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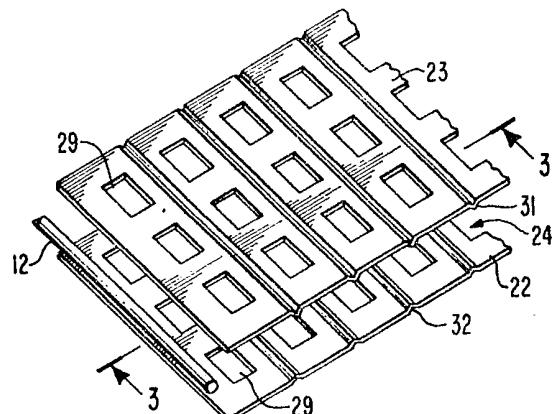
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(54) Beam clean up structure for flat panel display devices

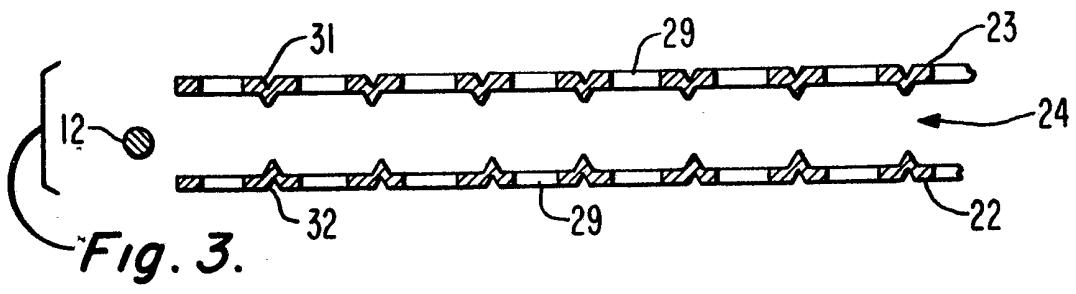
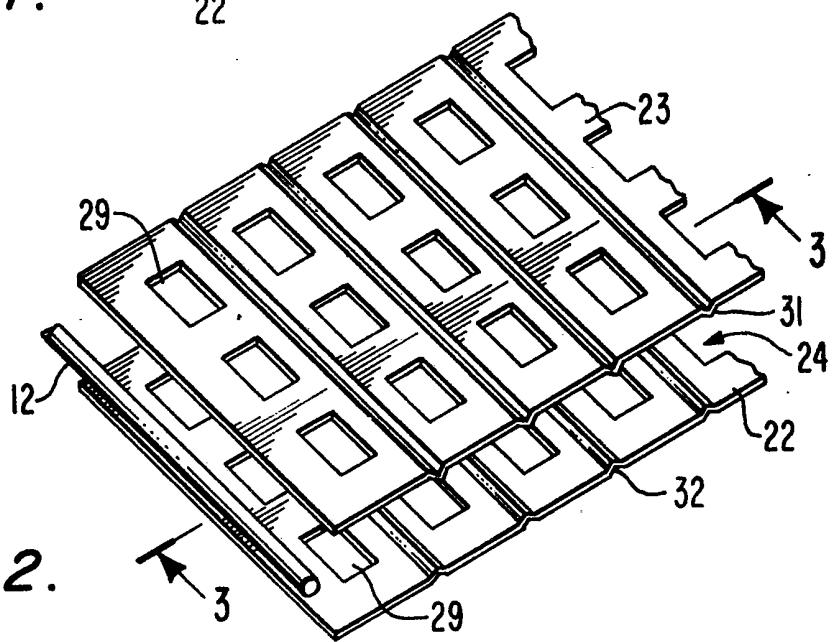
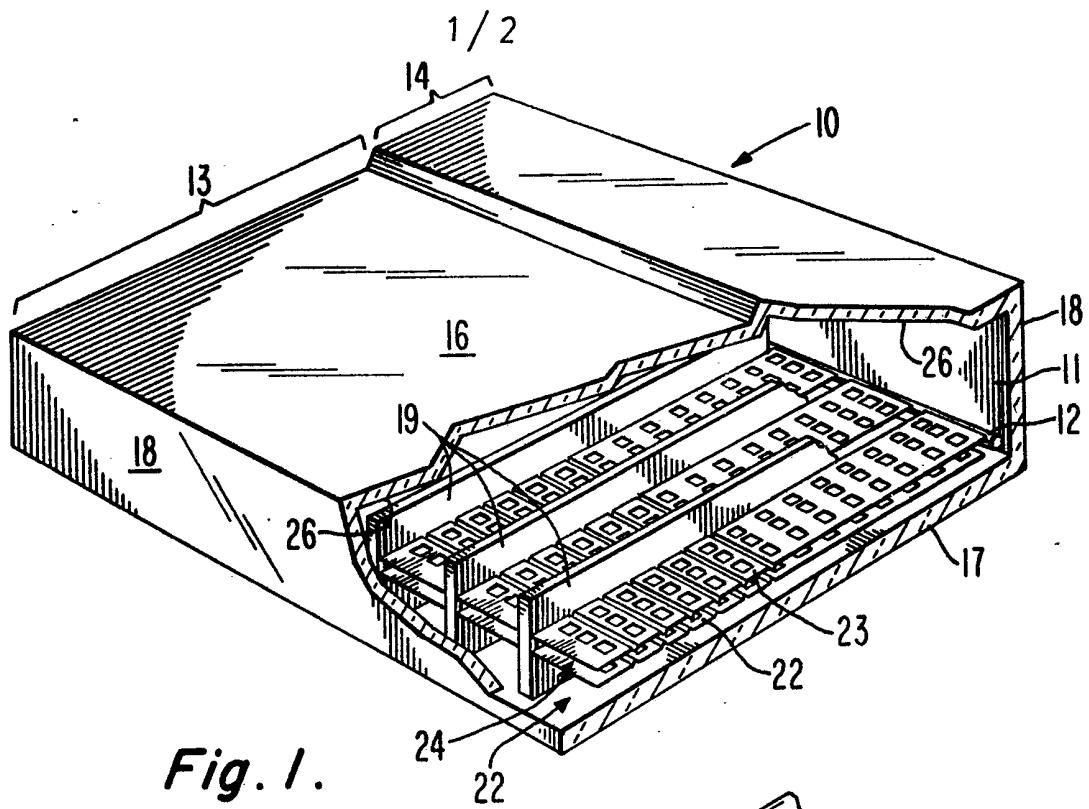
(57) In a flat panel display device including spaced parallel guide meshes (22, 23) between which electron beams propagate from an electron emissive cathode (12), the guide meshes are formed to include

