as shown in FIG. 1.

The chimney assembly which comprises glass shield 46, chimney 48, and cover member 52, is thereafter positioned coaxially about the crucible 53 within the annular receiving lip along the periphery of mounting base 44. The workpiece 22, which comprises a vidicon envelope including faceplate 12, and a predeposited conductive coating 14 thereon, is thereafter coaxially positioned about the chimney in engagement with the upper annular mating surface of the manifold 32. The workpiece is then hermetically sealed to the apparatus 20 by screwing the collar 78 as previously described. Once sealed, the workpiece 22 is evacuated by one or more vacuum pumps interconnecting with the orifice of the lower end 34 of manifold 32, to a vacuum level approximately 10^{-6} torr. An oven is thereafter placed about the workpiece 22 and the internal components of apparatus 20, and the assembly heated to approximately 450°C. for a period of 60 minutes, for example, to bake out any remaining contaminants within the interior of the workpiece 22.

The previously described steps are intended to be illustrative of the cleaning and charging operation by which the workpiece 22 and the internal components of apparatus 20 may be prepared for the critical steps of evaporating and forming the PbO layer and are not otherwise intended to be critical or limiting.

A PbO layer may now be formed on the coating 14 of the workpiece 22 by means of the following described steps which are accomplished during a "dynamic state of atmospheric flushing" of the interior of workpiece 22. The flushing is performed by introducing a series of gases and/or water vapor within the workpiece 22 by means of tubulations 64-68, as hereinafter described, while simultaneously evacuating the workpiece with an operative vacuum pump connected to manifold 34. A high rate of flushing or continuous renewal of the atmosphere of the interior workpiece 22 has been found desirable and may, for example, be accomplished by means of a vacuum pump system capable of pumping approximately 100 liters per sec. from the manifold 32 having an orifice about 27 mm. in diameter. The hereinafter described admission rates of gases and/or vapors from tubulations 64-68 are speci-

fied with regard to such an evacuation rate. While the rates herein disclosed are preferable, it is understood that the evacuation rate, and the admission rates of gases and/or water vapor may be suitably adjusted by persons skilled in the art to provide necessary convection and renewal of the atmosphere proximate to the surface region upon which PbO deposition is to occur as herein described.

After the interior of the workpiece 22 has been cleaned as above described, the internal components of apparatus 20 and workpiece 22 are cooled; the RF heater coil 88 is coaxially mounted in horizontal alignment about the crucible 53 external to the workpiece 22; and the block heater 80 is placed on the faceplate 12 of workpiece 22 which has been precoated with a silicone grease, or other suitable conductive media, to suitably intermesh in engagement within the receiving cavity 82.

During the formation of the PbO layer, the temperature of the block heater 80, and of the thermally connected faceplate 12 must be accurately maintained at a temperature of between 100°C. and 110°C. $\pm 1^\circ\text{C}$. The temperature of the faceplate 12 is critical, as it has been discovered that a necessary red hexagonal crystalline state for the PbO layers 16 and 18 may only be accomplished while maintaining the faceplate 12 within that temperature range. Moreover, PbO crystalline size is also largely controlled by means of the temperature of faceplate 12.

The temperature of the faceplate 12 is uniformly established within the above defined temperature range by means of external heating and control apparatus (not shown) interconnected to thermocouple 84 within the block heater 80. Once the desired faceplate temperature has been achieved, the dosing valve 72 is opened to admit oxygen to the workpiece 22 interior at a dynamic flushing rate at which there is achieved a substantially constant measurement on the Pirani gauge, interconnected to tubulation 68, of approximately 4×10^{-3} torr of pressure. A period of time approximating 120 seconds is thereafter required to establish a stable flushing rate of the interior workpiece 22. The dosing valve 74 is then opened to also admit water vapor to the workpiece 22 interior at a dynamic flushing rate at which there is achieved a substantially constant measurement of pressure on the Pirani gauge of approximately 1.4×10^{-2} torr. It is preferable that the ratio of admission rates of the water vapor and oxygen be about 10 to 4 as herein described. A period of time approximating 120 seconds is again required to establish a stable flushing rate of the interior of workpiece 22.

