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CATHODE RAY TUBE

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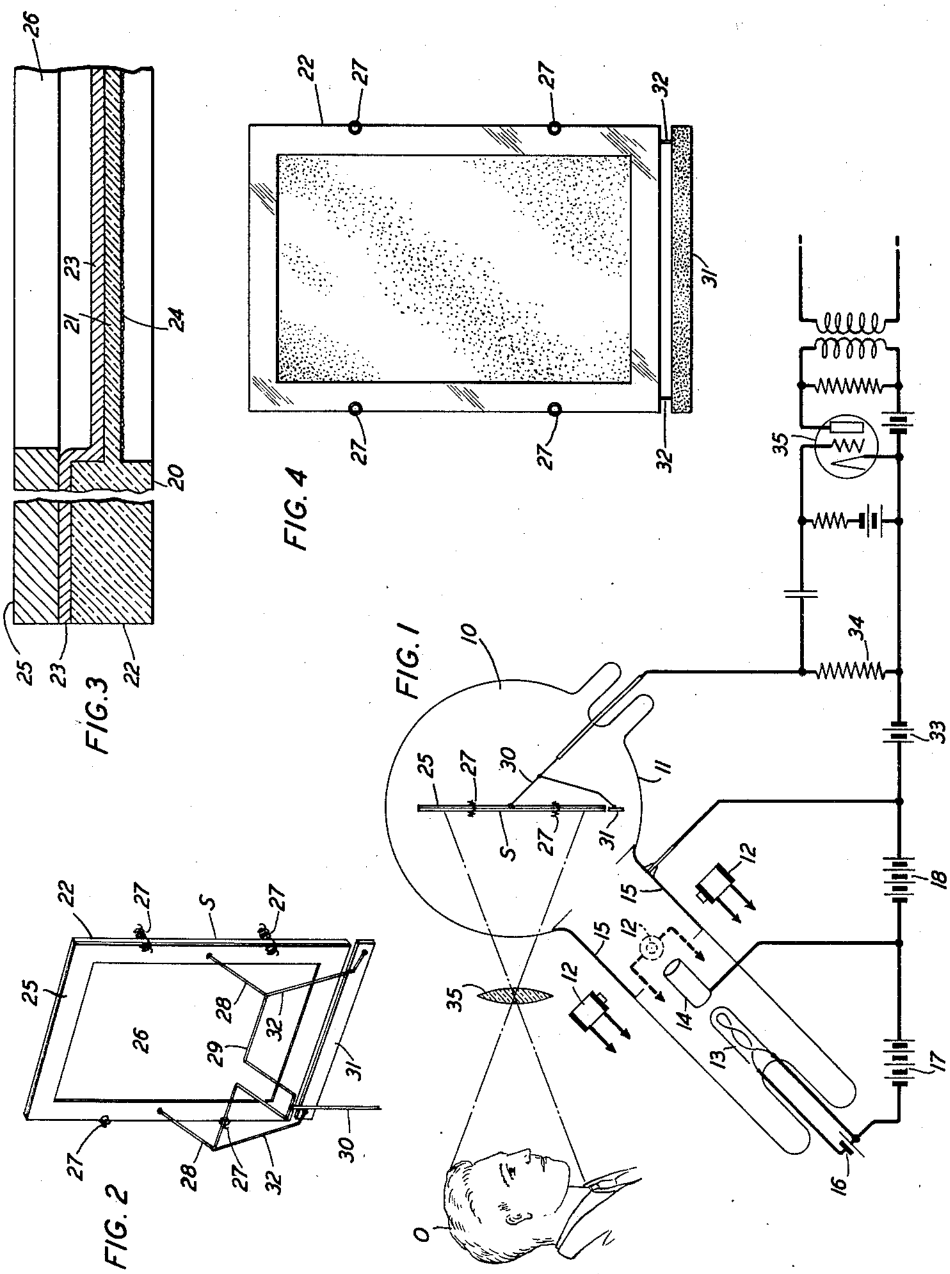

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CATHODE RAY TUBE

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This invention relates to apparatus utilizing stored electric charges and more specifically to mosaic screen structures of cathode ray tube devices for television.

