

Dec. 15, 1953

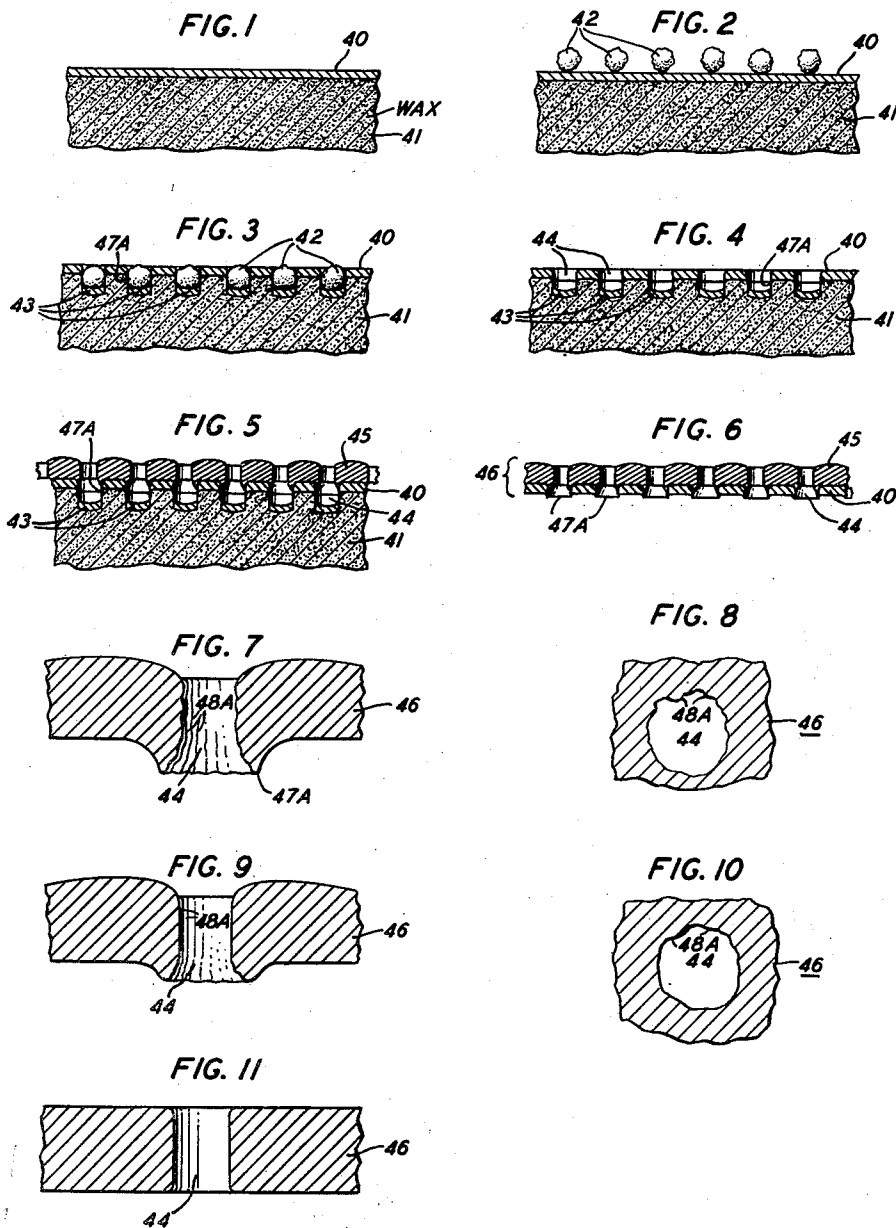
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2,662,274

PREPARATION OF APERTURED METAL SCREENS

Original Filed Dec. 29, 1948

3 Sheets-Sheet 1



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PREPARATION OF APERTURED METAL SCREENS

