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(71) Applicant (for all designated States except US): **THOMSON LICENSING S.A.** [FR/FR]; 46 Quai A. Le Gallo, F-92100 Boulogne-Billancourt (FR).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **WILBUR, Leonard, Pratt, Jr.** [US/US]; 2360 Hancock Drive, Lancaster, PA 17601 (US).

(74) Agents: **TRIPOLI, Joseph, S.** et al.; 2 Independence Way, Suite #200, Princeton, New Jersey 08540 (US).

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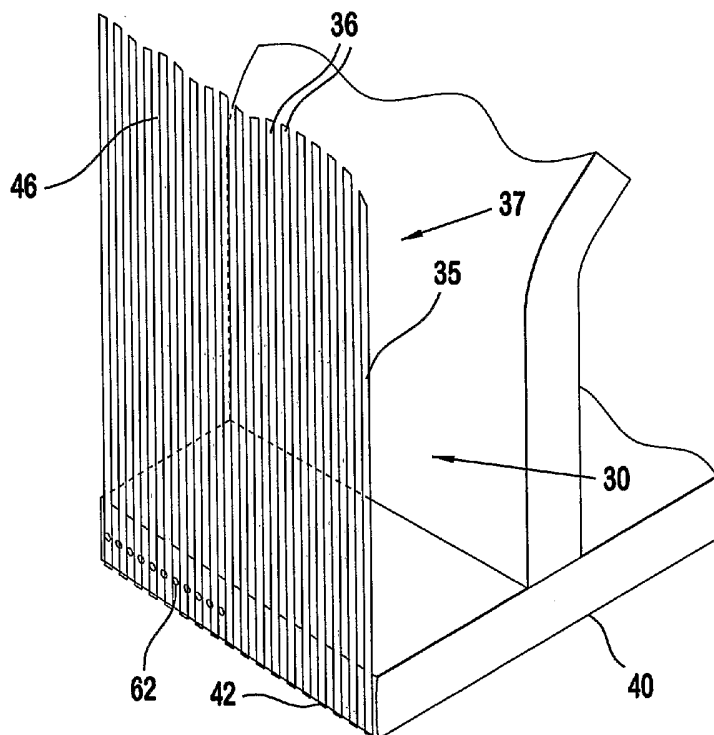
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(54) Title: CATHODE RAY TUBE HAVING A TENSION MASK ASSEMBLY AND METHOD OF MANUFACTURING THE SAME



(57) Abstract: The invention provides a cathode ray tube (1) having a tension mask assembly (10) and a method of manufacturing the same. The tension mask assembly includes a strand tension mask having non-edged border sections (33) and a plurality of strands (36) which are supported by a tension mask support frame (20). The tension mask support frame includes two opposing support blade members (40) having curved edges to which the strands of the mask are secured. The method comprises supporting the strands by the unetched sections of the mask over the support blade members and applying a tensile force to the strands to maintain uniform alignment of the strands. The strands are then secured to the curved edges of the support blade members by relieving the tensile force and welding.

CATHODE RAY TUBE HAVING A TENSION MASK ASSEMBLY AND METHOD OF
MANUFACTURING THE SAME

Field of the Invention

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The present invention relates to a cathode ray tube having tension mask frame assembly and a method of manufacturing a tension mask frame assembly and, more particularly, to a tension mask frame having a pair of opposed cantilever frame members having curved attachment surfaces .

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Background of the Invention

A conventional shadow mask type color cathode ray tube generally comprises an electron gun for forming and directing three electron beams to a screen of the tube. The screen is located on the inner surface of the faceplate of the tube and is made up of an array of elements of three different color-emitting phosphors. In manufacturing the tube, a shadow mask, which is positioned within the tube and near the faceplate, is used in printing the screen array and defining the array borders. During tube operation, the shadow mask is precisely interposed between the gun and the screen to replicate the source positions during the screening process. The shadow mask effectively acts as a parallax barrier that shadows the screen and permits the transmitted portions of the electron beams to excite phosphor elements of the respective emissive color on the cathode ray tube screen.

In conventional tubes, the shadow mask is a domed thin sheet of metal capable of self-maintaining its configuration with the inner surface of the tube faceplate and is supported by a mask frame. Another group of masks commonly used in tubes is tension masks. Some tension masks are designed having tiebars and others have strands. Strand tension masks comprise a plurality of thin parallel strands that are stretched and welded to a rigid mask frame. The stretching of the strands provides the predetermined tension in the vertical dimension which is required to ensure that the apertures formed between the strands remain in alignment with the phosphor elements on the screen.

