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MOSAIC SCREEN FOR CATHODE-RAY TUBES

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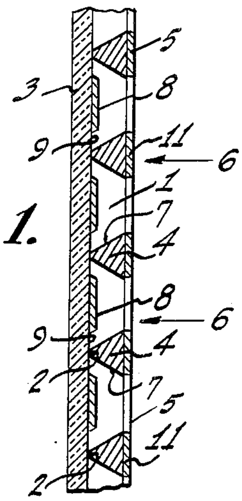

Fig. 1.

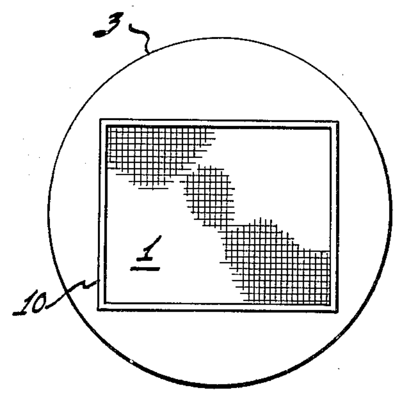

Fig. 2.

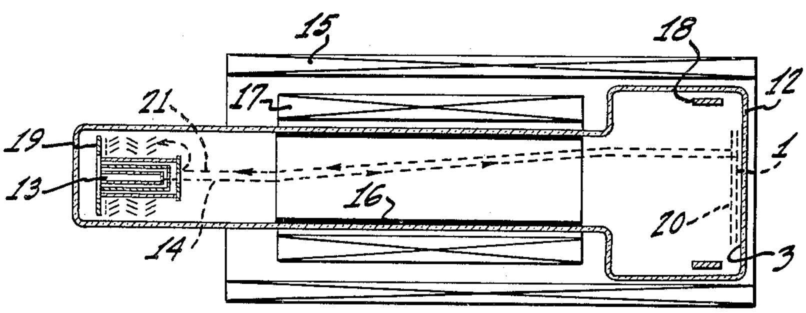

Fig. 3.

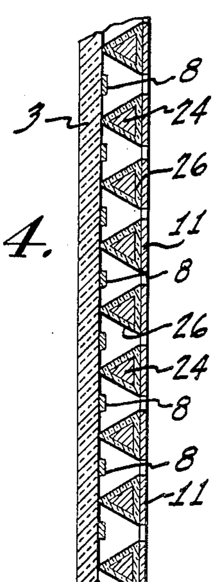

Fig. 4.

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MOSAIC SCREEN FOR CATHODE-RAY TUBES

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10 Claims. (Cl. 250—164)

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This invention relates to mosaic screens such as are employed in television transmitting tubes and for other purposes.

In manufacturing mosaic screens it is necessary to provide a multiplicity of insulated mosaic elements and for this purpose it has been proposed to evaporate metal, such as silver, through the interstices of a mesh onto an insulating surface forming thereon a multiplicity of mosaic elements. In manufacturing mosaic screens in this manner it is desirable to maintain the mesh in close contact with the insulating surface but it is found that when the mesh is so arranged the mosaic elements tend to adhere to metal deposited on the sides of the interstices of the mesh. In certain cases this is disadvantageous and the object of the present invention is to provide an improved manner of making a mosaic screen with a view to avoiding this disadvantage.

According to the invention there is provided a method of manufacturing a mosaic screen wherein a mesh is arranged in contact with an insulating surface, and metal is evaporated in vacuo through the interstices of said mesh onto said insulating surface forming thereon a multiplicity of mosaic elements, the interstices in said mesh being such that the area of the interstices is greater at the side of the mesh in contact with the insulating surface than at a section of the mesh towards the side exposed to the evaporated metal so that the metal deposited on the insulating surface does not extend into contact with the sides of the interstices of said mesh.

The mesh can subsequently be removed from contact with said surface without danger of dislodging the deposited mosaic elements, or alternatively the mesh may be retained in contact with said surface without destroying the insulation of the mosaic elements from one another. A preferred feature of the invention is that the said method may be applied to the manufacture of mosaic screens in electron discharge devices such as television transmission tubes, and the said mesh then retained in said device so that it can be used as an electrode in said device. The mesh may for example, be retained in contact with said surface or it may be moved to a small distance from said surface after said elements are formed.