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FIG. 12

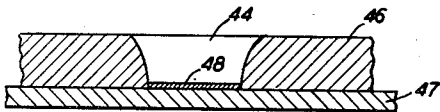


FIG. 13

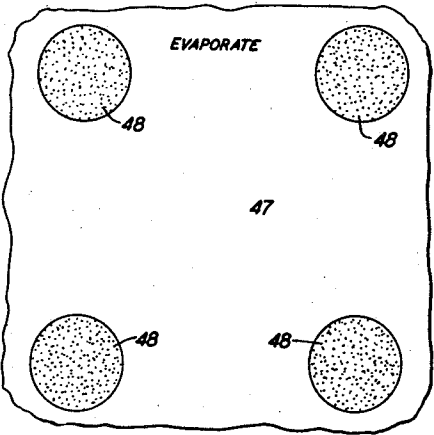


FIG. 14

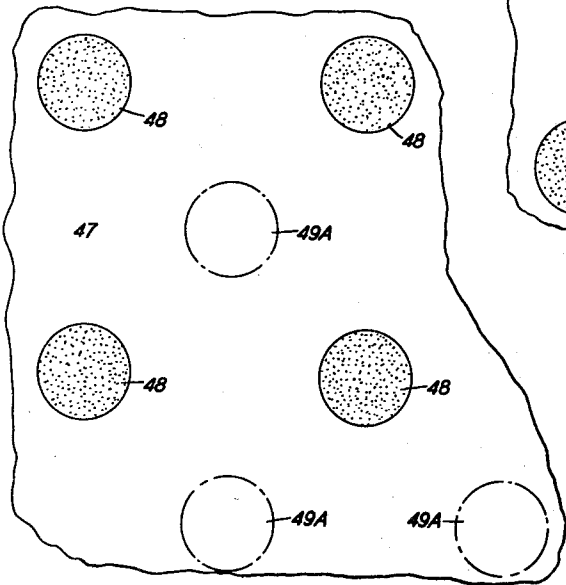


FIG. 15

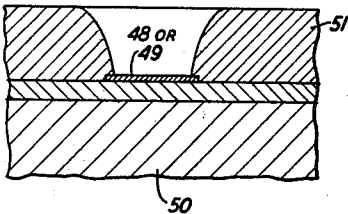
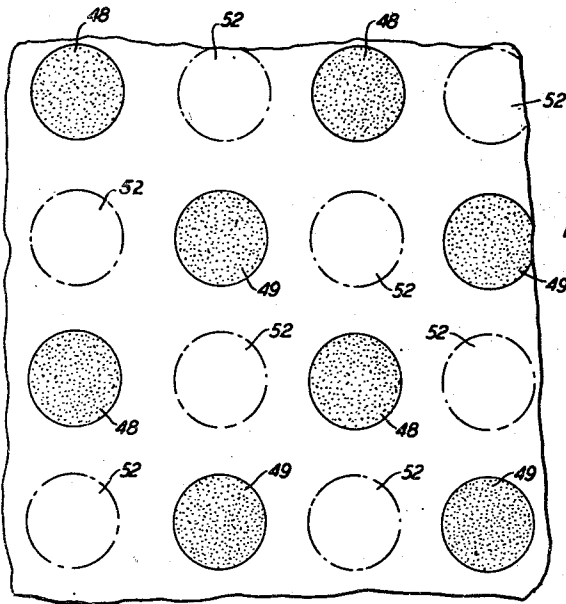