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Two different forms of attaching the strands to a frame can be found in conventional tubes. One form includes a border surrounding the central apertures of the mask which is welded to the frame. The solid border of the mask serves as an optical edge for forming the

black surround of the matrix which in turn defines the borders of the screen array of the tube screen. A secondary purpose of the solid mask border is to provide an electron shield at the edge of the active scan region so as to reduce undesirable electron scattering during vertical overscan. It has also been found desirable to make the tension mask and the mask frame from
5 different materials to reduce the required mask tension and weight of the mask-frame assembly. In commercial tension mask tubes, solid borders of the mask are welded to the mask frame. The consequence of having a solid border of the mask welded to a frame when the mask and the frame have different thermal expansion coefficients is that deformation of the solid borders can occur along the mask-to-frame weld points during thermal processing of
10 the tube, thereby permanently deforming the active portion of the mask. Such deformation has led the way to the second way of attaching strands to a frame, which is to individually attach mask strands (or other etch portions) to the mask frame. For example, efforts have been made to attach strands directly to support blade members of the mask frame. Unfortunately, individual attachment of mask strands has also been problematic because the strands tend to
15 break during the attachment process. Strand breakage is believed to be caused by heat concentration along the mask-to-frame weld points along the edges of support blade members. During the welding process, the strands may be overheated while in tension causing them to melt and break away from the support blade member edges. Therefore, an improved process is required for individual attachment of mask strands to a mask frame without deformation or
20 breakage.

Summary of the Invention

The invention provides a cathode ray tube having a tension mask assembly and a
25 method of manufacturing the same. The tension mask assembly includes a strand tension mask having non-edged border sections and a support frame including two opposing support blade members having curved edges to which the strands of the mask are secured. The method comprises supporting the strands by the unetched border sections of the mask over the
over the support blade members and applying a tensile force to the strands to maintain
30 uniform alignment of the strands relative to each other with minimum tension load on the strands. The strands are then secured to the curved edges of the support blade members by relieving the tensile force and heating.

Brief Description of the Drawings

The invention will now be described by way of example with reference to the accompanying figures of which:

5 Figure 1 is a cross sectional view of a CRT according to the present invention.

Figure 2 is a perspective view of a tension mask and frame assembly according to the present invention.

Figure 3 is an exploded perspective view of an edge area of the tension mask assembly as shown in Figure 2.

10 Figure 4 is a front planar view of the tension mask used in the assembly of Figure 2.

Figure 5 shows a schematic view of the pneumatic jig wherein the tension mask strands are under pressure.

Figure 6 shows the pneumatic jig similar to Figure 5 wherein pressure on the strands has been reduced to a desirable level.

15 Figure 7 shows the circular welding apparatus making a pass over an edge of the support blade member.

Figure 8 is a side view of a support blade member in the frame assembly of Figure 2.

Figure 9 is a cross sectional view of the support blade member and tension mask of Figure 3.

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Detailed Description of the Invention

Figure 1 shows a cathode ray tube (CRT) 1 having a glass envelope 2 comprising a rectangular faceplate panel 3 and a tubular neck 4 connected by a funnel 5. The funnel 5 has
25 an internal conductive coating (not shown) that extends from an anode button 6 toward the faceplate panel 3 and to the neck 4. The faceplate panel 3 comprises a viewing faceplate 8 and a peripheral flange or sidewall 9, which is sealed to the funnel 5 by a glass frit 7. A three-color phosphor screen 12 is carried by the inner surface of the faceplate panel 3. The screen
30 12 is a line screen with the phosphor lines arranged in triads, each of the triads including a phosphor line of each of the three colors. A tension mask support frame assembly 10 is removably mounted in predetermined spaced relation to the screen 12. An electron gun 13, shown schematically by dashed lines in Figure 1, is centrally mounted within the neck 4 to

generate and direct three inline electron beams, a center beam and two side or outer beams, along convergent paths through the tension mask frame assembly 10 to the screen 12.

The CRT 1 is designed to be used with an external magnetic deflection yoke 14 shown in the neighborhood of the funnel-to-neck junction. When activated, the yoke 14 subjects the three beams to magnetic fields which cause the beams to scan horizontally and vertically in a rectangular raster over the screen 12.

The tension mask support frame assembly 10, as shown in Figure 2, has a frame 20 which includes two long sides 22 and 24, and two short sides 26 and 28. The two long sides 22, 24 of the tension mask support frame assembly 10 are parallel to a central major axis, X, of the tube; and the two short sides 26, 28 are parallel to a central minor axis, Y, of the tube. The sides 22, 24, 26, 28 are preferably formed of rectangular tubular material. It should be understood however that other geometry tubular materials or other solid materials could be utilized to form these sides. The two long sides 22, 24 and two short sides 26, 28 preferably form a continuous mask support frame 20 and lie in a common plane generally parallel to a tension mask 30. A pair of support blade members 40 are mounted on the two long sides 22, 24. The tension mask support frame assembly 10 further includes a tension mask 30 supported by edges 42 of each support blade member 40 as will be described below.

