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(54) Display device and cathode-ray tube for such a display device, method and device.

(57) A display device comprising a cathode-ray tube having means for generating an electron beam, a display screen having a phosphor pattern and a colour-selection electrode (30) extending in front of the display screen. When in operation, the electron beam is incident on the colour selection electrode (30) at an angle. The colour selection electrode (30) contains an integrated Venetian-blind structure. Such a colour-selection electrode (30) has a high mechanical stability and a high magnetic screening. The method is characterised in that the colour-selection electrode (30) is manufactured from a flat plate in which grooves are formed according to a staggered pattern. This is a simple method of manufacturing a colour-selection electrode (30) suitable for a colour-display device according to the invention. A device for stretching a colour-selection electrode (30) plate is also described.

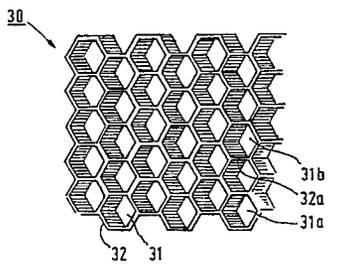

FIG.3

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DISPLAY DEVICE AND CATHODE-RAY TUBE FOR SUCH A DISPLAY DEVICE, METHOD AND DEVICE.

The invention relates to a display device comprising a cathode-ray tube which comprises in an evacuated envelope means for generating at least one electron beam, a display screen and a colour-selection electrode in which apertures are formed and which extends in front of the display screen, said colour selection electrode having the structure of a Venetian blind.

The invention also relates to a cathode-ray tube which is suitable for such a display device.

A display device of the type described in the opening paragraph is known from British Patent Specification 1,223,723.

In said specification a description is given of a display device comprising a cathode-ray tube. Said cathode-ray tube comprises a display screen. A colour selection electrode is arranged in front of said display screen. When in operation, the electron beam is incident on the colour selection electrode at an angle. The colour-selection electrode comprises apertures through which the electron beam is directed towards the display screen. Said apertures are formed by walls extending in the direction of the electron beam. The colour selection electrode is an electrode of the so-called "Venetian-blind" type. "Venetian-blind structure" is to be understood to mean herein a system of walls which extend relative to the plane of the colour selection electrode at an angle and between which apertures are formed. The known colour-selection electrode comprises elongated strips extending in the direction of the electron beam. The known colour-selection electrode has a small mechanical stability. In British Patent Specification 1.223.723, it is proposed to improve the mechanical stability of the colour selection electrode by providing it with thin tensile stressed wires. However, such a colour-selection electrode is unsuitable for mass production. Moreover, in this case the mechanical stability of the colour-selection electrode depends on the connection between the strips ind the wires. If a wire of the colour-selection electrode becomes detached, the colour selection electrode is mechanically weaker at this location than at others. This may lead to deformations of the colour selection electrode.

One of the objects of the invention is to provide a display device of the type described in the opening paragraph, which comprises a mechanically rigid colour-selection electrode.

For this purpose, the display device according to the invention is characterized in that the Venetian-blind structure is integrated in a plate.

As a result hereof, said blinds form a coherent assembly and the colour selection electrode is mechanically rigid.

A further advantage of the display device according to the invention is that the colour-selection electrode provides a better magnetic screening of the electron beam.

An embodiment of the display device according to the invention is characterized in that the Venetian-blind structure is integrated in the plate by deformation.

Consequently, the material of the colour selection electrode is more rigid.

An embodiment of the display device according to the invention is characterized in that for each aperture at least two walls extending opposite each other are provided with a conducting layer, and the display device comprises means for generating a potential difference between said conducting layers.

In this way, colour selection can be easily achieved.

The invention also relates to a method of manufacturing a colour selection electrode.

The method according to the invention is characterized in that the colour selection electrode is manufactured from a plate having a staggered pattern of grooves which are separated from each other, the plate being stretched.

It has been found that the grooves widen into apertures when the plate is stretched. The apertures are bounded and surrounded by walls extending at an angle relative to the plane of the plate. Such walls will hereinafter also be termed "Venetian blinds". The angle at which the walls extend can be adjusted by the degree to which the plate is stretched. The Venetian blinds form a coherent assembly.

In the stretching operation, preferably, stretching forces are exerted on a number contact points on either side of the plate, the distances between two points in a direction extending at least transversely to the direction of the stretching forces being variable.

In the stretching operation, the plate is stretched in one direction, the direction of stretching; in the direction transversely to said direction of stretching the plate tends to contract. If the contact points cannot be moved relative to each other, this will lead to non-uniform deformations in the plate.

An embodiment of the method according to the invention is characterized in that the flat plate is composed in such a manner that a conducting layer is present on both sides of said flat plate and that an insulating separating layer is arranged between said conducting layers.

In this way, a colour-selection electrode in

which for each aperture at least two walls extending opposite each other are provided with a conducting layer can be manufactured in a simple manner.

The invention also relates to a device for stretching a colour-selection electrode having grooves, the device comprising means for exerting a stretching force on at least four contact points, the contact points being arranged pairwise opposite each other and the distance between two contact points in a direction transversely to the direction of stretching is variable.

The invention will be explained in more detail by means of several exemplary embodiments and with reference to the accompanying drawings, in which

Fig. 1 is a sectional view of the known display device;

Fig. 2 is a sectional view of a detail of the known display device;

Fig. 3 is a partly perspective elevational view of a colour selection-electrode which is suitable for a colour display device according to the invention;

Fig. 4 is a sectional view of a further example of a colour selection electrode which is suitable for a display device according to the invention;

Fig. 5a is a top view of a flat plate having grooves, from which plate a colour-selection electrode suitable for a display device according to the invention can be manufactured;

Fig. 5b is a partly perspective elevational view of a colour selection electrode manufactured from the flat plate shown in Fig. 5a;

Figs. 5c and 5d are top views of flat plates with further examples of staggered patterns of grooves;

Fig. 6 is a sectional view of a flat plate comprising a conducting plate which is provided on one side with an insulating layer on which a conducting layer is provided;

Fig. 7 is a sectional view of a further example of a flat plate which is composed so that the flat plate comprises two conducting layers;

Fig. 8 shows a display device according to the invention;

Figs. 9a and 9b diagrammatically show a device according to the invention;

Figs. 9c and 9d show a further example of a device according to the invention.

The Figures are diagrammatic and not drawn to scale, in general, corresponding parts in the various embodiments generally bearing the same reference numerals.

Fig. 1 is a sectional view of the known display device. A display device 1 comprises a display window 3 in an evacuated envelope 2, said display window being provided with a display screen 4 on the inside. Said display device 1 further comprises a generation system 5 for generating an electron beam 6. Said electron beam 6 enters a deflection space 9 at a location 8. The deflection space 9 is bounded by electrodes 10 and 11 and grid 12. After the electron beam has described a parabolic path in the deflection space 9, it impinges on the grid 12. A colour selection electrode 13 is arranged between the grid 12 and the display screen 4.

Fig. 2 is a sectional view of a detail of the known display device. The electron beam 6 is incident on the grid 12. The colour selection electrode 13 is arranged between the grid 12 and the display screen 4. This colour selection electrode 13 contains Venetian blinds 14 and thin, tensile-stressed wires 15. The Venetian blinds extend in the direction of movement of the electron beam 6. The display screen 4 contains phosphor patterns 16, 17 and 18. These patterns comprise cathodoluminescing phosphors in red, green and blue, respectively. When in operation, the grid 12 is energized by applying a potential of approximately 3000 V, the display screen by applying a potential of approximately 20 000 V, the Venetian blinds are energized by applying a potential between 400 and 500 V. A potential of 400 V focuses the electron beam 6 on the phosphor pattern 16, a potential of 500 V focuses the electron beam 6 on the phosphor pattern 18.

The wires 15 provide mechanical stability to the colour selection electrode 13. However, such a construction is unsuitable for mass production. Besides, the mechanical rigidity of the colour-selection electrode depends on the connection between the colour-selection electrode and the wires. When a wire of the colour-selection electrode becomes, detached the colour-selection electrode is mechanically weaker at this location than at others. This may lead to deformations of the colour-selection electrode.

Fig. 3 is a partly perspective elevational view of a colour selection electrode 30 which is suitable for use in a display device according to the invention.

The colour selection electrode 30 comprises a coherent Venetian-blind structure which is integrated in a plate. Said Venetian-blind structure comprises walls 32 surrounding apertures 31. Adjoining apertures 31a and 31b have a common wall 32a. The walls form an angle with the plane of the colour-selection electrode.

The Venetian blinds form a coherent assembly. By virtue hereof, the mechanical rigidity is much larger than in the case of the colour-selection electrode 13 shown in section in Fig. 2.

A colour-selection electrode screens the electron beam from magnetic fields, for example the earth's magnetic field. The screening effect of a colour selection electrode which is suitable for a

display device according to the invention exceeds that of the known colour-selection electrode. In two directions, viz. the direction of movement of the electron beam and the direction transversely to the walls, the screening action of both types of colour-selection electrode is approximately equal. In the direction transversely to both the above-mentioned directions, the colour-selection electrode which is suitable for a colour display device according to the invention provides a better screening of the electron beam than the known colour-selection electrode.

Fig. 4 is a sectional view of a further example 40 of a colour selection electrode which is suitable for a display device according to the invention. For each of the apertures, two opposed walls 41 and 42 are provided with conducting layers 43 and 44, respectively, and an insulating layer 45. Said conducting layers can be connected to means for generating a potential difference between the conducting layers. As a result hereof, electron beams passing through the colour selection electrode can be deflected and, consequently, colour selection by the colour-selection electrode can be obtained in a simple manner. It is further possible to prevent secondarily emitted electrons from passing through the colour selection electrode by applying a potential difference between the layers 43 and 44. To this end, the layers 43 have to be at a negative potential relative to the layers 44.

Fig. 5a is a top view of a flat plate 50 from which a colour selection electrode suitable for a colour display device according to the invention can be manufactured by deformation. The flat plate has a staggered pattern 51 of grooves 52. The pattern may be provided in the flat plate by means of, for example, etching. The grooves may also be formed in the flat plate by means of cutting or in another way. By exerting forces F at the locations 53, the plate is stretched, the parts of the flat plate 50 which are located between the grooves are made to extend in a plane which differs from the plane of the plate and the grooves widen into apertures and form an integrated Venetian blind structure. By virtue of this deformation the yield point of the Venetian-blind structure increases. In a preferred embodiment of the method according to the invention, the contact points move towards each other in the stetching operation when the forces F are applied. Preferably, the number of contact points is equal to the number of rows of apertures. When the contact points cannot move towards each other in the stretching operation, a butterfly-like deformation of the plate takes place. The dimension of the plate transversely to the direction of stretching will decrease in the middle of the plate whereas it remains the same at the side faces of the plate.

Fig. 5b is a partly perspective elevational view of a colour selection electrode 54 which is formed from the flat plate 50. By means of hatching, two of the Venetian blinds, 55a and 55b, from which the integrated Venetian-blind structure can be considered to be constructed are shown in Fig. 5b.

Figs. 5c and 5d are top views of flat plates with further examples of staggered patterns of grooves.

Fig. 6 is a sectional view of a flat plate 60 which comprises a conducting plate 61 which is provided on one side with an insulating layer 62 on which a conducting layer 63 is deposited. Said flat plate comprises grooves 64. When such a plate is stretched, a conducting layer is present on either side of each aperture. The conducting layers can be connected to means for generating a potential difference between the conducting layers. The provision of the conducting layer 63 before the plate is stretched has the advantage, relative to a method in which the conducting layer 63 is applied after the plate has been stretched, that the risk of electric contact between layer 63 and plate 61 is reduced and that a stretched plate can be accommodated directly in the colour-display device. As a result hereof, the risk that the stretched plate is damaged is reduced.

Fig. 7 is a sectional view of a further example of a flat plate 65 which is composed in such a manner that said flat plate 65 comprises two conducting layers. The flat plate 65 comprises an insulating carrier 66 which is provided with conducting layers 67 and 68 on both sides.

Fig. 8 is a sectional view of an example of a display device 70 according to the invention. Display device 70 comprises an emission means 72 which is accommodated in a cathode ray tube 71 and by means of which a row of electron beams 74 is emitted in a deflection space 75 between deflection strips 76 and a colour-selection electrode 77. The colour selection electrode 77 is arranged in front of a display screen 78 on the inside of a display window 79. When in operation, voltages are applied to the deflection strips 76 in such a manner that, initially, after entering the deflection space 75 the electron beams 74 describe a straight path extending parallel to the deflection strips 76 and the colour selection electrode 77. The electron beams are deflected through an angle towards the colour-selection electrode by applying a high voltage to one or more deflection strips.

Figs. 9a and 9b diagrammatically show a device 80 for stretching a plate. Said device comprises pulling stretching elements 81 up to and including 84. Said elements are fixed to a plate 86. The elements pull wires 87 up to and including 90. By virtue of the use of wires, the locations where the elements are fixed to the plate 86 can move along with the deformation of the plate. In Fig. 9b a

further improvement has been made. The device 80 comprises means which ensure that the stretching force exerted by the wires on the plate during stretching exends at least substantially in the direction of stretching. In this example, the stretching device comprises pins 91 and 92 in which grooves 93, 94, 95 and 96 are formed. During stretching, the pins rotate in such a manner that the locations where the wires 87 and 88 leave the grooves are always at least substantially in line with the contact points of these wires on the plate 86. The same applies to the wires 89 and 90. Figs. 9c and 9d are sectional views of a plate 100 comprising grooves 101 and a stretching device having means for determining the direction in which the walls move during stretching. The stretching device is provided with brackets 104 and 105 which are arranged between the stretching elements with which forces F are exerted on the plate 100 and the contact points on the plate 100. During stretching, the slits 101 open in such a manner that the resulting apertures are oriented substantially along the surfaces 106 and 107 of the brackets 104 and 105.

It will be obvious that within the scope of the invention many variations are possible to those skilled in the art. For example, the display device according to the invention is not limited to the shape of the cathode-ray tube shown herein. The cathode-ray tube may be of the type shown in Fig. 1 as well as of the type shown in Fig. 8, or of any other type comprising a colour selection electrode having a Venetian-blind structure.

Claims

1. A display device comprising a cathode-ray tube which comprises in an evacuated envelope means for generating at least one electron beam, a display screen and a colour-selection electrode in which apertures are formed and which extends in front of the display screen, said colour-selection electrode having the structure of a Venetian-blind, characterized in that the Venetian-blind structure is integrated in a plate.

2. A display device as claimed in Claim 1, characterized in that the Venetian-blind structure is integrated in the plate by deformation.

3. A display device as claimed in Claim 1 or 2, characterized in that of each aperture at least two walls extending opposite each other are provided with a conducting layer, and the display device comprises means for generating a potential difference between said conducting layers.

4. A cathode-ray tube which is suitable for use in a display device as claimed in Claim 1, 2 or 3.

5. A method of manufacturing a colour-selection electrode, characterized in that the colour-selection electrode is manufactured from a flat plate having a staggered pattern of grooves which are separated from each other, said flat plate being stretched.

6. A method as claimed in Claim 5, characterized in that the flat plate is composed in such a manner that a conducting layer is present on both sides of said flat plate and that an insulating separating layer is arranged between said conducting layers.

7. A device for stretching a colour-selection electrode plate in which grooves are formed, said device comprising means for exerting a stretching force on at least four contact points which are arranged pairwise opposite each other and the distance between two contact points in a direction transversely to the direction of stretching is variable.

8. A device as claimed in Claim 7, characterized in that the device comprises means which ensure that, in operation, the stretching forces exerted on the plate extend at least substantially in the direction of stretching.

9. A device as claimed in Claim 7 or 8, characterized in that the device comprises means for determining the direction in which the grooves are opened in the stretching operation.

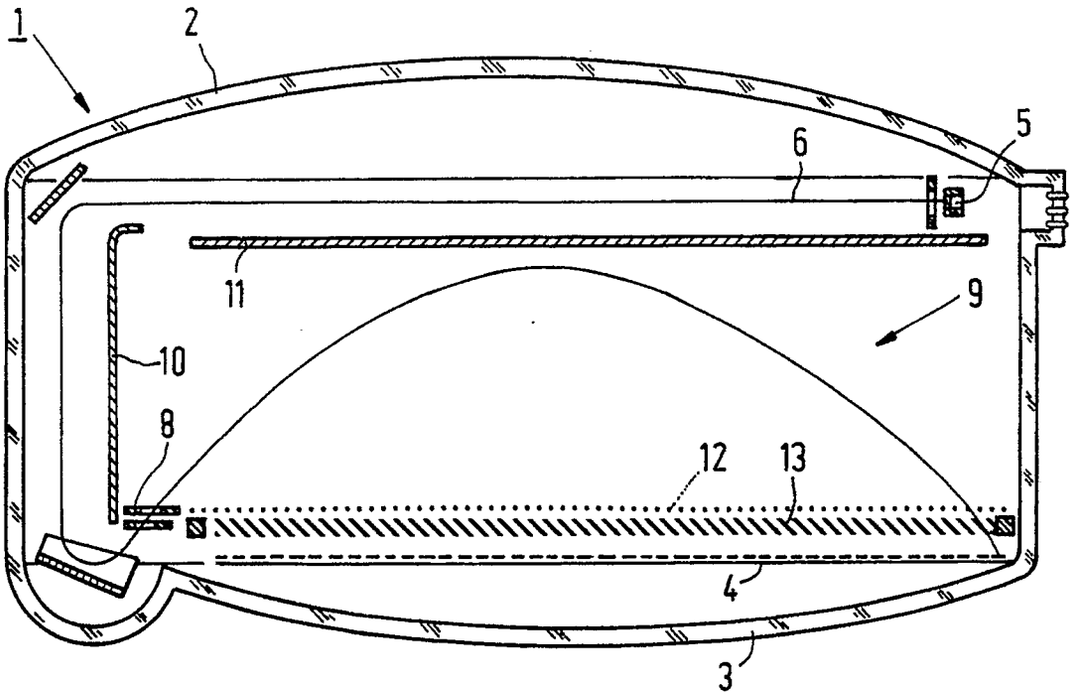

FIG. 1

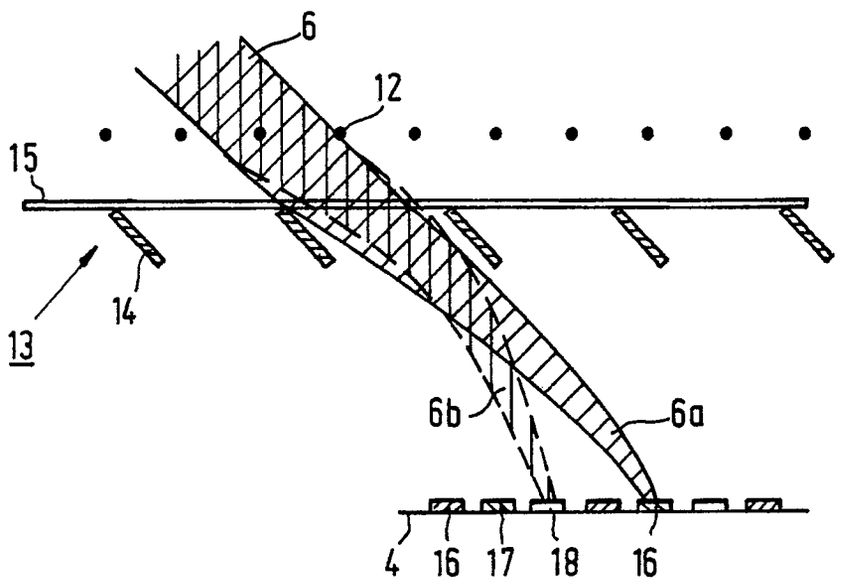

FIG. 2

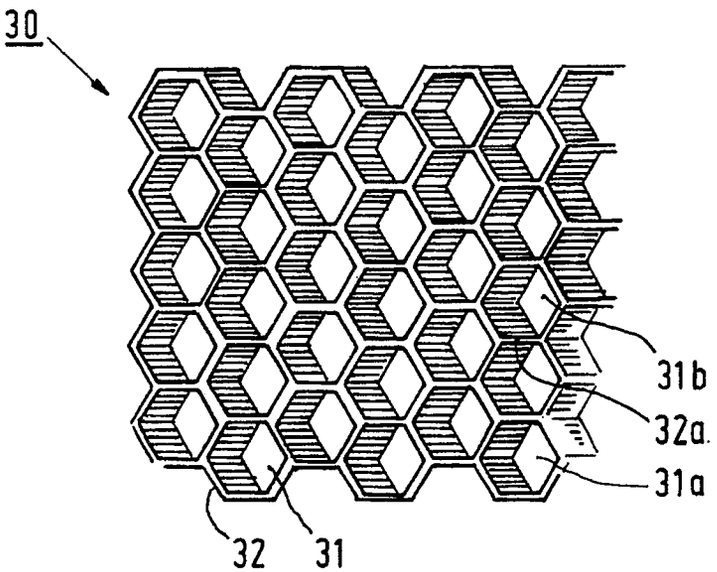

FIG.3

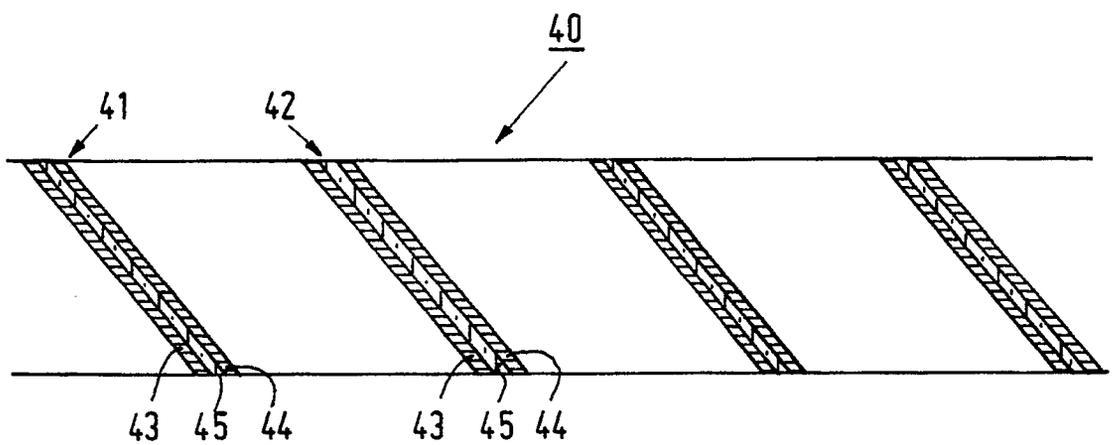

FIG.4

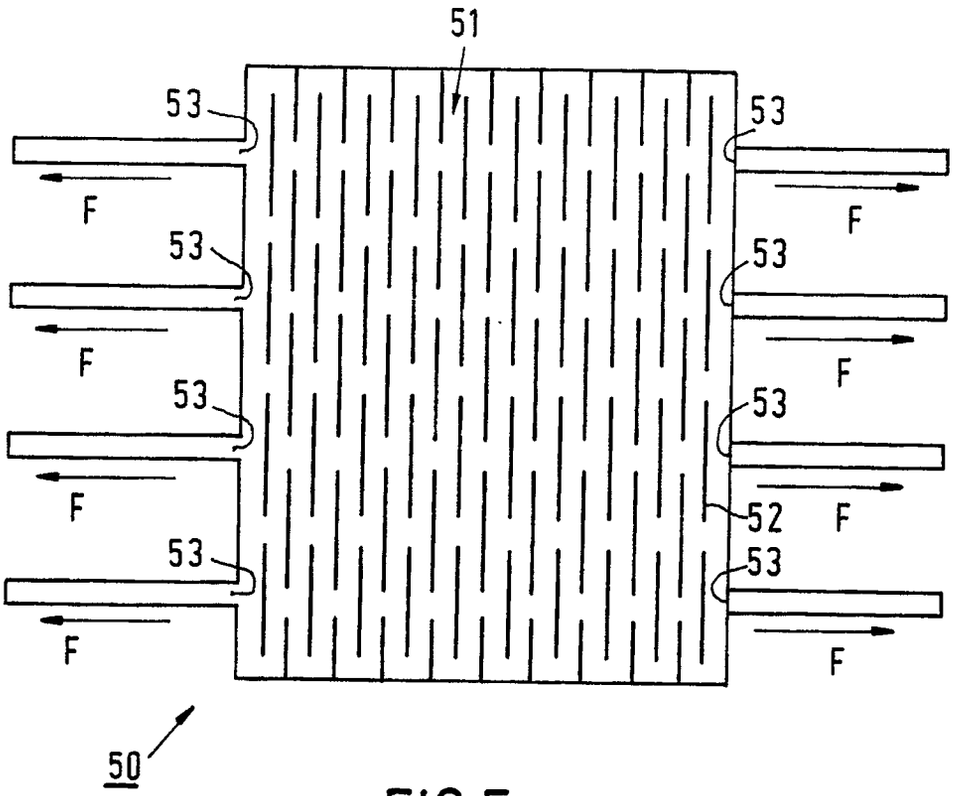

FIG.5a

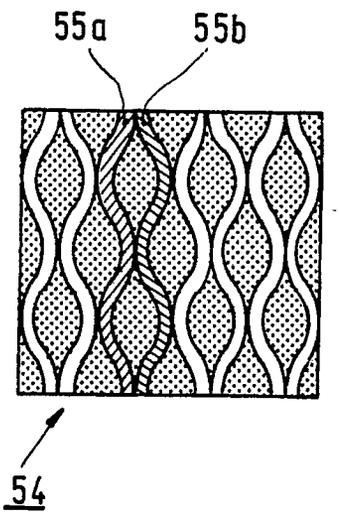

FIG.5b

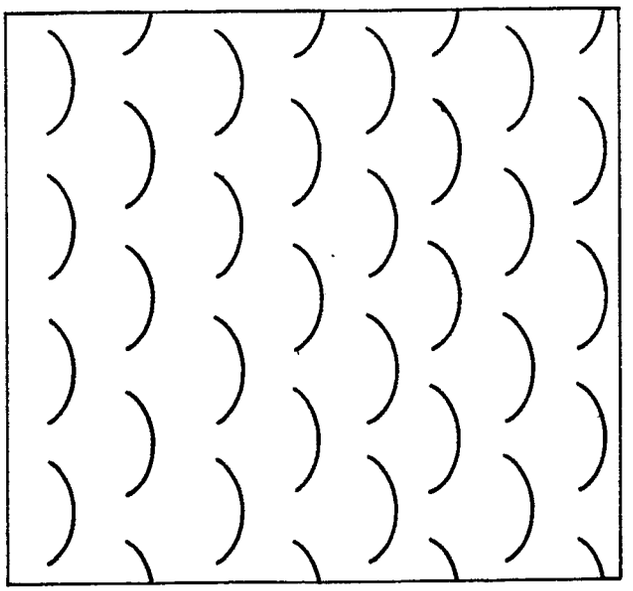

FIG. 5c

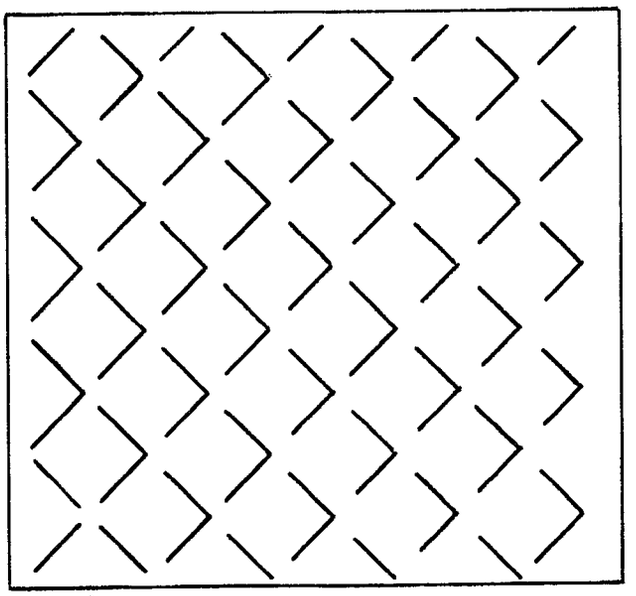

FIG. 5d

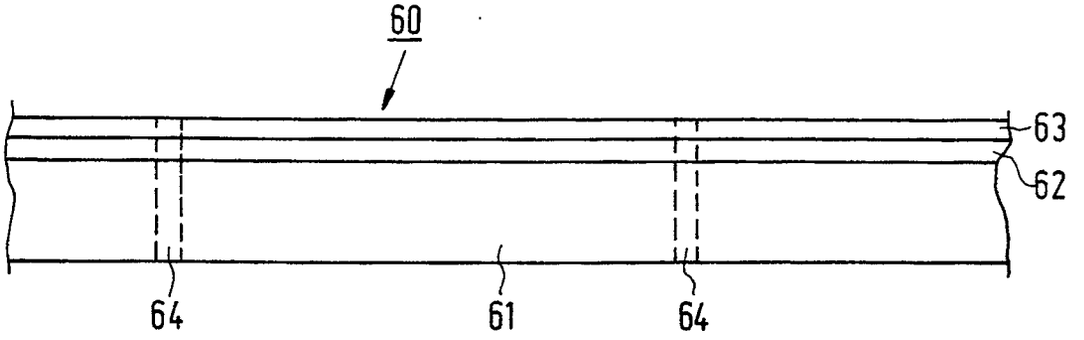

FIG.6

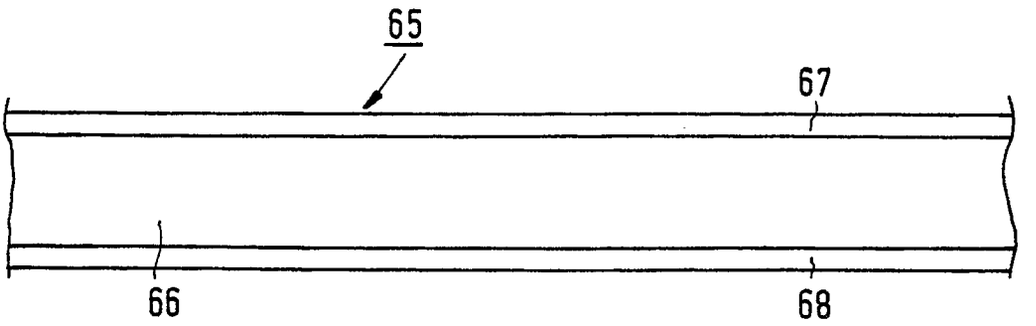

FIG.7

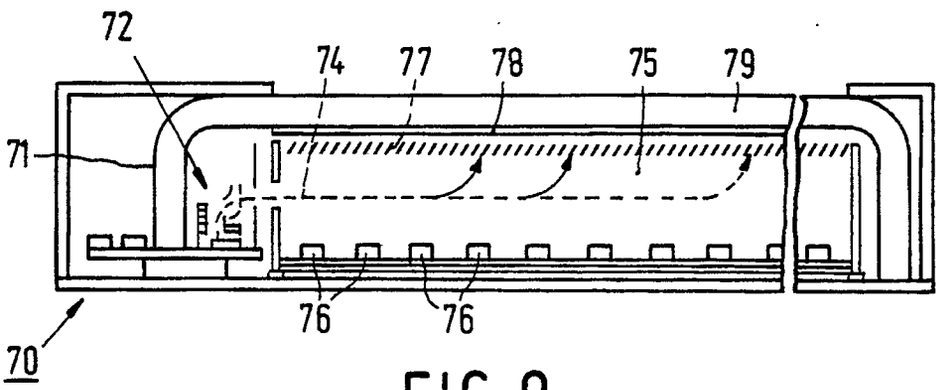

FIG.8

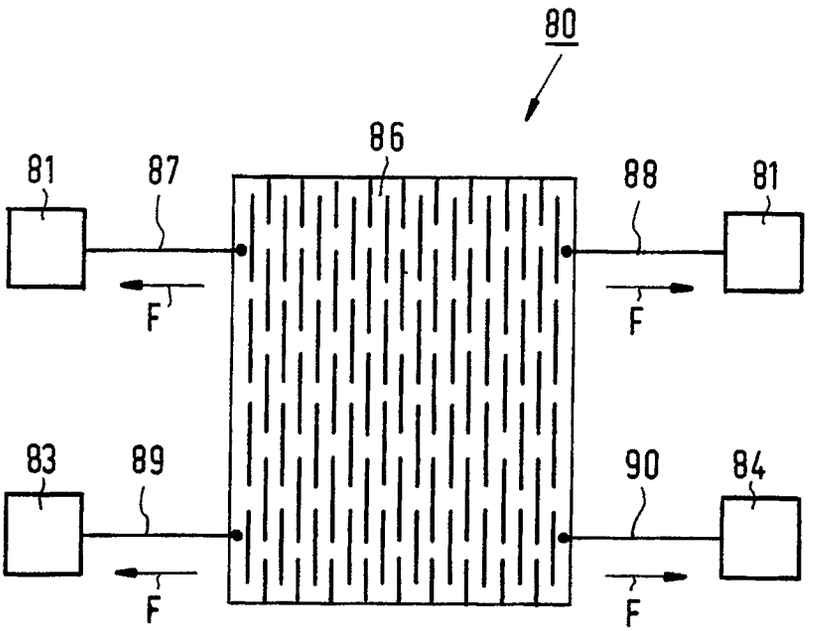

FIG.9a

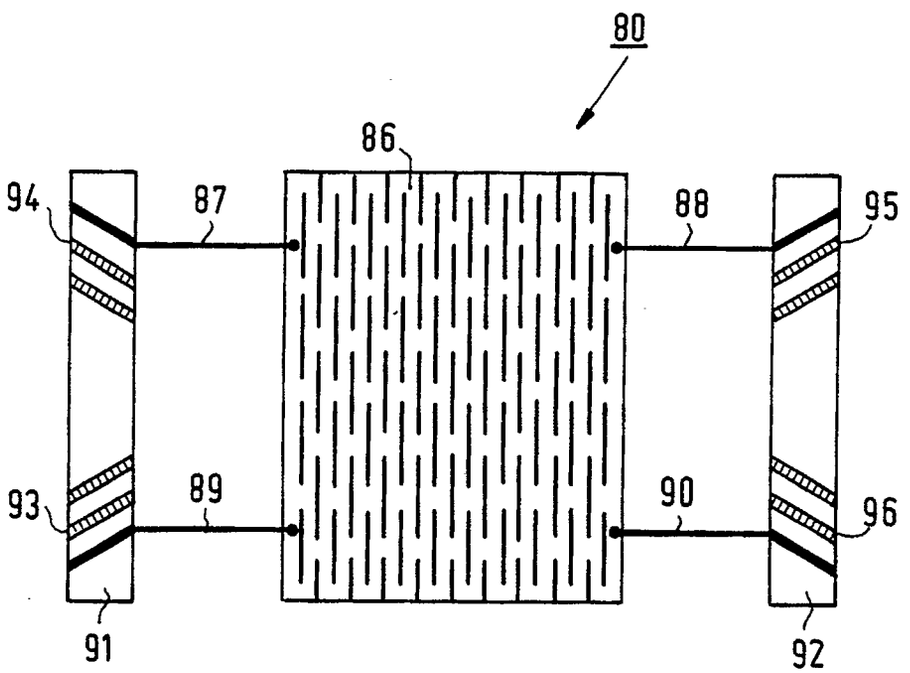

FIG.9b

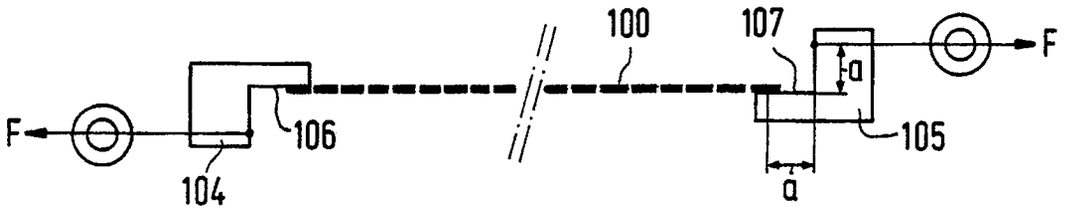

FIG.9c

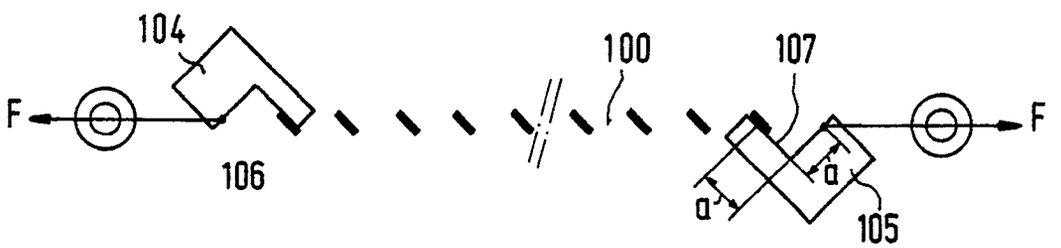

FIG.9d

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2909

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)
D,A	US-A-3 621 319 (HEYNISH) * Column 2, line 55 - column 3, line 8, column 3, lines 51-72; figures 1,2 *	1,5,7	H 01 J 29/80
A	EP-A-0 288 095 (PHILIPS) * Column 4, lines 40-46; figures 1-3 *	1,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 J 29/00
H 01 J 9/00
H 04 N 9/26

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	04 February 91	ROWLES K.E.G.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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