Once a stable flushing rate of the admitted oxygen and water vapor into the interior of workpiece 22 is established, the RF heating coil 88 is connected to a suitable source of RF energy by which controlled heating of crucible 53 is accomplished.

At this point in the processing, the crucible 53 is heated in timed sequence in accordance with the following preferable time-temperature cycles with accuracy of $\pm 10^\circ\text{C}$., as measured by the thermocouple consisting of wires 58 and 60, and externally associated equipment: (1) 660°C. for a period of 1 minute; (2) 740°C. for a period of 1 minute; (3) 820°C. for a period of 1 minute; (4) 870°C. for a period of 1 minute; and lastly, (5) 950°C.-1000°C. for a period of 1 to 1½ minutes. Inasmuch as the PbO material within crucible 53

only begins to sublime or vaporize at temperatures exceeding 880°C., occurring in step (5), steps (1) - (4) provide a series of additional baking or cleaning steps. The vaporization of the charge of PbO within crucible 54 initially is unstable for the period of 60-90 seconds during the period of step (5).

Once a stable rate of evaporation is achieved from apertured lid 56 of crucible 53, the cover member 52 is removed by external magnet means. The cover member acts as a magnetically controlled shutter across the upper opening of the chimney 48. Evaporation of the PbO charge within crucible 53 is thereby begun from the chimney 48 and is continued until the temperature of the crucible increases rapidly thereby indicating a substantial depletion of the PbO charge.

During the previously described heat evaporation step, subsequent to step (5) and the removal of cover member 52, oxygen and water vapor flushing of the workpiece 22 interior is maintained while simultaneously providing, as previously described, a substantially uniform faceplate temperature of between 100°C. and 110°C. $\pm 1^\circ\text{C}$. In this manner, it has been found that a relatively homogeneous layer of PbO may be formed on the coating 14 comprising the signal electrode of the workpiece 22, and that a controlled thickness thereof may be obtained by carefully adjusting the charge of PbO previously inserted within the crucible 53. For example, it has been found that the previously described process may be utilized to form a substantially uniform and homogeneous 20 micron thickness of PbO on the coating 14 corresponding to the combined thickness of regions 16 and 18 wherein the faceplate 12 and its signal electrode 14 define a diameter of about 27 mm. The requisite charge of PbO to form such a PbO layer on a coating 14, may comprise, for example, a cylindrically shaped charge of PbO powder defining a diameter of 6.5 mm. and a thickness of 9 mm.

Once the temperature of the crucible 53, as externally monitored by means comprising wires 58 and 60, begins rising at a rapid rate (i.e., for a given approximately constant RF energy source connected to the coil 88) the RF energy source connected to coil 88 is turned off; the heater block 80 is removed from the faceplate 12; the oxygen dosing valve 72 and the water vapor dosing valve 74 are turned off; and the dosing valve 73 is turned on to admit gas "X" within the interior of workpiece 22. The gas "X" may comprise any of the inert gases selected from Group VIII A of the Periodic Table of the Elements, or nitrogen.

Dosing valve 73 is adjusted to admit gas "X" to the interior of workpiece 22 at a rate at which there is achieved a substantially constant pressure measurement on the Pirani gauge, interconnected to tubulation 68, of between about 4×10^{-2} torr to about 6×10^{-2} tori; however, preferably about 4×10^{-2} torr. Once a stable flushing rate for gas X has been achieved within the interior of workpiece 22 a source of electrical glow discharge with direct current potential is interconnected to the coating 14 and to the crucible 53 by means of an electrical connection to ring 36 and wires 58 or 60, respectively. The potential so applied preferably is approximately 900-1000 volts, however, differing potentials may be provided to advantage by persons skilled in the art. The connection of such glow discharge potential, of either positive or negative polarity, to either the signal electrode (comprising coating 14),

or the crucible 53 produces a glow discharge ion current between the signal electrode and the crucible 53. The signal electrode current of approximately 60 microamperes, for example, has been found to be associated with the appropriate application of (positive or negative) direct current potential as herein described, of about 1,000 volts in which the target 10 includes a diameter of about 27 mm. The glow discharge is preferably continued for a period of 60 seconds. However, other time periods of from 1-5 minutes may be utilized to advantage. The potential applied to the signal electrode and the crucible 53 is disconnected at the termination of a suitable glow discharge time period.