projections (31, 32) extending into the electron beam propagation space (24). The projections restrict the electron propagation space in a direction perpendicular to the planes of the guide meshes and thus clean up the electron beam by capturing electrons near the extremities of the space.

Fig. 2.



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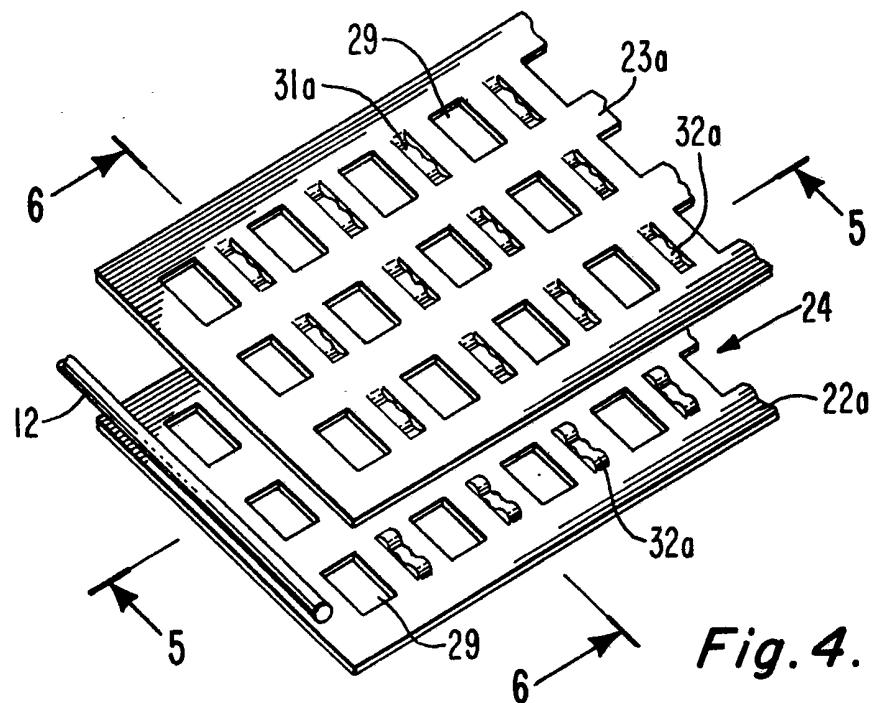


Fig. 4.