FIG. 16



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FIG. 17

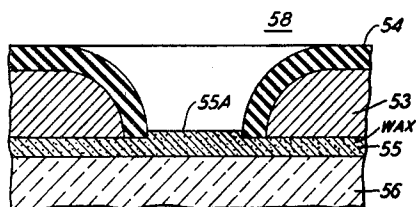


FIG. 18

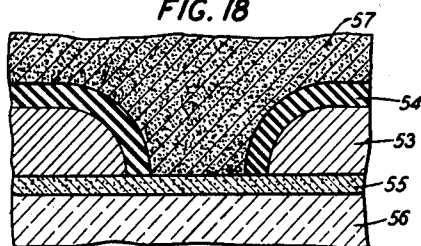


FIG. 19

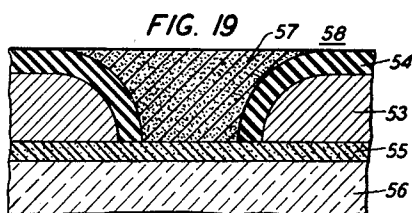


FIG. 20

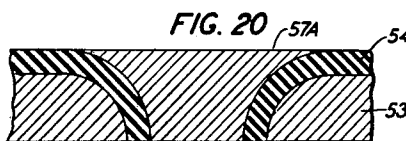


FIG. 21

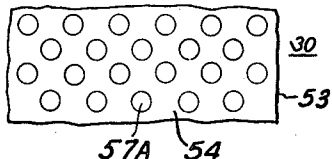


FIG. 22

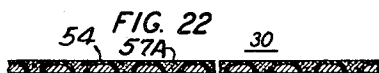
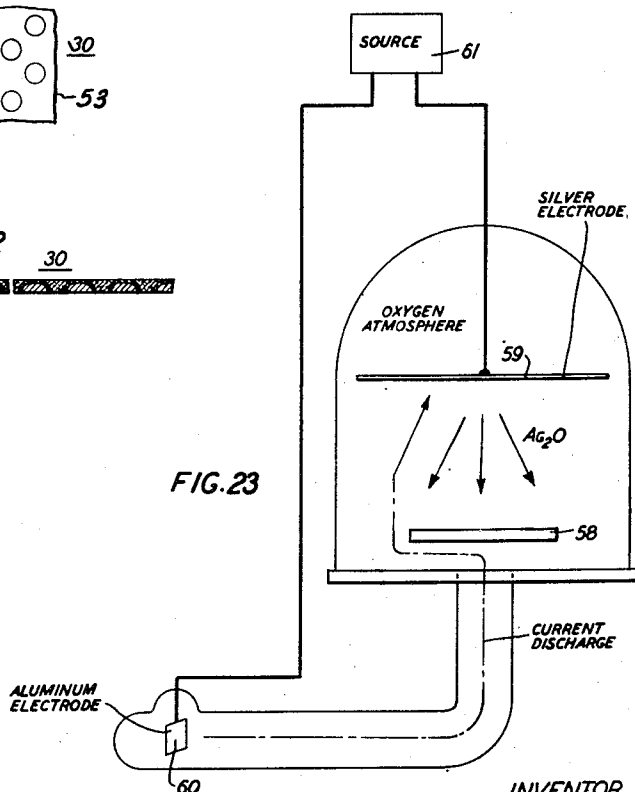


FIG. 23



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PREPARATION OF APERTURED METAL
SCREENS

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Original application December 29, 1948, Serial No.
67,917. Divided and this application October
27, 1949, Serial No. 123,873

3 Claims. (Cl. 29—163.5)

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This invention relates to electro-optical devices and more specifically to methods of making apertured metal screens which can be used, for example, in the production of target or screen structures for use in television transmitter tubes. This application is a division of application Serial No. 67,917, filed December 29, 1948.

It has long been recognized in the development of electron camera tubes for generating picture signals at a television transmitting station that there are many advantages in projecting an electron image of the object for transmission onto one side of the screen of the tube and scanning the opposite side of the screen with a cathode-ray beam formed in the tube. An example of a camera tube employing such a "two-sided" target or screen is the so-called "image orthicon" tube, described in an article entitled "The image orthicon—a sensitive television pick-up tube" by Albert Rose, Paul K. Weimer and Harold B. Law, appearing in the July 1946 issue of the Proceedings of the I. R. E., beginning on page 424. The two-sided target makes possible the separation of charging and discharging processes so that the sensitizing procedures and electric fields appropriate to each can be incorporated in the tube without mutual interference. The target must conduct charges between its two sides or surfaces but not along either surface. Moreover, it should have a conducting element therein or nearby to act as the common capacitor plate for the separate picture elements. It has been found very difficult to construct satisfactory commercial targets of this type.

It is an object of the present invention to provide novel and improved methods for making apertured metal screens which can be used, for example, in the production of two-sided electron camera tube targets which have a large number of discrete conducting elements per square inch.

In an exemplary method of making an apertured metal screen in accordance with the invention which can be used in the production of a two-sided mosaic target for camera tubes and the like, a thin metal film is formed on a wax block and then very small, hard particles are insufflated onto the film and pressed into it leaving a perforated screen on the surface. A thick coating of a suitable metal such as nickel is then electroplated on the screen without closing up the holes. The thickness of the screen is thus increased and it can be utilized in the making of targets or for other purposes. By way of example, a complete method of making a camera tube target is described below to show one way

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in which the apertured metal screen of this invention can be utilized.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof in which:

Figs. 1 to 6, inclusive, illustrate various steps in a process of producing an apertured metallic screen in accordance with the invention;

Figs. 7 to 11, inclusive, illustrate steps in the process of electrolytically polishing the screen shown in Fig. 6;

Figs. 12 to 16, inclusive, illustrate a method of increasing the number of holes in the screen shown in Fig. 11;

Figs. 17 to 20, inclusive, illustrate a method of filling the apertures in the screen shown in Fig. 16 with insulated plugs;

Fig. 21 is a top view of a schematic representation in greatly enlarged form of a portion of target utilizing and apertured metal screen made in accordance with the invention;

Fig. 22 is a sectional side view of portions of such a target; and

Fig. 23 shows apparatus used in making the target.