Referring now to Figures 3 and 4, an exploded section of the tension mask 30 and frame assembly 10 are shown. As shown in Figure 4, the tension mask 30 is formed from a thin sheet of metal such as steel which is etched or otherwise processed to produce a plurality of strands 36 between unetched sections 33. As shown in Figure 3, the strands 36 extend between and are attached to the support blade members 40 parallel to the minor axis Y. It should be understood, however, that although the strands 36 are shown here extending parallel to the minor axis Y, designs are conceivable in which the strands 36 extend parallel to the major axis X and the support blade members 40 are located parallel to the minor axis Y. An optional border (not shown) may also be attached over the strand and the support blade member interface to create an optical edge or to provide additional mechanical support.

Referring now to Figures 8 and 9, the support blade members 40 and interface with the tension mask 30 will be described in greater detail. As best shown in the exploded side view of Figure 8, the support blade member 40 can have a curved edge 42. The curved edge 42 is formed to have a radius α such that it has a high point 43 located between a pair of low points 44. The radius is created to provide a smooth edge surface onto which the strands 36 may be welded as best shown in Figure 9. Here, a single strand 36 is shown extending over the curved

edge 42 of the support blade member 40. The strand 36 is attached to the high point 43 by a weld 62 leaving small spaces between the low points 44 and the strand 36. The optional border may also be attached over the strands 36 at the weld 62.

Referring now to Figures 5-7, a process will now be described in detail for applying
5 strands 36 to the support blade members 40 at the curved edge 42. It should be understood that while these figures and description will be directed to a single curved edge 42, the same process is simultaneously applied to the opposite curved edge 42 shown in Figure 2. First, the curved edge 42 is rounded and smoothed to remove sharp edges as shown in Figure 8. The curved edge 42 may be rounded with a slight radius α , for example a radius of 0.375 inch and
10 then smoothened. The rounding and smoothing operation is performed to remove any sharp edges from the support blade member 40 which may contribute to breaking the strands during the welding process. Sharp edges are undesirable because they act as a cutting surface along the strands 36 as the strands 36 soften during the welding process. The support blade members 40 are placed in tension by applying an inward force on each support blade member 40 near
15 the curved edge 42 using known techniques. Next, the plurality of strands 36 are laid over the support blade member 40 such that they extend beyond respective edges 42. The tension mask 30 is held in place by a pneumatic jig 50 holding the unetched sections 33 as shown in Figure 5. The strands 36 are held taut by the jig 50 in order to maintain the strands properly positioned in uniform alignment relative to each other. The pneumatic jig 50 has at least one
20 pneumatic cylinder 52, a shaft 54 extending from the pneumatic cylinder 52 and an attachment arm 56 which is driven by the shaft 54. Pressure is applied to the pneumatic cylinder 52 as shown by the indicator 51 such that the pneumatic jig 50 applies a tension on the strands 36 along their length which is parallel to the minor axis Y in this example. The pneumatic jig 50 operates to keep the strands 36 taut by applying a small tensile force which
25 is sufficient to maintain alignment but prevent the strands 36 from breaking during the subsequent welding steps.

After application of tension through the pneumatic jig 50 to ensure proper placement and spacing of the strands 36 over the curved edges 42, pressure is released from the pneumatic cylinder 52 as shown by the indicator 51 of Figure 6 to reduce the tension on the
30 strands 36 to a desirable level. Frictional forces or drag in the pneumatic cylinder 52 maintain the strands 36 in position while not applying excessive tensile forces which may cause the strands 36 to break during the subsequent welding step which will now be described.

Next, as shown in Figure 7, a welding apparatus 60 such as a welding wheel is rolled or otherwise moved along the edge 42 in a first pass over the strands 36 in order to spot weld or otherwise attach each strand 36 to the curved edge 42. The welding apparatus 60 applies intermittent current in pulses shown schematically by the gauge 64 to form welds 62 at
5 desired locations along the strands 36. The current on/off pulse frequency is determined such that it is statistically very probable to form at least one spot weld on each strand 36 as the welding apparatus 60 rolls over the edge 42. Upon completion of the first pass, a second pass may be made with the welding apparatus 60 in the reverse direction to ensure that each strand 36 is properly attached the curved edge 42. The optional border may then be applied over the
10 welded strands 36 and edge 42 to protect the strand edges. Tension on the support blade members 40 is then removed to place the attached tension mask 30 in tension. Upon completion of the process, the edges of the strands 36 may be trimmed to be flush with the curved edge 42. In alternative embodiments, multiple passes with the welding apparatus 60 may be applied. The first pass of the welding apparatus may include reduced current pulses at,
15 for example, forty percent of full current with subsequent passes having increased current to form the welds. Current and pulse rate may be adjusted in each pass to reduce heating or increase heating of the strands to desired levels for each pass so as to prevent strand breakage during the welding process and during subsequent tube processing operations.

An advantage of the process described here is that strands 36 can be accurately
20 positioned along the edges 42 and reliably attached directly to the curved edges 42 without breaking during the process.