Cathode ray tube devices having mosaic screen structures are well known. One known form of cathode ray tube for television transmission comprises a screen structure made of a sheet of mica over one surface of which is disposed a great number of individual elements of an electrically conductive material, such as silver. These elements are spaced with respect to each other and each is photosensitized. In operation, an image of the object to be televised is projected upon the photosensitive mosaic to develop electrostatic charges on the respective elements, these charges corresponding in magnitude to the respective and corresponding values of light intensity at the elemental areas over the object. The tube is provided with means for developing a cathode ray beam and for directing it upon the photosensitive mosaic surface, which ray is deflected in a well-known and predetermined manner for scanning. During the scanning action the electrostatic charges referred to are successively readjusted to an equilibrium value to develop picture signals for transmission.

The use of mica as a dielectric member presents several disadvantages. When mica is heated it tends to blister. Also, because of its flaky structure, mica cannot be made as thin as desired nor does it have as high a dielectric constant as some other materials, as for example, glass. Furthermore, mica possesses the disadvantage that it tends to degas in high vacuum tubes. In order to have a high electrostatic charge it is desirable that the dielectric be both thin and of a material having a high dielectric constant. Heretofore, glass, although it has a higher dielectric constant than mica, has not been successfully used because when it was made of the desired thinness it could not be handled without breaking it.

In accordance with the present invention there is provided a novel dielectric element particularly useful as a substitute for the mica element above described and free from the disadvantages of mica mentioned in the preceding paragraph. This element is of glass, or other material of similar character which can be etched or dissolved, and is formed by a process of etching or dissolving the major portion of a glass disc or plate so as to leave an exceedingly thin uniform sheet integral with a supporting rim, the sheet being so thin that without a support it could not be handled without breaking. Such elements are obviously capable of use also as the dielectric elements of condensers designed for other purposes.

Preferably, in carrying the invention into effect, a glass blank is etched by total immersion in hydrofluoric acid. The edges of the blank are protected with suitable material, such as beeswax, so that the film produced has a border of thick glass. The etching is effected in a manner to be later described to ensure even thickness of the finished films.

After the glass member has been prepared, a discontinuous film of silver is formed on one surface of the glass center portion and this discontinuous film photosensitized to form a mosaic screen member. During the photosensitizing process, it is difficult to ascertain the photosensitivity acquired by the screen member due to the fact that conductive connection cannot be made to the discontinuous film. A photoelectric monitor plate is provided in close proximity to the mosaic screen which may be used to ascertain the degree of sensitivity of the photo-emissive material applied to the mosaic during the sensitizing process.

The invention will be more readily understood from the following description taken in connection with the accompanying drawing forming a part thereof in which:

Fig. 1 shows a cathode ray television transmitter embodying the invention;

Fig. 2 is an enlarged perspective view of the mosaic screen used in the transmitter of Fig. 1 taken from the back;

Fig 3 is an enlarged cross-sectional view of the mosaic screen of Fig. 2 and its supporting bracket member; and

Fig. 4 is an enlarged front view of this screen.

Referring more particularly to the drawing, Fig. 1 shows a television transmitter employing a cathode ray tube 10 and its associated circuits. The tube 10 comprises a gas-tight container 11 enclosing an electron gun assembly for producing a moving beam of electrons and for accelerating this beam toward a screen S at the end of the tube away from the electron gun, and suitable means such as, for example, deflecting coils 12 for causing the beam to scan the elemental areas of the screen S.

The electron gun assembly comprises a cathode 13 and an anode 14 for producing a beam of electrons and an anode 15, which is shown as a conducting coating of any suitable material, such as for example, sputtered platinum, inside of the tube and extending along the surface of the tube for accelerating this beam toward the screen S. A battery 16 supplies current to heat the cathode 13. A battery 17 places the anode 14 at a positive bias with respect to the cathode 13, and a battery 18 places the anode 15 at a higher positive potential than the anode 14. Sweep circuits, not shown, but which may be of any well-known form, are connected by any appropriate means to the deflecting coils 12 to cause the electron beam to scan every elemental area in turn of the mosaic screen S, line by line. While deflecting coils have been shown, it is obvious that any other means for producing the deflection of the beam may be used instead, as for example, electrostatic deflecting plates, or one set of coils and one set of plates.

Reference will now be made to Figs. 2, 3 and 4 for a more detailed description of the mosaic screen structure S. This screen comprises a glass member 20, which is prepared by a process to be hereinafter described, in the form of a very thin center portion 21 and a thicker edge portion 22. On the face of the glass member away from the electron beam is coated a thin coating 23 of a suitable electrical conducting material, such as platinum. On the surface of the center portion 21 nearer the electron beam is coated a discontinuous layer 24 of a suitable material, such as silver, which discontinuous layer is sensitized so that the surface 24 is photo-emissive.