This feature of the invention is especially applicable to television transmission tubes operating with cathode potential stabilisation. The said mesh may then be employed as the signal plate in said tube, whereby the transparent signal plate usually employed in such tubes can be dispensed with and the consequent loss of light avoided.

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In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings, in which:

Fig. 1 illustrates diagrammatically one example of the method of manufacturing a mosaic screen according to the invention;

Fig. 2 illustrates a preferred feature of the said example;

Fig. 3 illustrates diagrammatically a television transmission tube embodying a mosaic screen manufactured in accordance with the said example of the invention; and

Fig. 4 shows a cross section of a mosaic screen according to a modification of the invention.

In the example illustrated, a suitable low-shadow ratio mesh 1 of fine pitch and of which the bars, as indicated at 4, have a triangular or wedge-shaped section is held so that the ridges or edges 2 of the mesh are in close contact with an insulating surface 3, for example of glass or mica. Due to the cross-sectional shape of the bars of the mesh the area of the interstices is smaller at the side of the mesh 5 than at the side in contact with the surface 3. The insulated surface 3 with the mesh 1 held in contact therewith is then exposed to metal evaporators in a suitably evacuated chamber and metal is evaporated through the mesh 1 on the insulating surface 3. It is known that when metal is evaporated in vacuo the trajectories of the evaporated particles are straight lines, and if the evaporators are located at a considerable distance from the surface 3 it is possible to make these trajectories approximately normal to the surface 3, as indicated by the arrows 6, and hence due to the fact that the area of the interstices at the side 5 of the mesh is smaller than at the other side, the evaporated metal is deposited on to the insulating surface in the form of discrete elements 8 without extending into contact with the side walls 7 of the bars of the mesh, and also leaving an area 9 of the surface 3 surrounding each element 8 clear of metal by reason of the said area being in the shadow of the side walls 7. The mosaic elements 8 are therefore insulated from one another although, as shown, the metal mesh 1 is not insulated. Metal is of course also deposited on the exposed surface 5 of the mesh, as indicated at 11, there forming a conducting grid but the deposited metal does not destroy the insulation of the mosaic elements 8 from one another. The evaporated metal is preferably antimony, but other metals for example a stibide or silver, may be employed. The mosaic elements 8 may be subsequently rendered photosensitive in any known manner. Meshes having other cross-sections than the mesh 1 may be employed, provided the interstices have a smaller area at some section towards the side of the mesh 5 than at the side in contact with the surface on which the mosaic elements are to be formed.

As a result of the above method, the mesh 1 can be retained in position in contact with the insulating surface 3 provided with the mosaic elements 8, and can be used subsequently as an electrode in capacitative relationship with the mosaic elements, in a television transmission tube or other electron discharge where a mosaic screen is employed. In some cases however where the mesh 1 is employed as an electrode it may be desirable to remove it to a very small distance (for example from 0.04 to 0.001 inch) from the surface 3, and this can be done after the evaporation of the metal without disturbing the mosaic elements 8. When it is intended that the mesh 1 should be employed subsequently as an electrode at such a distance from the mosaic screen, it may in the first instance be mounted at the appropriate distance from the surface 3 and brought into contact with the surface by electrostatic attraction during the evaporation of the metal the mesh being normally sufficiently flexible to permit this. Alternatively the mesh 1 may be mounted in contact with the surface 3 in the first instance and moved to the appropriate distances after the evaporation.

Instead of an un-insulated metal mesh 1 as illustrated in Fig. 1, which may be of nickel, the mesh may if desired be insulated. For example, as shown in Fig. 4, the mesh 24 may be made of aluminium which is anodised to provide an aluminium oxide coating 26 for the required insulation, or the mesh may be made of woven glass, or other materials provided with any suitable form of insulating coating. Where an insulated mesh 24 is employed, the conducting grid 11 deposited on the exposed side 5 enables the mesh to be employed subsequently as an electrode as in the case of where the mesh is not insulated.