What is Claimed is:

1. A process for forming a CRT having a tension mask assembly comprising a tension mask formed of a plurality of strands located between unetched sections, the strands being supported by a tension mask support frame, the process comprising the steps of:

smoothing an edge of a support blade member on the tension mask support frame;

positioning the strands over the edge wherein the strands are held taut by the unetched sections;

applying a tensile force to the strands to properly locate the strands in a desired spacing;

relieving the tensile force; and,

moving a welding apparatus across the edge over the positioned strands while applying current pulses to the apparatus.

2. The process of claim 1 wherein the tensile force is applied by at least one pneumatic cylinder.

3. The process of claim 2 wherein the tensile force is relieved by removing pressure from the pneumatic cylinder.

4. The process of claim 1 wherein a current pulse rate applied to the welding apparatus to ensure that at least one weld is applied to each strand.

5. The process of claim 1 further comprising the step of moving the welding apparatus across the edge over the positioned strands while applying current pulses to the apparatus a second time to ensure that each strand receives at least one weld.

5 6. The process of claim 1 further comprising applying a tensile force to the support blade member before positioning the strands over the edge.

7. A process for welding strands of a tension mask directly to an edge of a support blade member comprising the steps of:

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positioning the strands over the edge;

applying a tensile force to the strands to properly locate the strands in a desired spacing;

15

relieving the tensile force; and,

rolling a welding apparatus across the edge over the positioned strands while applying current pulses to the wheel.

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8. The process of claim 7 further comprising the step of smoothing the edge before positioning the strands over the edge.

9. The process of claim 7 wherein the tensile force is applied by at least one pneumatic cylinder.

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10. The process of claim 9 wherein the tensile force is relieved by removing pressure from the pneumatic cylinder.

11. The process of claim 10 wherein a current pulse rate applied to the welding apparatus which ensures that at least one weld is applied to each strand.

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12. The process of claim 11 further comprising the step of rolling the welding apparatus across the edge over the positioned strands while applying current pulses to the wheel a second time to ensure that each strand receives at least one weld.

13. The process of claim 7 further comprising applying a tensile force to the support blade member before positioning the strands over the edge.

5 14. A cathode ray tube having a tension mask frame assembly which supports a tension mask formed of a plurality of strands extending between un-etched borders of the tension mask, the tension mask assembly comprising:

two pair of opposing sides connected to form a rectangular frame;

10 a pair of support blade members attached to one of the pairs of opposing sides, the support blade members each having a curved edge for receiving strands of the tension mask; and,

15 an attachment section located along the curved edge where the strands are attached.

15. The cathode ray tube of claim 14 wherein the curved edge is profiled to have a high point located between a pair of low points.

20 16. The cathode ray tube of claim 15 wherein the attachment section is located on the high point along the curved edge.

17. The cathode ray tube of claim 16 wherein the strands are each attached by a weld.

25 18. The cathode ray tube of claim 16 wherein a small space is formed between each strand and the low point.

AMENDED CLAIMS

[received by the International Bureau on 15 May 2005 (15.05.05)

original claim 14 has been amended.

Original claims 1-13 and 15-18 are unchanged (1 page)]

13. The process of claim 7 further comprising applying a tensile force to the support blade member before positioning the strands over the edge.

14. A cathode ray tube having a tension mask frame assembly which supports a tension mask formed of a plurality of strands, the tension mask assembly comprising:

two pair of opposing sides connected to form a rectangular frame;

a pair of support blade members attached to one of the pairs of opposing sides, the support blade members each having a curved edge for receiving strands of the tension mask; and,