The screen S is mounted on a bracket member 25 which preferably has a cut-out portion 26 corresponding to the center portion 21 of the glass member 20. The glass member 20 is fastened to the bracket 25 by any convenient means, such as for example, small spring clips 27 which tend to force the conducting bracket member 25 in contact relation with the film 23 on the glass member 20. Attached to the bracket 25 are members 28 which are connected by any suitable means, such as by soldering or welding, to an intermediate member 29 to which a contact member 30 is attached. The members 28 and 29 also act to support a narrow monitor plate 31 by means of members 32 which are connected by any suitable means, such as by soldering or welding, to members 28 and 29. It is, of course, to be understood that this invention is not limited to the specific means described above for making contact from the mosaic screen S to the member 30.

The monitor plate 31 comprises a metal base, such as silver, coated with a thin layer of photo-emissive material. This monitor plate 31 is connected by means of support members 32 and 29 to contact 30, which is connected to a battery 33 through resistance 34. The positive side of the battery 33 is connected to the anode coating 15. The anode 15 and the monitor plate 31 thus form the anode and cathode members of a photoelectric cell, the purpose of which will be pointed out more fully below.

The preparation of the glass member 20 for use in the screen S will now be described. A piece of glass preferably about .005 of an inch thick is etched by total immersion in a suitable etching solution such as hydrofluoric acid, the edges of the glass being protected with a suitable substance not affected by the hydrofluoric acid, such as for example, beeswax, so that the film of glass produced by the etching process has a border of glass by which it may be supported which has the thickness of the original glass plate.

As a specific example of this process let it be assumed that the original glass blank has the dimensions $2\frac{3}{16}$ inches times $3\frac{1}{8}$ inches times .005 inch. The edges and all four borders on both sides of the blank are covered with beeswax so that a center portion $1\frac{3}{4}$ times $2\frac{3}{4}$ inches is left. The piece of glass is then totally immersed in concentrated hydrofluoric acid and the center portion which is unprotected from the beeswax is etched until the center portion is very thin. It has been found possible to prepare glass films of a surface area of about six square inches and a thickness of from .001 to .0007 inch by this method. Such films without the supporting rim in accordance with this invention are entirely too fragile to permit handling. Even thinner films can undoubtedly be prepared by this process. While it is found that the element may sometimes be prepared by a single immersion, it is generally preferable to use several immersions in order that extreme accuracy may be produced. The later immersions may be in more dilute solutions than the earlier. Between immersions the partially etched glass may be dipped into an inert liquid such as water immediately after taking it out of the hydrofluoric acid. This is to remove the acid and thus temporarily stop the etching and to remove a cloudy-looking film which forms on the glass when it has been immersed for some time in the acid. Failure to periodically remove this film may result in an uneven etch. This technique makes it possible to repeatedly measure the thickness of the film of glass and to stop the etching before some part of the glass film has been etched completely through.

Instead of hydrofluoric acid, an etching solution made of 6 parts (by weight) of concentrated hydrofluoric acid, 1 part sulphuric acid and 3 parts water may be used. In this case silver chloride or a mixture of silver chloride and silver iodide having a low melting point would be used as the material not susceptible to the etching solution.

By this process the glass portion in the center of the blank is made so thin that it could not be handled were it not for the unetched border 22. The thin center portion 21 makes possible a higher capacity between the platinum surface 23 on one side and the photosensitive mosaic 24 on its other surface, more uniform thickness of the dielectric, and larger dimensions of the element than have been attained heretofore and its use avoids the troublesome degassing action of mica.

After the glass blank has been prepared so that the center portion is as thin as desired and there is approximately a quarter of an inch raised border all around the center portion, silver is sputtered on the center portion of one face of the blank for about twenty to thirty minutes. The silver layer is then heated to a temperature of from 400 to 500 degrees centigrade (usually between 425 to 450 degrees centigrade) and then cooled. The heating causes the silver to break up into discrete globules. This process may be repeated one or more times in order to obtain a film of silver of the desired form. A platinum film is then formed on the entire back surface of the blank by sputtering. The blank is then mounted in the bulb and the tube baked out and evacuated so that all of the elements in the tube are thoroughly degassed. The tube is allowed to cool to room temperature and oxygen is then admitted. The silver layer is then wholly or partially oxidized by any suitable means such as, for example, a high frequency discharge. At the conclusion of the oxidation process, excess gas is removed by evacuation and a known amount of caesium is admitted in the bulb by flashing a "caesium" pill. The pill is flashed in a side tube or in the bulb so that caesium vapor passes into the bulb to photosensitize the globules of the screen S and also to photosensitize the silver monitor strip **31**. For a description of a process of photosensitizing with a "caesium" pill and the composition of such a pill, reference may be made to British Patent 381,606 to George R. Stilwell and Charles H. Prescott, Jr., complete accepted October 10, 1932. The tube may then be baked at a temperature of about 200 to 225 degrees centigrade for varying periods of time to remove all gases.