Fig. 2 of the drawing illustrates a preferred method of mounting the mesh 1 in contact with the surface 3 which is shown as a flat glass disc. A cement consisting of lead borate powder is applied to the glass disc by painting a suspension of the powder in acetone or water on to the disc, so as to form a frame conforming to the periphery of the mesh 1, and the cement is then glazed by heat treatment at a temperature of about 400 to 500° C. A similar frame 10 of the cement is applied in a similar way to the periphery of the mesh 1 and while the disc is maintained at glazing temperature the mesh is placed on the glass disc. Heating is continued until the two cement frames have fused. On cooling of the cement, the mesh contracts relatively to the glass disc and becomes taut. A similar method may be employed for mounting the mesh where the surface 3 is of mica or other material having a smaller coefficient of expansion than that of the material. In addition other cements than lead borate having the property of softening when heated, for example lithium borate, may be employed, and where it is intended that the mesh 1 be subsequently employed as an electrode at a small distance from the surface 3 the mesh may be cemented as above described to an annulus or frame which in turn is secured or otherwise held in position against the surface 3, electrostatic attraction being employed to hold the mesh in contact with the surface 3 during the evaporation.

Alternatively the mesh 1 mounted on a frame in any suitable way may be supported in position against the surface 3 or the whole of the ridge side of the mesh 1 may be sprayed with lead borate cement and the mesh 1 caused to adhere to the surface 3 over the entire area of the mesh by the same heat treatment as described with reference to Figure 2. An advantage of fixing the mesh 1 on the surface 3 is that leakage under the mesh is prevented so that the insulation of the mosaic elements 8 from one another is improved. Where the mesh 1 is mounted on a frame and supported in position in contact with the glass surface it may be advantageous for the surface 3 to be slightly convex towards the mesh in order to ensure close contact.

As stated, the invention is especially applicable to the manufacture of mosaic screens for use in television transmission tubes operating with cathode potential stabilisation, and in Figure 3 there is illustrated a television transmission tube of this kind, parts which are not relevant to the present description being omitted. The tube comprises an electron gun 13, a solenoid 15 which produces the enveloping axial magnetic field, two pairs of deflecting coils, of which one pair 17 is shown for imparting horizontal and vertical deflections respectively to the beam of electrons 14 from the electron gun, a wall anode 16, a decelerating electrode 18 and electron multiplier 19. These parts are arranged and function in the same way as in a television transmission tube such as known by the registered trade-mark "Orthicon" and need not be further described. The tube is, however, provided with a mosaic screen by the method described with reference to Figure 1 or Figure 4 and the mesh 1 is retained in position and employed as the signal plate of the tube. It is therefore possible to dispense with the transparent signal plate usually provided in such tubes and during its manufacture the mosaic elements 8 of the mosaic screen are evaporated through the mesh 1 directly on to the inner surface of the transparent end wall 12 of the tube, said inner surface constituting therefore the surface 3.

During the operation of the tube, an optical image of the object for transmission is projected on to the mosaic screen on the surface 3 and charges the capacities provided between the mosaic elements 8 of the mosaic screen, and the mesh 1, so as to produce a positive charge image of the object for transmission in known manner, and the screen is then scanned by the beam 14 at such low velocity that said capacities are discharged and the mosaic elements 8 of the screen are restored to an equilibrium potential corresponding substantially to the cathode of the electron gun 13, unrequired electrons forming a return beam 21 which is directed into the electron multiplier 19 from which a signal output is obtained. The mesh 1 is arranged to have a sufficiently fine pitch as not to be resolved in the picture.

The mesh 1 is preferably biassed to a potential of a few volts positive (for example 4 volts) with respect to the cathode of the gun 13, and hence with respect to the potential at which the mosaic screen is stabilised in the absence of light thereon. The mesh 1 then serves to conduct away photo-electrons liberated from the mosaic screen, but at the same time also functions as a control electrode and prevents mosaic elements 8 on the mosaic screen from charging to a potential appreciably higher than the potential of the mesh 1. The charge on the mosaic elements which intensely bright parts of the object for transmission may cause is therefore limited and the limit can be varied by varying the bias applied to the mesh 1. It is therefore possible to improve the signal "gamma" of the tube and to eliminate or reduce picture distortion due to deflection of the incident beam of electrons 14 by highly charged mosaic elements, thereby reducing th geometrical distortion which arises in tubes operating with cathode potential stabilisation.