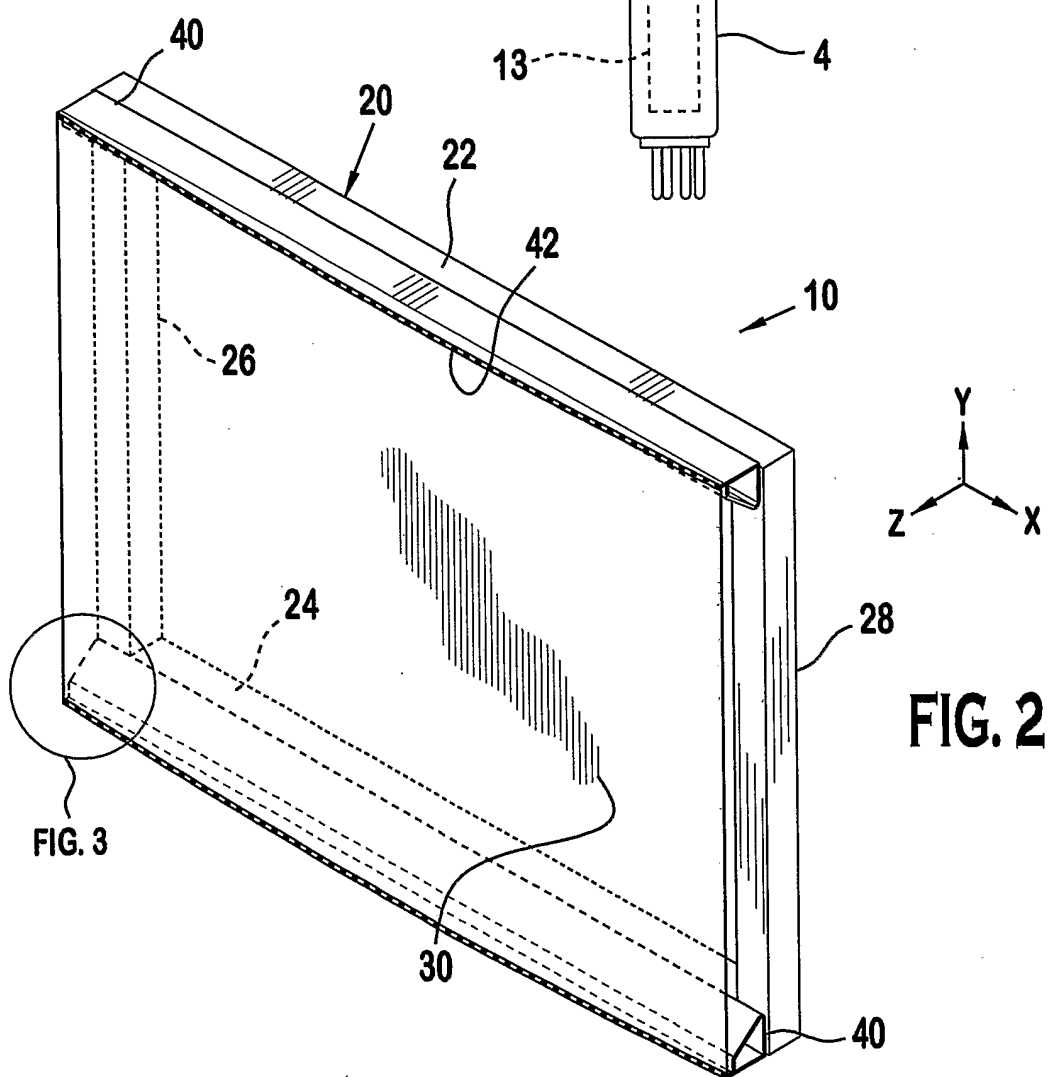
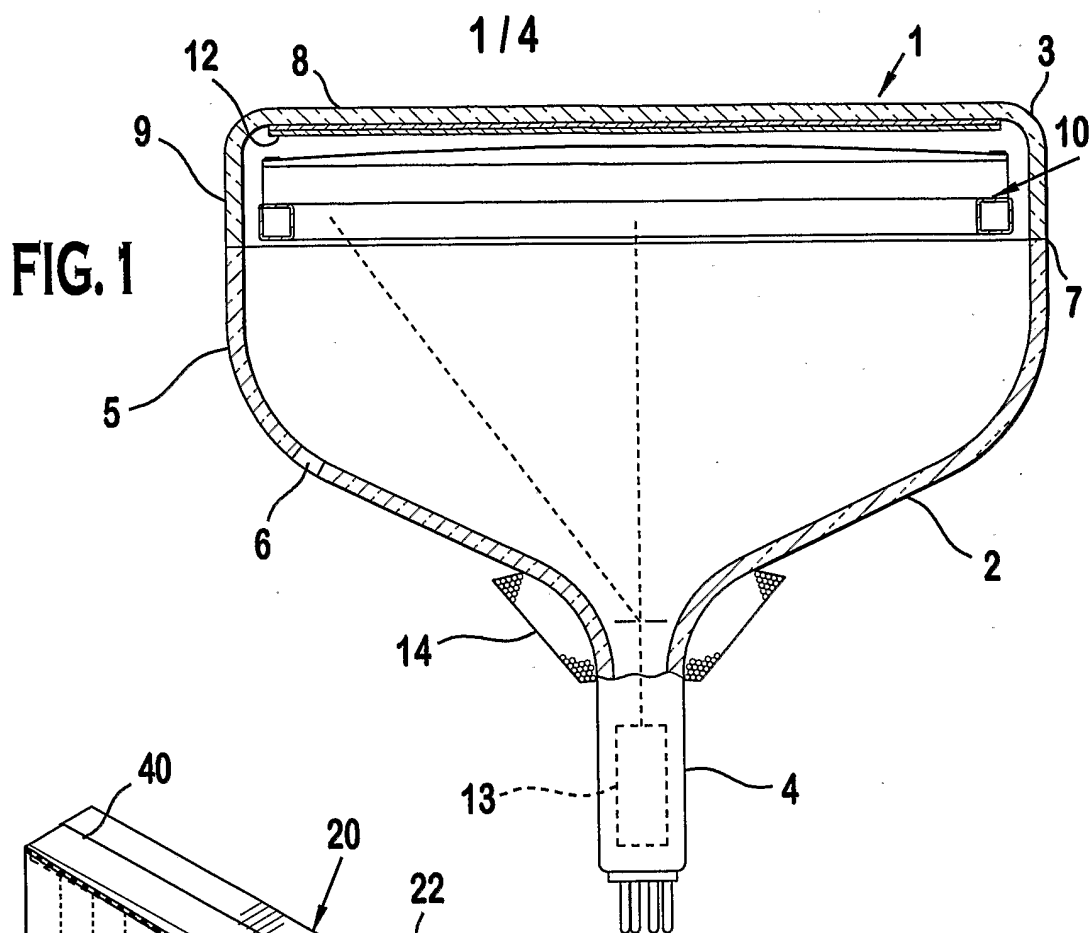
an attachment section located along the curved edge where the strands are attached.