When mica is used as the dielectric material, difficulties may develop due to the large amount of gas released from the mica during the baking process. Mica contains relatively large amounts of oxygen and hydrogen, both in the free state and combined as water vapor. The water vapor in particular is troublesome in that it may react with the caesium during the baking process. Furthermore, an excessive amount of baking is necessary to free the mica of gases and water vapor which may result in disintegration, flaking or blistering of the mica sheet. Glass, on the other hand, is relatively easily degassed and with no resulting disintegration. Again, glass is the material ordinarily used for the container and it is advantageous from the point of view of simplicity of technique in forming the light sensitive film to employ the same materials in the containing and supporting structures where possible.

The purpose of the monitor strip **31** will now be made clear. During the photosensitizing process, it is impossible to tell with any degree of accuracy the photoelectric sensitivity of the caesium layer on the discrete globules of silver because electrical contact cannot be made to the globules since they are supported on an insulating member. As the monitor plate **31** is separated from the photosentive mosaic screen S and because contact can be made to its photosensitive layer, it is possible to shine light on the monitor member alone and measure the flow of current between the monitor **31** and the anode member **15** with a suitable microammeter (not shown), the battery **33** placing the cathode monitor member **31** at a negative potential with respect to the anode member **15**. In measuring this current the resistance **34** and the amplifying circuit are not used in the hookup. If by a method of trial and error the exact quantities of material going into the "caesium" pill are predetermined, the monitor strip may be unnecessary. By means of the monitor member **31**, therefore, the degree of sensitization of the mosaic screen S can be very accurately controlled as it is assumed that the sensitivity of the insulated silver globules is very nearly the same as that of the monitor plate.

The operation of the mosaic screen in the cathode ray tube **10** is as follows: Light from a suitable source (not shown) and reflected from an object or field of view O is focused upon the center portion of the mosaic screen S by means of a suitable optical system, represented generally by the lens **35**. The photo-emissive material **24** on the mosaic screen emits electrons, the degree of emission from any elemental globule being dependent upon the intensity of the light thrown thereon from the object. Each globule thus becomes charged because of the condenser action of the dielectric **21** and the platinum film **23** and the photo-emissive surface **24** on its opposite faces, the degree of the charge for any particular globule corresponding respectively to the light-tone value of the corresponding elemental area of the object. The electron beam generated by the cathode **13** and the anode **14** and accelerated by the anode **15** is caused to scan every elemental area in turn of the center portion of the mosaic screen S by means of the action of the deflecting coils **12**. This scanning is repeated about 20 times a second, so that advantage can be taken of the phenomenon of persistence of vision at the receiving station. As the electron beam scans the mosaic, it passes over each element in turn, releasing the charge it has acquired and driving it to equilibrium. Due to the fact that each element is coupled by capacity to the film **23**, the sudden change of charge of the elements will induce a change in charge on the film **23** and result in a current pulse in the external circuit. For a more complete disclosure of a tube of this type, reference may be made to an article entitled "The iconoscope" by V. K. Zworykin in the January, 1934, Proceedings of the Institute of Radio Engineers, pages 16 to 32 inclusive and to an article by the same author in the July, 1936, "R. C. A. Review", page 60, entitled "Iconoscopes and kinescopes in television."

These pulses are amplifed by a suitable amplifier **35**, which may be, for example, a multistage amplifier. This image current may be used to modulate a suitable carrier for transmission over line or radio channels.

As a modification, the glass blank may be etched from one face only by preventing the acid from coming in contact with the other face of the blank, and the photosensitive material may then be applied to the smooth face rather than in the etched pocket.

As a further modification, the insulating support herein described may be used as a support for material which is not photosensitive, as for example, material which emits secondary electrons.

Other modifications may obviously be made without departing from the spirit of the invention, the scope of the invention being defined by the appended claims.

What is claimed is:

1. A composite target for cathode ray television transmitters comprising a brittle, vitreous dielectric member having a relatively thin flat center portion of uniform thickness comprising the greater part of the surface area of the dielectric member and of a thickness of the order of a few thousandths of an inch or less and a thicker border portion unitary therewith, a coating of conducting material on one face of said dielectric member, and a coating of discrete photosensitive globules on the center portion of said dielectric on the side away from said conducting film.