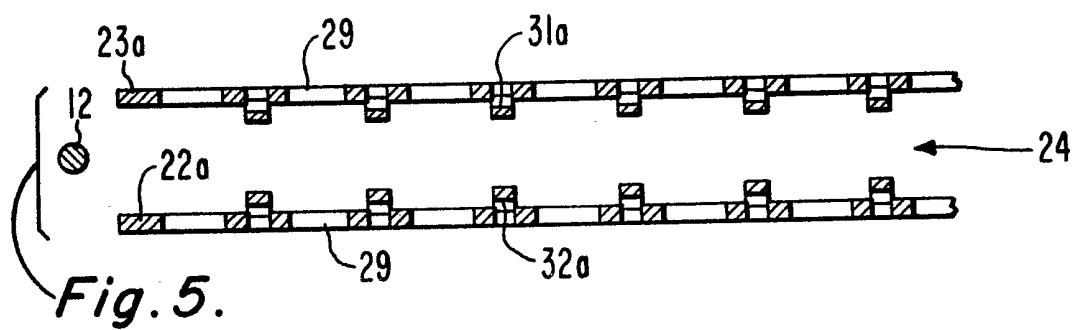


Fig. 5.

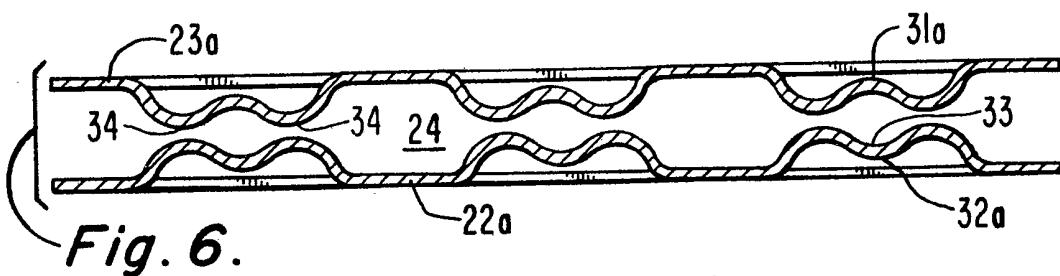


Fig. 6.

SPECIFICATION**Beam clean up structure for flat panel display devices**

This invention relates generally to flat panel display devices and particularly to an electron beam clean up structure for such devices.

U.S. Patent No. 4,069,439 discloses a flat panel display device including a pair of spaced parallel beam guide meshes between which electrons are propagated as beams. Arranged between the guide meshes at the end where electrons enter the guide structure are two additional meshes which narrow the electron propagation space for an initial portion of the beam guide structure. These additional meshes are used to capture electrons which are propagating near the guide meshes and thereby serve as beam clean up meshes. Operationally, the use of such clean up meshes is satisfactory.

However, the additional meshes add complexity and cost to the display device and create a problem in aligning the clean up members with the guide meshes.

U.S. Patent No. 4,128,784 also shows a flat panel display device utilizing parallel spaced electron beam guide meshes between which electrons are propagated as beams. The ends of the beam guides nearest the cathode are bent to converge toward one another and thereby narrow the space between which electrons can be injected into the propagation space. The bent portions, therefore, serve as a beam clean up means. This device is not adequate for high performance beam clean up because only a small number of electrons are captured by the bent portions. The major portion of the electrons have a velocity vector directed such that they miss the bent portions and enter the narrow space between the guide meshes and propagate along the beam guide near the guide meshes.

In the present flat panel display device the beam guides are formed to remove from the electron beam electrons that are travelling in a direction causing them to impinge upon the beam guide. The beam guide meshes are shaped to form projections protruding into the space in which the electrons propagate to capture the electrons travelling near the guide meshes.

In the drawings:

FIGURE 1 is a simplified perspective view of a flat panel display device incorporating a preferred embodiment of the invention;

FIGURE 2 is an enlarged perspective view, partially broken away, of a portion of the device of FIGURE 1.

FIGURE 3 is a cross section taken along line 3—3 of FIGURE 2.