15. The cathode ray tube of claim 14 wherein the curved edge is profiled to have a high point located between a pair of low points.

16. The cathode ray tube of claim 15 wherein the attachment section is located on the high point along the curved edge.

17. The cathode ray tube of claim 16 wherein the strands are each attached by a weld.

18. The cathode ray tube of claim 16 wherein a small space is formed between each strand and the low point.



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FIG. 3

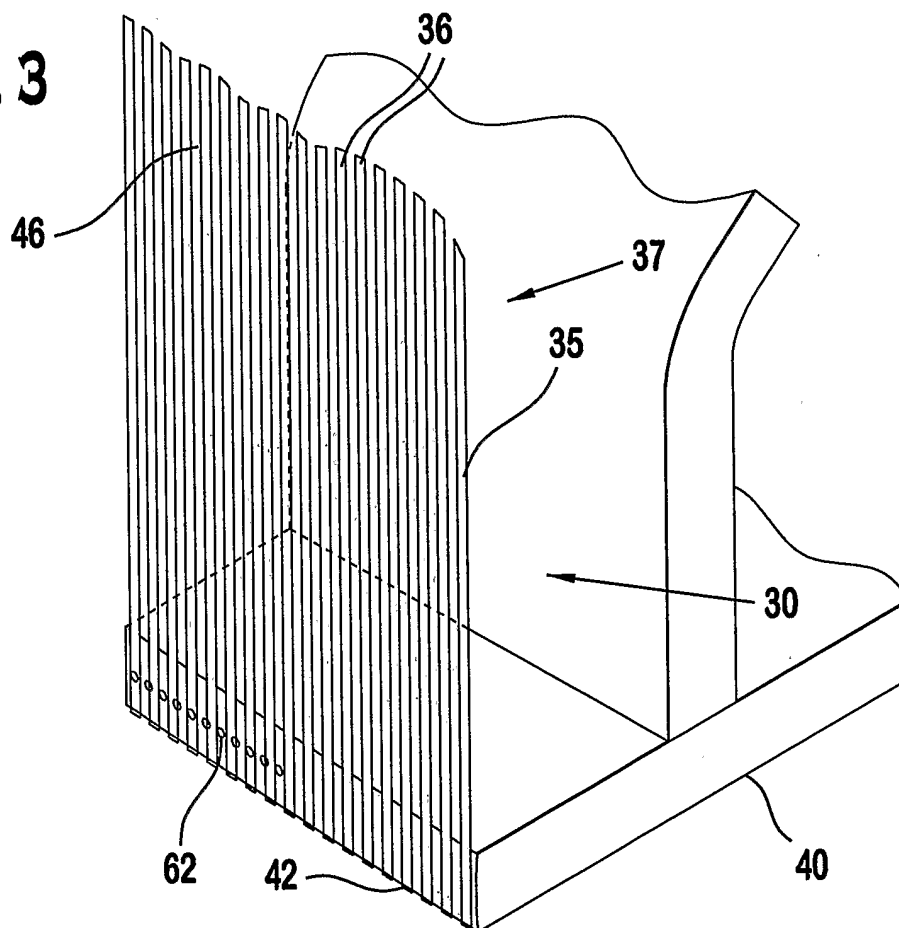


FIG. 8

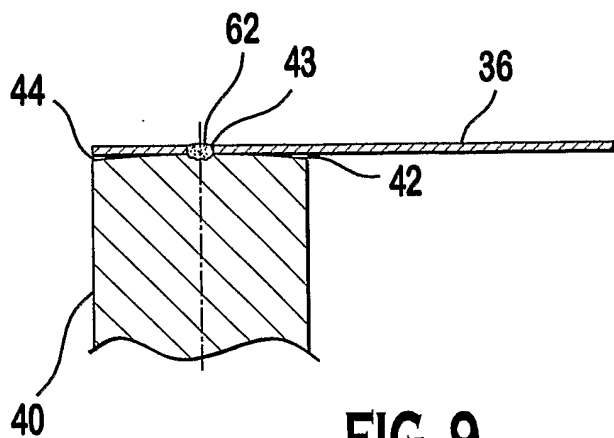
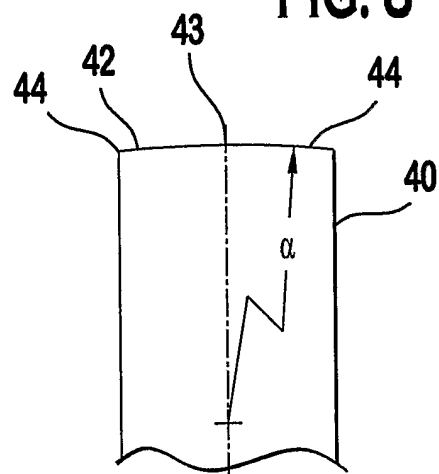