2. The combination with a flat glass dielectric film of uniform thickness of the order of .001 inch or less and an area of at least one square inch and a border portion of the same material projecting from a surface of said film a distance at least several times the thickness of the latter, of conductive layers of metal contiguous respectively to the two surfaces of said film.

3. The combination with a flat glass dielectric film of uniform thickness of the order of .001 inch or less and at least several square inches in area and a border portion of uniform thickness of the same material projecting from a surface of said film a distance at least several times the thick-

ness of the latter, of conductive coatings of metal on the respective surfaces of said film.

4. In combination, a glass gas-tight container, a flat film of glass mounted therein and a border portion of uniform thickness of the same material projecting from a surface of said film a distance at least several times the thickness of the latter, a film of light sensitive material on one surface of said glass film, a conductive metallic layer on the other surface of said glass film, and an electrode mounted within said container for receiving electrons from said light sensitive film.

5. An electric capacity element comprising a glass element in the form of a substantially flat sheet of the order of .001 inch or less in thickness and at least several square inches in area with a surrounding relatively thick supporting rim of substantially constant thickness throughout integral therewith, and a coating of conducting material on a surface of said glass element, said flat sheet merging abruptly into the thick supporting rim.

6. A target for cathode ray tubes in which the cathode beam scans the elemental areas of the target in succession, comprising an element consisting of a single piece of brittle vitreous dielectric material which can be etched or dissolved having a central flat portion to be scanned which is of uniform thickness of the order of a few thousandths of an inch or less and of an area of at least several square inches, and a rim portion of much greater thickness, whereby said element as a whole is given strength and rigidity by said unitary rim portion, said central flat portion merging abruptly into the rim portion which is of substantially constant thickness.

7. A method of constructing a sheet-like electric capacity element having an area of at least several square inches, which comprises the steps of coating the border of a thin flat sheet of glass to a distance from the edge thereof which is very small compared with the remaining portion, subjecting said member to an etching fluid to etch the entire uncoated central portion thereof to a thickness of several thousandths of an inch or less, and depositing a layer of conducting material in finely divided form on each of the surfaces of said glass sheet, whereby said sheet is strengthened and protected by said coating.

8. A composite target for cathode ray television transmitters comprising a brittle vitreous dielectric member having a relatively thin flat center portion of uniform thickness comprising the greater part of the surface area of the dielectric member and of a thickness of the order of a few thousandths of an inch or less and a thicker border portion unitary therewith, and a coating of electron emitting material on one surface of the center portion of said dielectric.

9. A composite target for cathode ray television transmitters comprising a brittle vitreous dielectric member having a relatively thin flat center portion of uniform thickness comprising the greater part of the surface area of the dielectric member and of a thickness of the order of a few thousandths of an inch or less and a thicker border portion unitary therewith having a flat surface parallel to the surfaces of said center portion, a coating of conducting material on one face of the center portion of said dielectric member, and a coating of photosensitive material on the reverse face of said center portion.

10. A method of constructing a target for a cathode ray television camera which comprises the steps of coating the border of a thin flat sheet of glass to a distance from the edge thereof which is very small compared with the remaining portion, subjecting said member to the action of an etching fluid to etch the entire uncoated central portion thereof to a thickness of several thousandths of an inch or less, depositing a layer of conducting material in finely divided form on each of the surfaces of said glass sheet, whereby said sheet is strengthened and protected by said coating, and photosensitizing one of said layers of conducting material.

11. A cathode ray camera tube comprising means for forming an electron beam, a target for said beam comprising a substantially rectangular plate-like element having a center portion of substantially uniform thickness of the order of .001 inch or less and a relatively narrow rim portion unitary therewith of a thickness of the order of several times that of said central portion, said rim portion having a flat face, the area of said central portion being at least a square inch, an adherent coating of metal on the side of said central portion remote from said beam forming means, an adherent discontinuous coating of a light sensitive material on the reverse side of said central portion, a metallic supporting member having a flat face in contact with said flat face of said rim portion for supporting said coated element wholly within said tube, means for causing said beam to scan said light sensitive coating, and means forming a conductive connection from the exterior of said tube to said metal coating.

12. The combination with a dielectric film of substantially uniform thickness of the order of a few thousandths of an inch or less having an area of at least one square inch and a border portion of the same material projecting from a surface of said film a distance at least several times the thickness of the latter, of conducting material in intimate contact respectively with the two flat surfaces of said dielectric film.

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