(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 570 065 A1**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **93201325.3**

(51) Int. Cl.5: **H01J 29/00**, H01J 29/06

(22) Date of filing: **07.05.93**

(30) Priority: **15.05.92 EP 92201386**

(43) Date of publication of application:
**18.11.93 Bulletin 93/46**

(84) Designated Contracting States:
**DE FR GB IT**

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## (54) Colour display tube having an internal magnetic shield.

(57) Colour display tube of the 3-in-line type having a display screen with a pattern of phosphor lines. The display tube has an internal shield with two long walls and two short walls. Each long wall is provided with at least one slit extending in the longitudinal direction of the tube and being remote from the edges of the walls, while for locally increasing the magnetic resistance the shield is particularly provided with a short transverse slit between at least one slit end and the opposite edge.

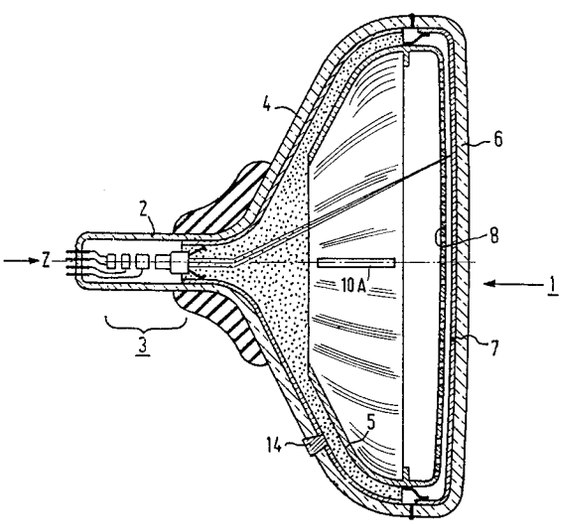


FIG.1

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The invention relates to a colour display tube comprising:

an envelope with a longitudinal axis, having a neck portion, a funnel portion and a window portion;

an electron gun arranged in the neck portion;

a display screen having a short axis and a long axis and a pattern of phosphor lines parallel to an axis of the display screen on the inner surface of the window portion;

a colour selection means arranged proximate to the display screen;

a magnetic shielding structure arranged within the funnel-shaped portion, which shielding structure has two long wall portions parallel to the long axis of the display screen and two short wall portions parallel to the short axis of the display screen, and an aperture at its gun-sided end, which aperature extends transversely to the longitudinal axis and constitutes a scanning aperture for electron beams produced by the gun and scanning the display screen.

A colour selection means is herein understood to mean, for example, an apertured shadow mask sheet or a wire mask.

The ratio between the dimension of the long central axis and the dimension of the short central axis of the display screen characterizes the picture format.

In a (colour) display tube the earth's magnetic field deflects the electron paths, which without any measures may be so large that the electrons impinge upon the wrong phosphor line (mislanding) and produce a discolouration of the picture.

Modern display tubes are provided with an internal magnetic shielding structure (shield) to limit the deviation of the electron path due to the earth's magnetic field. A complete shielding is not possible due to an aperture which is required for passing the electron beam. A horizontally directed spot displacement caused by the lateral earth's magnetic produces a risk of discolouration (N effect) in the corners only. The internal residual field can be influenced by means of an additional measure in such a way that the electron beam still passes the mask at the desired angle. This measure involves, for example the use of a shield with "vertically" directed slits (situated in a plane parallel to the short axis of the display screen). The internal residual field is then influenced in such a way that there is less spot displacement in the horizontal direction. The slits enhance the magnetic resistance in the shield material in the horizontal direction so that there is more spot displacement in the vertical direction. However, for picture tubes with phosphor lines extending in this direction this is no problem because it does not lead to discolouration. In the extreme case the shield is split fully magnetically ("split shield"). Overcompensation of the N effect may then even occur.

A problem of "vertically" directed slits is that the slit length is to be limited to ensure the mechanical stability of the shield so that an unacceptable spot displacement remains in the corners, particularly in large tubes. In large tubes having a picture diagonal of 41 cm or mor, such as 80 FS ("Flat Square") and 36 inch WS ("Wide Screen") it has been attempted to lengthen the slits to a maximum extent and to restore the resultant loss of mechanical strength by welding on supporting strips of non-ferromagnetic material. However, the following problems then occur.

1. Welding on the strips is a relatively expensive operation,
2. The spot welds are not very reliable (loosening),
3. Oil and grease residues behind the welded strips are difficult to remove (cathode poisoning).