FIGURE 4 is a perspective view, partially broken away, of another preferred embodiment.

FIGURE 5 is a cross section taken along line 5—5 of FIGURE 4.

FIGURE 6 is a cross section taken along line 6—6 of FIGURE 4.

FIGURE 1 shows one form of a flat panel display device 10 incorporating one of the preferred embodiments of the present invention. The display device 10 includes an evacuated envelope 11 having a display section 13 and an electron gun section 14. The envelope 11 includes

70 a faceplate 16 and a baseplate 17 held in spaced parallel relationship by side walls 18.

A plurality of spaced parallel support vanes 19 are arranged between the faceplate 16 and the baseplate 17 to provide internal support against 75 external atmospheric pressure and to divide the envelope 11 into a plurality of channels 21. Each of the channels 21 encloses a beam guide assembly for propagating electron beams along the channels 21. The beam guide assemblies 80 include pairs of spaced parallel beam guide meshes 22 and 23 extending transversely across the channels and longitudinally along the channels from the gun section 14 to the opposite side wall 18.

85 A line cathode 12 is arranged to emit electrons into the space 24 between the beam guides. The inside surface of the faceplate 16 is provided with a phosphor screen 26 which luminesces when struck by electrons. The screen can be composed

90 of three different phosphors arranged in a pattern, such as repeating triads of stripe-shaped elements, to produce a color visual output in response to electron excitation. A focus mesh (not shown) is spaced from and parallel to the mesh

95 23. A series of electrodes (not shown) is arranged on the inside surface of the baseplate 17 normal to the lengths of the channels 21. The focus mesh and electrodes are biased to focus the electrons in the space 24.

As shown in FIGURE 2 the guide meshes 22 and 23 contain apertures 29 which are arranged in columns longitudinally along the meshes and in rows transversely across the meshes. Typically, in the art the transverse rows of apertures are

105 referred to as periods. Electrons are emitted from the cathode 12 and propagate in the space 24 between the meshes 22 and 23. Each column of the apertures 29 serves as an electron beam guide so that each pair of meshes is capable of propagating three electron beams.

The guide mesh 23 contains a plurality of embossed projections 31 extending transversely across the mesh and preferably equally spaced between the rows of apertures 29. Similarly, the 115 mesh 22 contains embossed projections 32 which also extend transversely across the mesh between the rows of apertures 29. The projections 31 and 32 are aligned across the space 24 and protrude into the space 24 to reduce the dimension of the space which is normal to the planes of the meshes.

As shown in FIGURE 3, because the projections 31 and 32 protrude into the space 24, electrons travelling along the extremities of the space strike 125 the projections 31 and 32 thereby narrowing the electron beam. Electrons propagating along the space 24 follow a sinusoidal path the wavelength of which is dependent upon the physical and

operating parameters of the device. Effective beam clean up requires that projections 31 and 32 be present for a sufficient number of periods to equal the wavelength of the electron beam.

5 However, all the electrons within the electron beam are not in phase and accordingly additional projections are required to realize effective beam clean up. For example, an electron beam wavelength of six periods is obtained when the 10 guide meshes 22 and 23 are spaced by 50 mils (0.125 cm), the extraction electrodes are spaced from the mesh 22 by 20 mils (0.05 cm), the meshes 22 and 23 are biased at +70 volts, the extraction electrodes are biased at +350 volts and 15 the apertures 29 have a longitudinal dimension of 74 mils (0.19 cm) and are longitudinally spaced by 50 mils (0.125 cm). Accordingly, because of the difference in the phases of the electrons within the electron beam, projections would typically be used 20 for nine periods. If desired, clean up projections can be used for two full wavelengths of the electron beam, twelve periods for the exemplary parameters above. The space 24 is unrestricted along the guide meshes beyond the projections 31 25 and 32 which are furthest from the cathodes 12. The apertures 29 in the guide meshes 22 and 23 are aligned across the space 24. The 30 projections 31 and 32 are preferably centered between the rows of apertures and, therefore, also are aligned across the space 24. Accordingly, the 35 projections do not adversely affect the electrostatic fields which focus the electrons in the space 24.

The projections 31 and 32 are formed integral 40 with the guide meshes 23 and 22, respectively, and therefore, can be precisely located during the fabrication of the guide meshes. Additionally, the guide meshes 22 and 23 preferably are identical. For these reasons the guide meshes can be 45 fabricated and assembled using mass production techniques.