Referring more specifically to the drawings, Figs. 21 and 22 show, by way of example for purposes of illustrating one use of an apertured metal screen made in accordance with the invention, portions of a two-sided mosaic target 30 suitable for use in certain television transmitting tubes, such as, for example, the image orthicon type of tube briefly referred to above. It will be understood that Figs. 21 and 22 are merely schematic showings and the same applies to the other figures in the drawings. Target 30 comprises a thin metallic screen 53 of a suitable metallic material having a large number of holes to the linear inch, e. g., four hundred per inch or more. One surface, such as the top surface in Fig. 22, and the interiors of all the apertures in the screen 53 are coated with an insulating material 54. The interiors of all these apertures are filled with metallic plugs 57A. Successive steps in the preparation of the screen or target 30 will be easily understood by referring to Figs. 1 to 20, inclusive, in some of which for simplicity in the drawings, the structure around one aperture only has been shown.

The first six figures of the drawings illustrate schematically a method in accordance with the invention of forming a metallic screen having a number of apertures therein. Fig. 1 shows a thin conducting layer 40 of platinum or other suit-

able material which is evaporated, sprayed, sputtered or otherwise deposited on a wax block 41. Very small particles of uniform diameter are insufflated upon the surface of the film 40. These particles 42 may be any hard particle, such as diamond, sapphire, iron, nickel or other solid. Fig. 2 shows these particles on the conducting film 40.

As shown in Fig. 3, the particles 42 are pressed into the metal film 40 with a roller or a smooth flat or curved plate. This breaks small areas of the metal 40 away from the main part of the conducting film leaving thereby a perforated screen on the surface of the wax. Small areas 43 of the screen are pressed into the wax block 41.

If the particles 42 are conductors such as iron or nickel, they may be dissolved with nitric or hydrochloric acids. If the particles 42 are insulating particles this step can be omitted.

As thick a coat of nickel is applied to the platinum screen 40 as is possible without closing up the holes 44. The coating 45 is shown in Fig. 5.

The metal screen of Fig. 6 is suitable for a variety of purposes but one particular use will now be described by way of example.

Let it be assumed that an enlarged side view of one of the apertures 44 and of its surrounding metal is shown in Fig. 7, and a large cross-section of the aperture 44 is shown in Fig. 8. It is obvious that the actual aperture 44 is by no means as smooth as is represented in Fig. 7. It has been shown in this manner merely for convenience and simplicity in the drawings. It will be noted that the metal screen 46 shown in Fig. 7 has angular projections 47A around the hole and also small irregular projections 48A shown in Fig. 8. The screen 46 is then electrolytically polished by making it the anode in a solution of sulfuric acid and water (120 cc. H_2SO_4 to 80 cc. H_2O) at a high current density. This rounds off some of the projections and dissolves part of the nickel screen as indicated in Figs. 9 and 10 which otherwise correspond to Figs. 7 and 8, respectively. A thin film of metal is then electroplated upon the screen 46 and the polishing process is repeated and re-repeated as often as necessary to give the smooth screen 46 shown in Fig. 11. It will be noted that in Figs. 7 to 11, inclusive, no attempt has been made to show the various metal layers (such as, for example, layers 45 and 40) making up the screen, it being shown for simplicity merely as a solid metal screen 46.

Figs. 12 to 16, inclusive, illustrate a method of increasing the number of holes in the screen 46. As shown in Fig. 12, the metal screen 46 shown in Fig. 11 is placed upon and in intimate contact with a piece of thin filter material 47, such as paper, and a metal or other solid is evaporated through the holes 44 in the screen. This gives a pattern of thin solid dots 48 over the entire surface of the paper as indicated in Fig. 13. Obviously the dots are not perfect circles as shown in Fig. 13 but are shown thus for simplicity in the drawings.

The screen 46 is then shifted into position so that the holes 44 fall in the positions indicated by the clear circles 49A in Fig. 14, and a solid is evaporated through the holes in the screen while it is in this position to produce new thin solid dots 49 (shown in Fig. 16).

The metal screen 46 is then removed and the filter paper 47 upon which aluminum dots 48 and 49 have been superimposed is placed upon a filter

cylinder 50 of sintered glass or glass containing a multiplicity of capillary holes and a layer of silver oxide or copper oxide 51 is deposited upon the paper while vacuum is applied to the underside of the cylinder. The entire assembly is then placed in a reducing atmosphere and the silver oxide or copper oxide reduced to either silver or copper. The aluminum dots 48 and 49 are now etched out of the holes with concentrated potassium hydroxide solution giving a perforated metal screen having twice the number of holes possessed by the original screen.