If the mesh 1 is maintained, as stated, at a positive potential it will absorb electrons from the beam 14 whereas in the absence of the mesh 1 the insensitive insulating areas of the surface 3 of the mosaic screen between the mosaic elements 8, would be at cathode potential and would return all the incident beam 14 to the multiplier 19. Therefore the employment of the mesh 1 maintained at a positive potential will reduce the current from the insensitive areas of the mosaic screen and hence the modulation of the return beam will be improved with a corresponding improvement in the signal/noise ratio.

During tube operation the electron beam scans the surface of the target 1—3 on the end of tube 10. The screen 1 is sufficiently fine that the beam spot or cross-sectional area of the beam 14 at the target covers an area of the screen 1 embracing a plurality of interstices or apertures. Thus, the portion of the incident beam 14 intercepted by the positive mesh screen 1 will not be returned and only those portions of the beam 14 which pass through the mesh and are turned back by the discharged mosaic elements 8 will constitute the return beam 21. Without the presence of a positive mesh 1, the return beam 21 would include not only the portions turned back by the discharged mosaic elements 8 but also a large component turned back by the insulating areas of the insulator surface 3 which would be at cathode potential or more negative than cathode potential during tube operation.

In some cases it may be necessary or preferable to remove the mesh 1 after the evaporation of the mosaic elements 8, to a small distance from the surface 3 of the mosaic screen, (for example about .04 inch) while maintaining the mesh and the surface parallel. In this case the capacity of the mosaic elements 8 to the mesh 1, may be too small to use the mesh 1 as a signal plate and it may be necessary to employ the usual transparent signal plate.

A further metal mesh indicated at 20 in Figure 3 may also be included in the tube, parallel to the surface 3 and about 1 cm. distant from it, the mesh 20 being maintained at a potential of about 10 volts positive with respect to the wall anode 16 and the anode of the gun 13, which will be maintained for example, at about 100 to 200 volts positive with respect to the thermionic cathode of the gun 13. The mesh 20 in such a case serves to prevent positive ions reaching the mosaic screen on the wall 12 thus reducing or removing the "ion-spot" which is troublesome in television transmission tubes employing cathode potential stabilisation. It has also been found that such a mesh, by causing uniform deceleration of the electron beam 14 near the mosaic screen, reduces distortion and causes the area scanned by the return beam 21 to be very small. In this case by the use of lift plates, the return beam can be diverted into an electron multiplier separate from the electron gun 13, rather than a multiplier such as 19 which employs the anode of the gun 13 as the first multiplying electrode.

While the invention has been described as applicable especially to a television transmission tube operating with cathode potential stabilisation it will be understood that mosaic screens manufactured in accordance with the invention can be applied to other electron discharge devices employing mosaic screens.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. For use in a cathode ray discharge device, a mosaic screen comprising a transparent insulator backing plate, a metal mesh including bars and interstices therebetween having one side fixed against one surface of said backing plate, an insulating material coating the surface of said metal mesh, a plurality of photosensitized metallic elements on said one surface of said backing plate, each one of said metallic elements positioned in alignment with an interstice of said mesh and spaced from the others of said elements and from said mesh, and a conductive metal film covering the bars on the other side of said mesh.

2. For use in a cathode ray discharge device, a mosaic screen comprising a glass backing plate, an aluminum metal mesh including bars and interstices having one side fixed against one surface of said backing plate, an insulating oxide layer coating said aluminum mesh, a plurality of photosensitized antimony metal elements on said one surface of said backing plate, each one of said antimony elements positioned in alignment with an interstice of said mesh and spaced from the others of said elements and from said mesh, and a metal film covering the bars on the other side of said mesh.