It is an object of the present invention to provide a display tube of the type described in the opening paragraph, in which the earth's magnetic field is shielded at least as satisfactorily as in the known display tube without, however, detrimentally influencing the mechanical stability of the shield, even in large tubes (with a screen diagonal from 41 cm onwards).

According to the invention, a display tube of the type described in the opening paragraph is therefore characterized in that each of the long wall portions of the shielding structure has at least one elongated aperture extending transversely to in the longitudinal direction of the wall and being remote from the edges of the wall, the magnetic resistance of the wall being locally higher than at both sides of the aperture between at least one end of the aperture and the adjacent edge of the wall.

Within the scope of the invention, the magnetic resistance of the wall for the lateral field can be increased in different ways, for example, by

- local deformation (by means of a centre punch or a laser beam) in the area between the aperture and the edge;
- local diffusion of a non-magnetic material, such as aluminium suitable for use in an evacuated space, in the area between the aperture and the edge.

A very effective measure appears to be the provision of a transverse slit between at least one end of the elongate aperture and the adjacent edge of the wall.

This can be realised by T-shaped widening of the elongate aperture at one end, but it is mechanically more favourable to provide a separate transverse slit. A transverse slit may be provided at the gun side, at the display screen side or at both

sides of the slit-shaped aperture. The effect is greatest at the display screen side because this is closest to the location where influence should be exerted on the electron beam.

The effect of the measures according to the invention is enhanced if the shield is made of a sheet material.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter. In the drawings

Fig. 1 is a longitudinal sectional view of a colour display tube;

Figs. 2A to 2F are diagrammatic representations to illustrate the beam mislandings on the display screen due to the earth's magnetic field for different shields;

Fig. 3A is a partial elevational view of a first embodiment of an internal shield;

Fig. 3B is a partial elevational view of a second embodiment of an internal shield;

Fig. 3C is a partial elevational view of a third embodiment of an internal shield; and

Fig. 3D shows a fourth embodiment of a shield.

Fig. 1 shows a colour display tube 1 having a glass envelope which comprises a neck portion 2 accommodating an electron gun system 3, a funnel-shaped portion 4 within which a magnetic shield 5 is arranged, and a window portion 6 whose inner surface is provided with a display screen 7 having a pattern of phosphors arranged along parallel lines. A shadow mask 8 is arranged opposite the display screen 7.

The shape of the magnetic shield 5 in display tube 1 roughly follows the contours of the funnel-shaped portion.

Modern display tubes are provided with an internal magnetic shield to reduce the deviation of the electron path due to the earth's magnetic field. A complete shielding is not possible due to the apertures required for the electron beams. In a lateral field only the horizontally directed spot displacement in the corners causes a risk of discolouration (N effect).

The internal residual field is influenced *via* an additional measure in such a way that the electron beam still passes the mask at the desired angle.

Fig. 2A shows an example of a shield 9 in a rear view, in which no residual field correction is realised.

Fig. 2B shows the associated spot displacement in the corners, similarly as in a lateral earth's magnetic field.

Fig. 2C shows a shield 5 with vertically directed slits 10a, 10b. The internal residual field is influenced thereby in such a way that there is less spot displacement in the horizontal direction. The slits increase the magnetic resistance in the shield material in the horizontal direction so that there is more spot displacement in the vertical direction (Fig. 2D). However, this is not important for line tubes because it does not cause discolouration.

Fig. 2E shows the shield 25 split completely magnetically. Overcompensation of the N effect may even occur in this case (see Fig. 2F).

A problem of the vertically directed slits is that the slit length is to be limited to ensure the mechanical stability of the shield so that an unacceptable spot displacement remains in the corners, particularly in large tubes. When the slits are further extended, the mechanical stability can be restored by welding on supporting strips of a non-ferromagnetic material. However, the previously mentioned problems then occur.

Within the scope of the invention, the slits are not extended any more than is justified in connection with the mechanical stability of the shield and the magnetic resistance for the lateral field in alignment with the afore-mentioned vertically directed slits is enhanced by

- increasing the path length of the field lines by increasing the iron, and/or by
- locally degrading the magnetic properties of the material of the shield.

Figs. 3A to 3B show some embodiments. Their use is attractive in all "line" tubes with a screen diagonal from 41 cm onwards, particularly in tubes having an aspect ratio of more than 4:3, such as 14:9 and 16:9.

Fig. 3A is an elevational view of a corner portion of a shield 20 having a long side wall 31 provided with an elongate transversal aperture, or slit 32. In the area between one end of the slit 31 and the opposite edge 33 of the wall 31 the magnetic properties of the shield material are degraded over a length $l_1$ by means of a special treatment. This treatment may be a mechanical deformation (for example, by means of a centre punch) or a deformation by means of a laser beam, or diffusion of a non-magnetic material (for example, Al). Instead of one slit, a shield with two (or more) - particularly shorter - slits 62, 62' can be used in this embodiment (Fig. 3D).