The metal screen produced by the process illustrated by Figs. 12 to 15, inclusive, is now used in the repetition of this procedure to produce a metal screen having holes including those shown as 48 and 49 in Fig. 14 and also those shown in the portions of the dotted circles 52 in Fig. 16. This produces a screen shown as 53 in Fig. 17 which contains four times the total number of holes as the screen shown in Fig. 12 and twice the number of holes per linear inch as that shown in Fig. 12.

Figs. 17 to 20, inclusive, illustrate a method of filling the apertures in the screen 53 with insulated metallic plugs. Referring now to Fig. 17, the metal screen 53 is coated with insulating layer 54. This is obtained by condensing the vapor of a suitable substance such as cryolite on the top of the screen or by insufflating glass on the screen and then fusing it to give the coating 54. A uniform coating of beeswax, asphaltum or other adhesive 55 is applied to a fairly thick stiff piece of metal or glass 56. The adhesive is flowed on the metal or glass 56 by melting or by use of a solution of the adhesive in a solvent such as carbon tetrachloride. Evenness of spreading can be assured by spinning in a horizontal plane. The coated metal screen 53 is pressed onto the wax film 55 so that a small amount 55A of the wax is pushed into each hole of the screen as shown in Fig. 17. Silver oxide 57 is then applied to the surface of the unit of Fig. 17 by bombarding silver in oxygen with high voltage discharges. This can be accomplished in the apparatus shown in Fig. 23 wherein the unit 58 shown in Fig. 17 and represented schematically by a rectangle in Fig. 23 is mounted in the path between a silver electrode 59 and an aluminum electrode 60 in an oxygen atmosphere, a source of high direct-current voltage 61 being connected between the two electrodes. Because of the oxygen atmosphere a multiplicity of silver oxide particles 57 is built up in the apertures of the unit 58.

The excess silver oxide is then wiped off leaving the silver oxide plugs 57 in the holes of the screen 53 as shown in Fig. 19. The unit is then heated up and the screen is removed from its support.

The screen of Fig. 19 is then heated in hydrogen to reduce the silver oxide 57 to silver buttons 57A. Alternatively, it can be treated with a liquid reducing agent like one of those frequently used in photography, for example. This produces a screen one elemental portion of which is shown in Fig. 20 and another larger portion of which is shown to a somewhat smaller scale in Figs. 21 and 22.

Various alternative steps and procedures other than those mentioned above are of course possible without departing from the spirit of the invention, the scope of which is pointed out in the claims. The disclosed over-all process of making mosaic screens of the type shown in Figs. 21 and 22 is claimed in the parent application, Serial No. 67,917, filed December 29, 1948;

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the methods disclosed herein of electrolytically polishing apertured metal screens (Figs. 7 to 11, inclusive) are claimed in a copending application of the present inventor, Serial No. 123,874, filed October 27, 1949, the methods disclosed herein of increasing the number of holes in apertured metal screens (Figs. 12 to 16, inclusive) are claimed in another copending application of the present inventor, Serial No. 123,875, filed October 27, 1949; and the sputtering method disclosed herein and the apparatus used therefor (Figs. 17 to 20, inclusive, and 23) are being claimed in still another copending application of the present inventor, Serial No. 123,876, filed October 27, 1949.

What is claimed is:

1. The method of making an apertured screen having at least 400 holes to the linear inch for an electron camera tube target comprising the steps of placing a thin metal layer on a support member, insufflating a large number of very small hard particles on said metal layer, pressing the particles into and through said metal layer thereby forcing portions thereof into said support, removing the particles from the apertures produced thereby, and thickening by electroplating the thin apertured metal screen produced by said pressing.

2. The method of making an apertured screen having at least 400 holes to the linear inch for an electron camera tube target comprising the steps of placing a thin metal layer on a support member, insufflating a large number of

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very small hard particles on said metal layer, pressing the particles into and through said metal layer thereby forcing portions thereof into said support, removing the particles from the apertures produced thereby, and coating a layer of metal on the apertured thin metal layer.

3. The method of making an apertured screen having at least 400 holes to the linear inch for an electron camera tube target comprising the steps of placing a thin metal layer on a support member, insufflating a large number of very small metal particles on said metal layer, pressing the particles into and through said metal layer thereby forcing portions thereof into said support, dissolving in acid the metal particles in the apertures produced thereby, and thickening by electroplating the thin apertured metal screen produced by said pressing.

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