The integral forming of the projections 31 and 32 in the guide meshes causes some stretching and thinning of the mesh metal along the lines 50 where the shaped projections are formed. This can be avoided by etching, scribing, or otherwise removing a small amount of metal along the lines where bending occurs during the formation of the 55 projections.

FIGURE 4 shows a beam guide structure including spaced parallel guide meshes 22a and 23a. The meshes 22a and 23a are identical to the meshes 22 and 23 of FIGURE 2 with the exception of the configuration of the projections 31a and 32a which replace the projections 31 and 32 on 60 FIGURE 2.

In the FIGURE 4 embodiment the electron beam clean up structure consists of partially struck ribbon-like projections 31a and 32a which 65 protrude into the space 24 between the meshes 22a and 23a. The projections 31a and 32a are aligned with the columns of apertures 29 and are arranged in transverse rows preferably centered between the transverse rows of the apertures 29.

and 32a is greater than the transverse dimension of the apertures 29. Additionally, as shown in FIGURE 5, the projections 31a and 32a are preferably centered between the apertures 29 and are aligned across the space 24.

As shown in FIGURE 6, the ribbon projections 32a and 32b are slightly concave in the center portions 33 so that the outer portions 34 protrude into the space 24 further than the center portions.

70 The electron beams propagate along the projections in the vicinity of the centers 33 so that the outer portions 34 serve as transverse clean up for the electron beams. The center portions 33 of the projections 31a and 32a each protrude into the space 24 a distance which is approximately 20% of the total dimension of the space in the direction perpendicular to the planes of the meshes.

75 In the embodiment shown in FIGURES 4, 5 and 6 the meshes 22a and 23a are identical and, therefore, the construction of the meshes is simplified. Additionally, because the projections 31a and 32a are integral with the meshes, mass production techniques can be used to precisely 80 manufacture the meshes.

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CLAIMS

1. A display device including two parallel spaced guide meshes forming a space between said guide meshes, said meshes having a plurality 95 of apertures arranged in columns longitudinally along said meshes and rows transversely across said meshes, said columns of apertures serving as guide paths for propagating electron beams between said meshes in said space, and electron beam clean up means for confining the cross section of said electron beams to maximum dimensions being provided, including a plurality of projections formed in said guide meshes between said rows of apertures and protruding into said space between said guide meshes.

100 2. A display device as defined in Claim 1 wherein said projections are embossed in said meshes and extend across the entire transverse dimension of said guide meshes.

105 3. A display device as defined in Claim 2 wherein said projections are V-shaped and restrict a maximum of 40% of the total dimension of said space in a direction perpendicular to the planes of said guide meshes.

110 4. A display device as defined in Claim 1 wherein said projections are ribbon-like elements struck from said meshes and are arranged in transverse rows between said rows of apertures and in longitudinal columns coincident with said columns of apertures.

115 5. A display device as defined in Claim 4 wherein said ribbon projections are curved into the space between said guide meshes to provide both longitudinal and transverse electron beam clean up.

120 6. A display device as defined in Claim 5 wherein said ribbon projections protrude into said space between said guide meshes a first distance in the proximity of the edges of said apertures and

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a second distance in the proximity of the centers of said apertures.

7. A display device as defined in Claim 6 wherein said first distance is greater than said

5 second distance.

8. A display device as claimed in Claim 7 wherein the total second distance protrusion of said ribbon projections in both of said guide meshes is a maximum of 40% of the total spacing

10 between said guide meshes.

9. A display device as defined in any preceding Claim wherein said projections are arranged in a portion of said guide meshes having a predetermined length measured along the

15 longitudinal dimension of said meshes, said predetermined length being at least as long as the propagation wavelength of said electron beams.

10. A display device as defined in any preceding Claim wherein said projections are substantially equally spaced between successive rows of apertures.

20 11. A display device as defined in Claim 10 wherein there is a maximum of nine of said rows of ribbon projections along a column of apertures.

25 12. A display device as defined in any preceding Claim wherein the first of said projections reached by a propagating electron beam lies between the first and second rows of apertures.

30 13. A display device having electron beam guide meshes with beam clean up projections substantially as hereinbefore described with reference to FIGURES 2 and 3 or FIGURES 4—6 of the accompanying drawings.