3. For use in a cathode ray discharge device, a mosaic screen comprising a glass backing plate, a metal mesh including a plurality of bars and interstices therebetween fixed against one surface of said backing plate, said bars being wedge-shaped and arranged with the edges thereof in contact with said one surface of said backing plate, a photosensitized metallic element fixed on said one surface of said backing plate in alignment with each one of said interstices, said bars insulatingly spaced from said elements.

4. For use in a cathode ray discharge device, a mosaic screen comprising a glass backing plate, an aluminum metal mesh including a plurality of bars and interstices therebetween having one side thereof fixed against one surface of said backing plate, said bars being of triangular cross-sectional area to form an edge contacting said one surface of said backing plate, a plurality of photosensitized transparent elements fixed on said one surface of said backing plate, each one of said photosensitized elements positioned in alignment with an interstice of said mesh, an oxide coating on the bars of said mesh to insulate said mesh from said photosensitive elements, and a metal film covering the other side of said mesh.

5. A discharge device comprising an evacuated envelope, means for producing a beam of electrons along a path within said envelope, a mosaic screen positioned within said envelope transverse to the path of said electron beam, said screen including an insulator backing plate having one surface positioned to intercept the electron

beam, a conductive mesh in contact with said one surface of said backing plate and a plurality of photosensitive metallic elements fixed on said surface of said backing plate, each one of said metallic elements insulatingly spaced from the others of said elements and said mesh.

6. A discharge device comprising an evacuated glass envelope, means for producing a beam of electrons along a path within said envelope, a mosaic screen within said envelope, said screen including a portion of said glass envelope intercepting the path of said electron beam, a metal mesh fixed against the inner surface of said envelope portion, a plurality of transparent photosensitive elements fixed on the inner surface of said envelope portion, each one of said photosensitive elements positioned in alignment with an interstice of said mesh and insulatingly spaced from others of said elements and from said mesh.

7. A discharge device including a tubular evacuated glass envelope, means for producing a beam of electrons parallel with the axis of said tube, a mosaic screen within said envelope, said screen comprising the end wall of said tubular envelope intercepting the path of said electron beam, a metal mesh fixed against the inner surface of said end wall and a plurality of transparent photosensitive elements fixed on the inner surface of said end wall, each of said photosensitive elements positioned in alignment with an interstice of said mesh and insulatingly spaced from others of said elements and from said mesh.

8. A discharge device including a tubular evacuated glass envelope, means for producing a beam of electrons parallel with the axis of said tube, said means including a cathode electrode mounted within said envelope, a mosaic screen within said envelope intercepting the path of said electron beam, said mosaic screen comprising a portion of an end wall of said envelope, a metal mesh fixed against the inner surface of said end wall and adapted to be maintained positive relative to said cathode electrode during tube operation and a plurality of transparent photosensitive elements on the inner surface of said end wall, each one of said elements in alignment with an interstice of said mesh to intercept said electron beam, each of said elements insulatingly spaced from others of said elements and from said mesh.

9. A mosaic screen for an electrical device, said screen comprising an insulator backing plate, a metal mesh including a plurality of bars and interstices therebetween fixed against one surface of said backing plate, said bars being wedge-shaped and arranged with the edges thereof in contact with said one surface of said backing plate, a photosensitized metallic element fixed on said one surface of said backing plate in alignment with each one of said interstices, said bars insulatingly spaced from said elements.

10. A discharge device comprising an envelope, means including a cathode electrode for producing a beam of electrons along a path within said envelope, a target plate electrode within said envelope transverse to the path of said electron beam, a metal mesh fixed against the surface of said target plate electrode intercepting said beam path and adapted to be maintained positive relative to said cathode electrode during tube operation, a plurality of photo-sensitive elements fixed to said intercepting surface of said target electrode, said photo-sensitive elements insulatingly spaced from each other and from said metal mesh.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,077,442	Tedham	Apr. 20, 1937
2,237,681	McGee et al.	Apr. 8, 1941
2,244,365	Iams	June 3, 1941
2,250,721	Moller et al.	July 29, 1941
2,401,220	Bonner	May 28, 1946