Fig. 3B is an elevational view of a corner portion of a shield 40 having a long side wall 41 in which a "vertical" slit 42 is provided. To increase the path length of the magnetic field lines, slit 42 is provided with a T-shaped end 44 in which the cross-piece of the T has a length $l_2$ of several tens of millimetres (for example, 40).

Fig. 3C is an elevational view of a corner portion of a shield 50 having a long side wall 51 in which a "vertical" slit 52 is provided. To increase the path length of the magnetic field lines, an auxiliary slit 54 having a length $l_3$ of several tens of millimetres (for example, 40 to 80) and a width of

several millimetres (for example, 3) is arranged transversely to the slit 52 between one end of the slit 52 and the opposite edge 53.

The length (*i.e.* the dimension transverse to the axis of the vertical "major" slits) of the transverse slits is smaller than the length of the "vertical" slits in all these cases. This is favourable for the mechanical stability of the shield.

The shield may be formed from one part or, for example, from two parts (cf. 2E). In the latter case the two shield parts (cf. 2E). In the latter case the two shield parts (which are U-shaped in that case) may be fixed to each other in such a way that the afore-mentioned elongate aperture, or apertures is, or are formed at the area of fixation.

## Claims

**1.** A colour display tube comprising:

an envelope with a longitudinal axis, having a neck portion, a funnel portion and a window portion;

an electron gun arranged in the neck portion;

a display screen having a short axis and a long axis and a pattern of phosphor lines parallel to an axis of the display screen on the inner surface of the window portion;

a colour selection means arranged proximate to the display screen;

a magnetic shielding structure arranged within the funnel-shaped portion, which shielding structure has two long wall portions parallel to the long axis of the display screen and two short wall portions parallel to the short axis of the display screen, and a aperture at its gun-sided end, which aperture extends transversely to the longitudinal axis and constitutes an aperture for passing electron beams produced by the gun and scanning the display screen, characterized in that each of the long wall portions of the shielding structure has at least one elongate aperture extending transversely to the longitudinal direction of the wall and being remote from the edges of the wall, the magnetic resistance of the wall being locally higher than at both sides of the aperture between at least one end of the aperture and the adjacent edge of the wall.

**2.** A colour display tube as claimed in Claim 1, characterized in that the magnetic resistance is locally increased by providing a transverse slit between at least one end of at least one elongate aperture and the adjacent edge of the wall.

**3.** A colour display tube as claimed in Claim 2, characterized in that a transverse slit is arranged at the display screen side of the at least one elongate aperture.

**4.** A colour display tube as claimed in Claim 2, characterized in that the transverse slit has a shorter length than the elongate aperture.

**5.** A colour display tube as claimed in Claim 1, characterized in that the magnetic resistance is locally increased by means of mechanical deformation.

**6.** A colour display tube as claimed in Claim 1, characterized in that the magnetic resistance is locally increased by diffusion of a non-magnetic material.