The glow discharge operation above described, completes the process by which regions 16, 18 are formed within the layer of PbO deposited on coating 14, as previously described. It is believed that the glow discharge operation herein described provides for the formation of a region by ionic bombardment, which effectively comprises a p type electrically conductivity material within a homogeneous layer of otherwise compensated intrinsic or n type electrical conductivity. It is apparent, therefore, that the process herein described may be broadly utilized in forming photoconductive lead monoxide layers of differing conductivity types, and is not restricted solely to vidicon targets. Photodiodes may, for example, be manufactured by methods similar to that herein described.

Unlike prior art methods, I have found that the formation of the layer 18 may be accomplished by glow discharge within an atmosphere of gas "X" consisting of a nitrogen gas or an inert gas selected from Group VIII A of the Period Table of the Elements. Prior art methods have emphasized the necessity of providing a glow discharge operation within an oxygen atmosphere to form by ionic bombardment a region of p type conductivity analogous to the layer 18.

Unlike one theory relating to glow discharge in oxygen in which the reaction of the oxygen ions with the substantially homogeneous PbO layer is believed necessary, it is believed that the critical function of the glow discharge, herein described, is the modification of the physical structure of the PbO material by the ionic bombardment of the glow discharge process itself without the necessity of including a gas atmosphere to react chemically with that material.

I have discovered that a glow discharge operation for the formation of region 18 within an atmosphere which is chemically non-reactive or inert with the substantially homogeneous PbO layer previously formed is particularly advantageous. For example, if the atmosphere (i.e., gas "X") comprises a nitrogen gas having a dew point of approximately -35°C ., a photoconductive layer of PbO may be formed for incorporation in vidicon targets or other photosensitive devices which is particularly responsive to the blue and green portion of the visible light spectrum. Also, I have discovered, that a significant unexplained reduction of defective tubes may be achieved as compared with otherwise identical processes utilizing oxygen as the glow discharge atmosphere. Targets and devices so manufactured do not appear to be as susceptible to the blue slump deficiency previously described. A significant reduction in the scrap of defective manufactured product has been achieved by this novel approach to manufacture of such photosensitive lead monoxide layers. Moreover,

the process appears to offer utility as a means of modifying spectral response of the manufactured product.

Inert gases such as argon, helium, etc., may be utilized to advantage for the glow discharge atmosphere. Targets have, for example, been successfully manufactured in which the glow discharge atmosphere has consisted of argon. Similar characteristics were displayed by the resultant targets as were displayed by those in which the glow discharge was accomplished in nitrogen.

Once the target 10 has been formed on the faceplate 12 of workpiece 22, the dosing valve 73 is closed and the vacuum system attached to manifold 34 is shut "off" after gas "X" has been evacuated from the interior of workpiece 22 to a pressure level of about 10^{-2} torr. A buffer gas of nitrogen is thereafter admitted to the interior of workpiece 22 by means of dosing valve 70, until atmospheric pressure is achieved within the interior of workpiece 22. If the gas "X" and the buffer gas both comprise nitrogen, the buffer gas may be immediately introduced into manifold 32 without waiting for the evacuation of the interior of workpiece 22 as previously described, thereby simplifying the manufacture of such photoconductive layers. Once atmospheric pressure is achieved by the introduction of the nitrogen buffer gas within the interior of workpiece 22, collar 78 is unscrewed, and the workpiece 22 is removed and transferred, for completion of a vidicon target assembly, to an evacuation sealing apparatus such as described in the previously referred to Patent issued to A. D. Eyster. The assembly of the workpiece 22 as part of an operative vidicon is there described and its disclosure in that regard, is herein incorporated by reference.