FIG. 9

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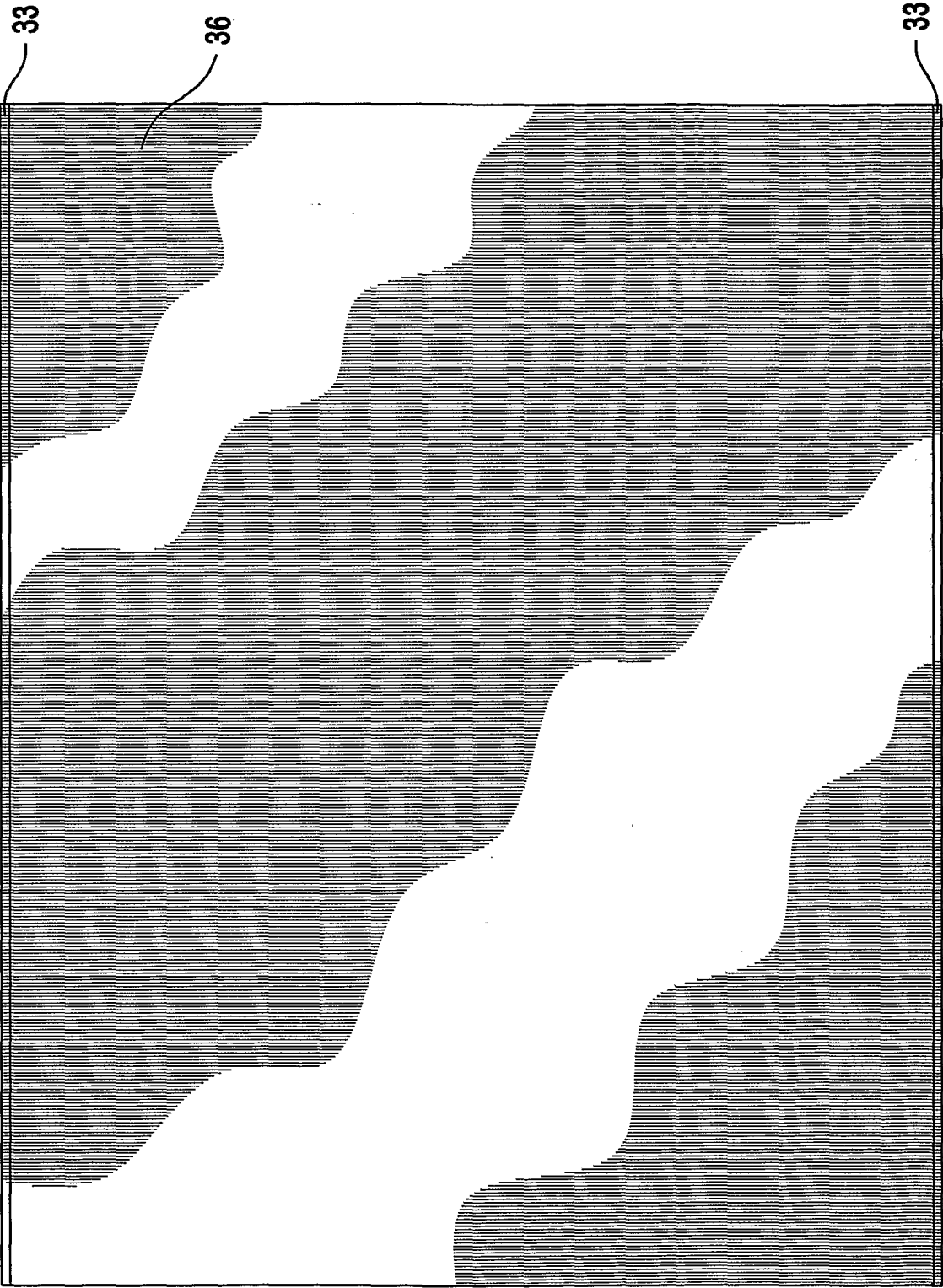
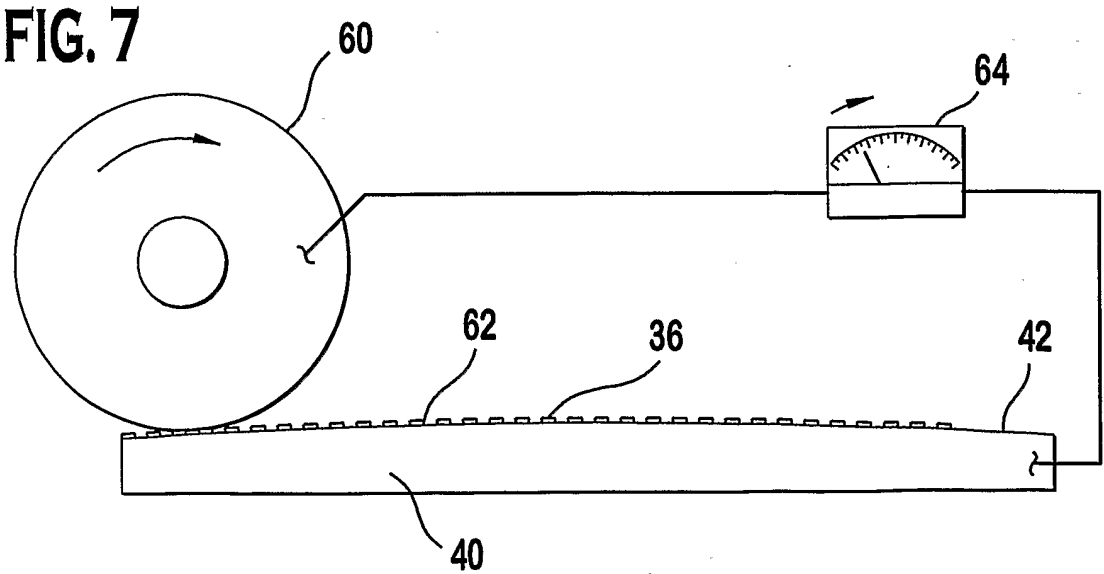
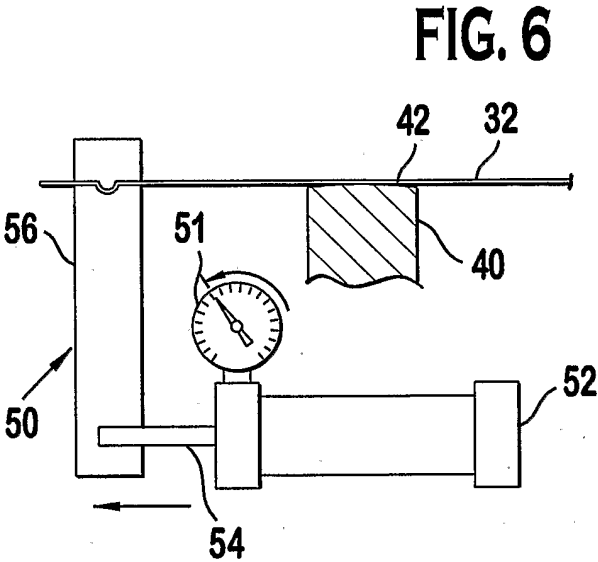
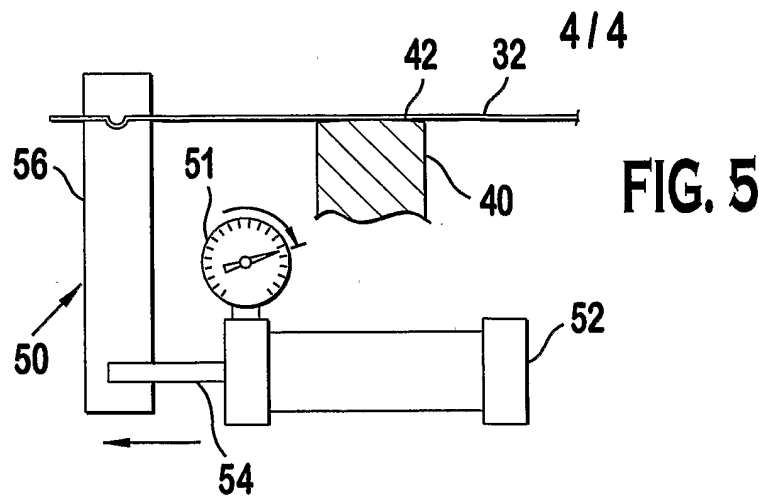


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/034868

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J9/14 H01J29/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 594 300 A (NOSKER ET AL) 14 January 1997 (1997-01-14) column 3, lines 15-29; figures 6,8 column 2, lines 58-61 -----	1-18
X	US 5 952 774 A (DIVEN ET AL) 14 September 1999 (1999-09-14) column 3, lines 9-14; figures 3,4 -----	1-18
X	EP 1 306 875 A (THOMSON LICENSING S.A) 2 May 2003 (2003-05-02) paragraphs '0006!, '0012!, '0013!, '0015!; figures 2-4 ----- -/--	1-18

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

21 April 2005

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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Weisser, W

INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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