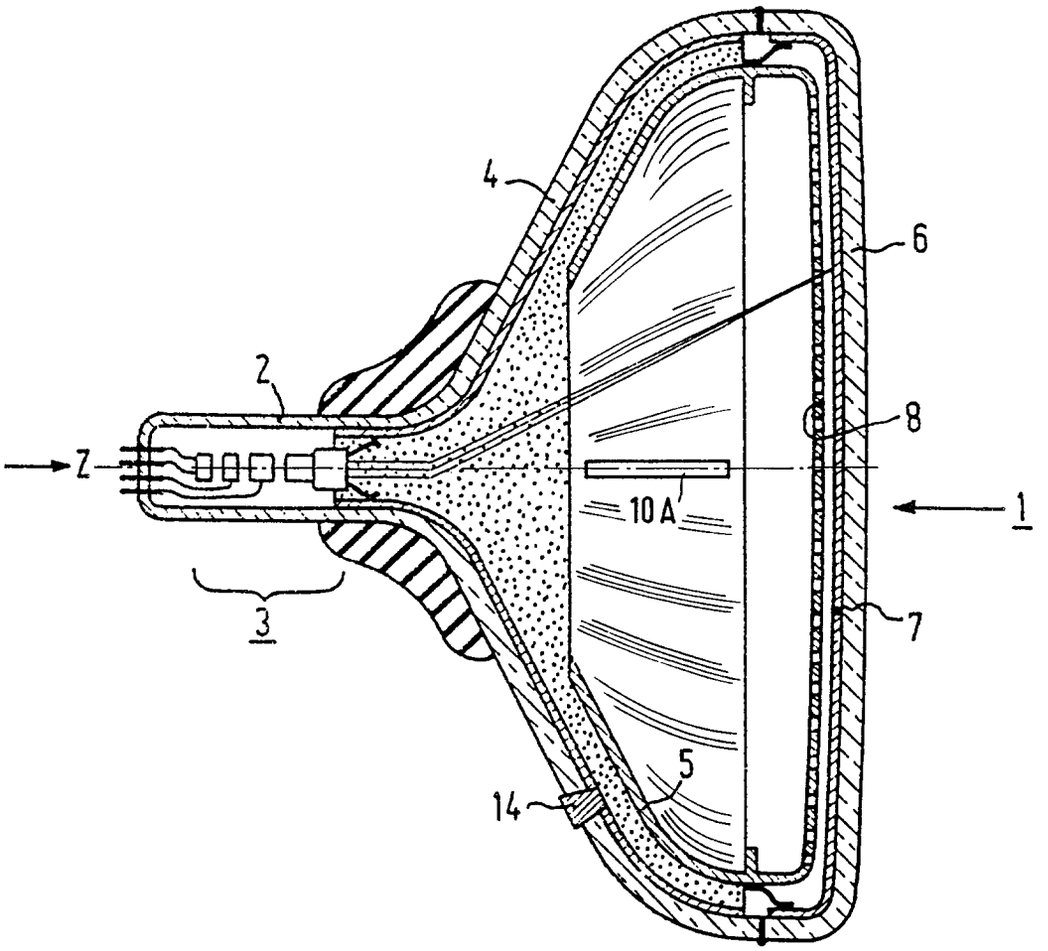


FIG.1

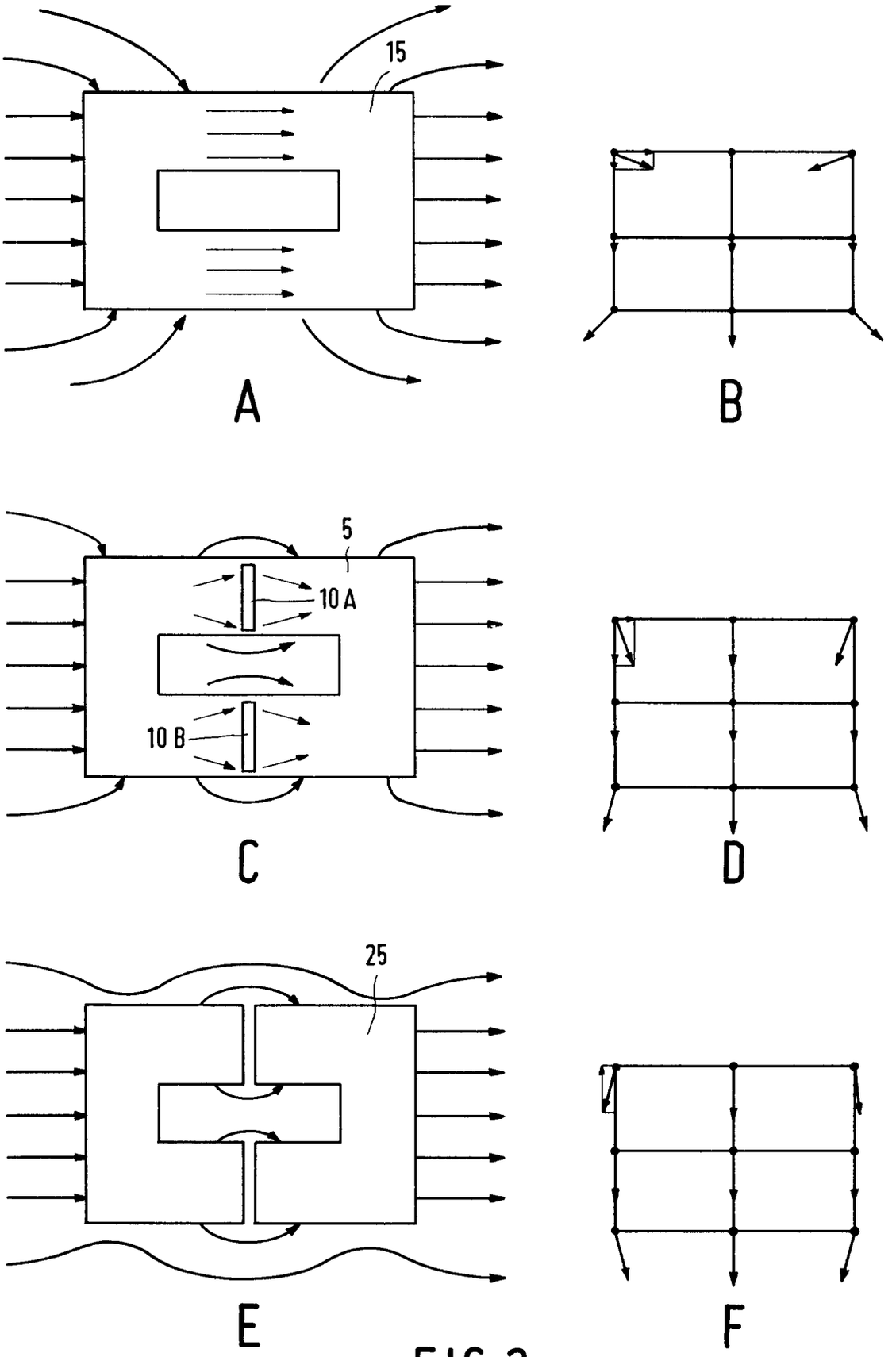


FIG. 2

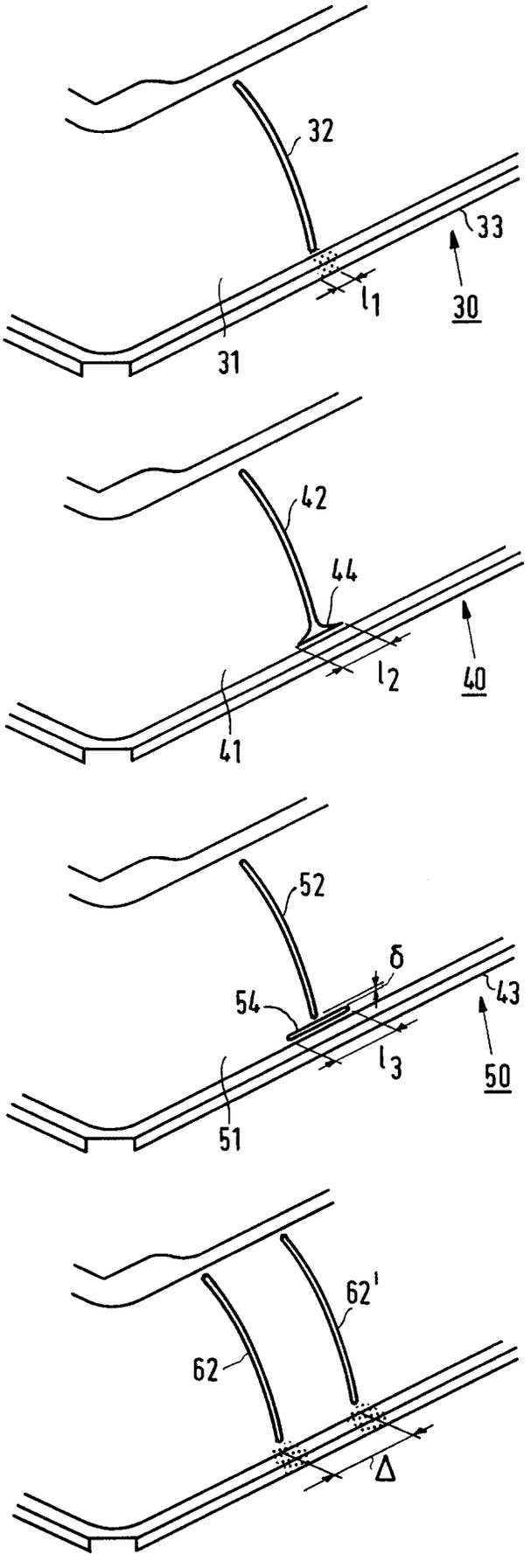


FIG.3

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# EUROPEAN SEARCH REPORT

Application Number

EP 93 20 1325

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5 ) |
|---|---|---|---|
| A | EP-A-0 403 010 (PHILIPS)<br>* claims 1,2 *<br>* figures 1-3 * | 1 | H01J29/00<br>H01J29/06 |
| A | EP-A-0 217 473 (NORTH AMERICAN CONSUMER ELECTRONICS)<br>* claims 1-3 *<br>* figures 1,2 * | 1 | |
| A | US-A-4 622 490 (R.E. BENWAY)<br>* Abstract *<br>* figures 1-3 * | 1 | |

| TECHNICAL FIELDS SEARCHED (Int. Cl.5 ) |
|---|
| H01J |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 20 AUGUST 1993 | DAMAN M.A. |

CATEGORY OF CITED DOCUMENTS

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