What I claim is:

1. A method of manufacturing a photosensitive device comprising the step of ionically bombarding a supported layer of lead monoxide, within an atmosphere containing at least one gas chemically inert with lead monoxide at a pressure of from about 4×10^{-2} to about 6×10^{-2} torr, by applying an electrical potential to said layer to effect electrical discharge through said atmosphere.
2. A method for manufacturing a photosensitive device in accordance with claim 1, wherein said atmosphere consists essentially of a gas selected from the group consisting of nitrogen and the inert gases.
3. A method for manufacturing a photosensitive device in accordance with claim 2, wherein said electrical discharge is for a period of time of about 1-5 minutes.
4. A method for manufacturing a photosensitive device in accordance with claim 3, wherein said supported layer comprises, prior to such electrical discharge, a substantially homogeneous layer of lead monoxide of one type of electrical conductivity.
5. A method for manufacturing a photosensitive device in accordance with claim 4, wherein said atmosphere is maintained in a dynamic state of flow and renewal by an apparatus and process in which continual flushing of said atmosphere abutting said layer is accomplished.
6. A method for manufacturing a photosensitive device in accordance with claim 5, wherein said gas comprises nitrogen having a dew point of about -35°C .

7. A method for manufacturing a photosensitive device in accordance with claim 6, wherein said atmosphere is maintained at a pressure of about 4×10^{-2} torr.

8. A method for manufacturing a photosensitive device in accordance with claim 1, wherein said lead monoxide layer is vapor deposited.

9. A method for manufacturing a photosensitive device in accordance with claim 8, wherein said vapor deposition of said lead monoxide layer is accomplished in an atmosphere of water vapor and oxygen, prior to said electrical discharge; wherein the atmosphere abutting said layer being vapor deposited is maintained in a dynamic state of flow and renewal by an apparatus and process by which continual flushing of that atmosphere is achieved during the period of time of said vapor deposition, whereby the pressure of said atmosphere is substantially maintained at about 1.4×10^{-2} torr.

10. A method for manufacturing a photosensitive device in accordance with claim 9, wherein said water vapor and oxygen comprising said atmosphere are in the ratio of about 10 to 4, respectively.

11. A method for manufacturing a photosensitive device in accordance with claim 10, wherein said ratio is substantially fixed.

12. A method for manufacturing a photosensitive device in accordance with claim 11, wherein said applied potential to said supported layer is from about 900 to about 1,000 volts.

13. A method for manufacturing a photosensitive device comprising the steps of:

- a. vapor depositing a substantially uniform and homogeneous layer of lead monoxide upon a supporting member; then,
- b. ionically bombarding said layer by applying to said layer of lead monoxide an electrical potential to effect an electrical discharge through a continuously renewed atmosphere consisting essentially of a gas selected from the group consisting of nitrogen and the inert gases, and at a pressure of from about 4×10^{-2} torr to about 6×10^{-2} torr.

14. A method for manufacturing a photosensitive device in accordance with claim 13, wherein said electrical discharge is for a period of time of about 1 to 5 minutes.

15. A method for manufacturing a photosensitive device in accordance with claim 14, wherein said vapor depositing is accomplished in a continuously renewed atmosphere consisting essentially of water vapor and oxygen in the ratio of about 10 to 4, respectively, at a pressure substantially maintained at about 1.4×10^{-2} torr.

16. A method for manufacturing a photosensitive device in accordance with claim 15, wherein said electrical potential applied to said layer is from about 900 to about 1,000 volts.

17. A method for manufacturing a photosensitive device in accordance with claim 16, wherein a surface of said supporting member upon which said vapor depositing of lead monoxide is accomplished is maintained during said vapor depositing at a temperature of between about 100° to 110°C .

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,909,308
DATED : September 30, 1975
INVENTOR(S) : John Franklin Heagy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 56: "tori" should be --torr--.

Column 9, line 15: " 10^{-2} " should be -- 10^{-6} --.

Signed and Sealed this

eighth Day of June 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks