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(54) Air foil wing extension for an air turn.

(57) Air turn for supporting and optionally drying a web, comprising an arcuate surface and two opposed, circumferentially spaced, transversely arranged air supply nozzle slots which supply pressurized air to the space between the web and the arcuate surface of the air turn. Air foil wing extensions are provided along the leading and/or trailing longitudinal edges of the air turn to reduce web flutter. Each wing extension includes a flat, non-perforated section and an angled perforated section.

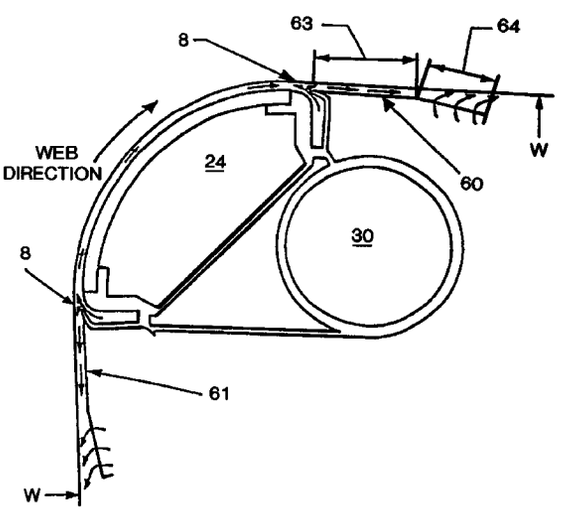

FIG. 4

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FIELD OF THE INVENTION

The present invention relates to devices for contactlessly drying and guiding traveling webs, and more particularly, an improved air flotation turning device which minimizes or eliminates web flutter and/or wrinkling.

BACKGROUND OF THE INVENTION

In web printing and drying operations, it is often desirable that the web be contactlessly supported in order to avoid damage to the web itself or to the coating (such as ink) previously applied to one or more surfaces of the web. One conventional arrangement for contactlessly supporting a web includes horizontal upper and lower sets of air bars between which the web travels. Hot air issuing from the air bars both dries and supports the web. Occasionally it becomes necessary to change the direction of web travel while maintaining the contactless environment. This can be accomplished using air turns, which are devices that support a flexible web on a cushion of air pressure as the web travels around a curved path. Air turns have a generally partially cylindrical surface through which pressurized air is introduced through various slots, holes or apertures, or other designs or patterns. Typical air turns which are commercially available are a 95° turn, which carries the web around a 95° arc, and a 20° "shallow wrap" turn, which carries the web around an arc of 20°.

Such air turns replaced grater rollers. Grater rollers were a means to turn the web utilizing frictional contact with the web. As a result, web marking problems often arose. Although the use of air turns eliminated marking problems, the absence of the additional frictional restraint provided by the rollers led to web tracking problems, especially in the case of "baggy" or non-uniform webs. To compensate for tracking problems, the air turn was used as a steering device. By tilting one edge of the air turn in a direction perpendicular to and toward the web, a force was provided tending to push the web away from that side. Conversely, if that end of the air turn were moved away from the web, the resulting air pressure forces pulled the web toward that end. Optical sensors are used to monitor web drift and send a signal to the steering drive motor controlling the position of the air turn. The drive motor moved the operator end of the air turn. Alternatively or additionally, the air turn could be tilted manually.

One example of an air turn is that disclosed in U.S. Patent No. 4,182,472 (the disclosure of which is herein incorporated by reference). Specifically, a guide for contactless support of a running web as the latter changes directions is provided. The guide is formed as a drum-like member having an arcuately curved surface which can be variable as to the length of its arc, depending on the degree of turn or change of direction desired for the running web. A series of parallel grooves extending in the direction of web travel are formed in the arcuate surface of the drum-like member. An air nozzle extends along the length of the drum-like member and at each end of the groves, and pressurized air is fed through the nozzles so as to form a pneumatic cushion between the web and the arcuate surface and thereby float the web. The grooves in the arcuate surface act as labyrinth seals in inhibiting the transverse air flow out of the cushion and towards the edges of the running web.

A further example of an air turn is provided in U.S. Patent No. 2,689,196, wherein a series of holes are formed in the cylindrical surface for the passage of pressurized air therethrough to support and guide a web passing over the drum. Similarly, U.S. Patent No. 3,097,971 discloses a device having a series of slits in the curved supporting surface and which extend longitudinally and/or transversely to the web. Air under pressure is passed through these slits to form a cushion between the drum and the web.

An important aspect of any flotation system is the stability of the web as it passes over the air bar. Airflow instabilities near the web can induce web flutter and subsequent web contact with mechanical parts of the drier, resulting in coating or web damage. Web flutter can be manifested in a multitude of forms, ranging from a violent flapping of the web to a high frequency drumming.

Excessive web flutter has been encountered in conventional air turn applications. Where a plurality of air turns are used together so that the web follows a sinusoidal path, web flutter has been encountered as the web leaves the lower air turn and before it reaches the upper air turn.

It is therefore an object of the present invention to minimize or eliminate web flutter at the exit and/or entry point of an air turn.

It is a further object of the present invention to reduce or eliminate excessive air turbulence at the exit and/or entry point of an air turn.

It is a still further object of the present invention to reduce or eliminate web wrinkle formation at the exit and/or entry point of an air turn.

SUMMARY OF THE INVENTION

The problems of the prior art have been overcome by the present invention, which is characterised by the features of claim 1.

Such an air turn is suitable for supporting and optionally drying a web. The air supply nozzle slots, which are preferably opposed, circumferentially spaced, and transversely arranged, supply pressurized air to the space between the web and the arcuate surface of the air turn. The air foil wing extensions provided along the leading and/or trailing long-

itudinal edges of the air turn serve to reduce web flutter.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a conventional air turn which can be used in accordance with the present invention;

Figure 2 is a cross-sectional view of a conventional air turn which can be used in accordance with the present invention;

Figure 3 is an isometric view of an air turn having air foil wing extensions in accordance with the present invention;

Figure 4 is a cross-sectional view of an air turn having air foil wing extensions showing the theoretical air flow pattern;

Figure 5 is a top view of an air foil wing in accordance with the present invention; and

Figure 6 is a side view of the air foil wing of Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

The web support provided by the present invention can support a moving web through various degrees of turning movement, but the present invention has been illustrated in Figure 1 as showing a web support for an approximate 90° turn, wherein the web W passes over, and without contact with,the support S. It should be understood that the following detailed description of the web support is for purposes of illustration and should not be construed as limiting of the present invention. The support S includes a member 1 formed generally with a 90° arcuate surface 2 which extends across the width of the web W to be supported,and preferably beyond the edges of the web. Shaft means SM are provided at each side of the support so that the device can be suitably mounted in the drier apparatus. A series of substantially parallel or parallel grooves 3 can optionally be formed in the surface of the arcuate member 1 and extend in the direction of web travel as disclosed in the aforementioned U.S. Patent No. 4,182,472. Preferably the grooves are generally rectangular in cross-section, but may assume other configurations so long as the effect thereof is to create a labyrinth seal whereby the flow of air out from the pressurized cushion is inhibited. The grooves 3 form circumferential ribs 4 and also define the upper surface 2 of arcuate form. Alternatively, the arcuate surface can be smooth, although it is preferred that labyrinth seals be formed therein.

An air nozzle N is located along each of the longitudinal ends of the support S and extends the full length thereof transversely across the width of the web being supported. The nozzles are generally U-shaped and have a sharp nozzle edge 6 (Figure 2) spaced a distance from the member 1 so as to define an elongated slot or nozzle 8 through which pressurized air is discharged towards the web. The size of the nozzle opening can be adjusted by a series of screws 12 or the like threadably engaged in the frame F of the device and extending freely through the nozzle N. The nozzle is secured to the support by any suitable means, such as screws or the like.

The sides of the support S include end plates 16 secured by cap screws to the ends of the arcuate member 1. The aforementioned shaft means SM are secured to the end plates such as by welding. The shaft means are adjustably mounted in the frame F of the apparatus so that the angular position of the support can be changed by rotating the support on the shafts.

The frame F has a series of holes 20 passing therethrough and through which pressurized air is fed from the chamber 24. Chamber 24 is also defined by members 2 and 28 (which can be formed out of sheet metal) secured to a central duct 30 such as by welding. Pressurized air is supplied to the end of the duct 30 by a supply conduit 31 from a suitable air supply AS. The duct 30 has a longitudinal opening 32 which allows air to feed into chamber 24 and be discharged through the nozzle N and to each of the grooves in the arcuate surface.

A barrier 34 may be optionally provided extending transversely to the direction of the web travel and across the grooves 3. The barrier 34 blocks the grooves intermediate their length to form a barrier to the air flow in the grooves and eliminate flow instability and prevent one slot 8 from dominating the other.

Turning now to Figure 3, air foil wing sections 60, 61 are shown, preferably fabricated from stainless steel. Each includes a flat, non-perforated portion 63 closest to the air supply slot of the air turn. The discharge air coming from the supply slot increases in velocity as it moves across the flat portions 63 of the wing, which is arranged with respect to the air turn so as to be parallel and in close proximity to the web. To that end, each air foil wing extension can be secured to the air turn by any suitable means, such as by screws attached to the frame of the device through brackets 65, 65'. The increased air velocity creates a pressure drop between the flat portions 63 and the web, which tends to draw the web towards the flat portions 63. A large reduction of web flutter, in the range of 80% to 100%, has been demonstrated. Although wings are preferably used at both the web entry and web exit ends of the web support, if web flutter occurs at only one end in a particular application, only one wing could be used at that end.

The air foil wing extensions also each include a perforated section 64 adjacent the flat section and remote from the air turn. As the discharge air moves onto the perforated sections 64, its velocity is gradually reduced. Preferably the perforated sections 64 are bent away from the web at a gradual angle, which

increases its distance from the web the further it extends away from the air turn. An angle of about 11° is especially preferred, as best seen in Figure 6. A plurality of perforated bleed ports (shown generally at 66 in Figure 3) of the perforated section 64 allow ambient air to be drawn into the gradual increasing area between the web and this section 64 of the wing. This also causes the air velocity and turbulence to diminish. The net result is a smooth discharge of air from the edges of each air foil wing 61, as shown in Figure 4.

The amount and location of the bleed ports 66 is important to achieve a gradual diffusion or slow down in air velocity coming off the flat, non-perforated portion 63 of the wing. Preferably the amount and size of the ports increases as the wing extends further from the non-perforated section 63. In a preferred embodiment in which the flat, non-perforated section 63 is 15.24 cm (6.0 inches) long and 1.47 m (57.75 inches) wide (not including brackets 65, 65'), the perforated section 64 is 51.5 mm (2.028 inches) long and includes three generally parallel rows of ports, as best seen in Figure 5. The first row 67 closest to the flat, non-perforated section 63 includes 62 ports having a diameter of 6.35 mm (0.25 inch) spaced 22 mm (0.875 inches) from each other, beginning and ending 44.5 mm (1.75 inches) from the sides of the wing. The middle row 68 includes 126 ports having a diameter of 6.35 mm (0.25 inch) spaced 11.1 mm (0.437 inches) from each other, beginning and ending 3.3 cm (1.312 inches) from the sides of the wing. The third row 69 furthest from the flat, non-perforated section 63 includes 64 ports having a diameter of 9.5 mm and spaced 22 mm (0.875 inches) from each other, beginning and ending 22 mm (0.875 inches) from the sides of the wing.

The perforated section 64 of the wing preferably terminates in a flange portion 70, as can be best seen in Figure 6. In the preferred embodiment, the flange portion 70 is 25.4 mm (1 inch) long, and includes a row of ports 71 having a diameter of 7.9 mm (0.312 inch).

Claims

1. A contactless web support (S) having an elongated arcuate surface (2) and over which, in use a running web (W) is floatingly supported; a pair of elongate nozzles (N) extending along the length of said arcuate surface of the web support, each of said nozzles having discharge slots (8) configured to discharge pressurized air over said arcuate surface; and means (AS,31) for supplying pressurized air to said nozzles; characterized by a first air foil wing extension (60) fixed to the leading or trailing longitudinal edge of said air turn assembly, said first wing extension comprising a first flat portion (63) extending away from said arcuate surface, and a second perforated section (64) adjacent said first flat portion.

2. A contactless web support according to claim 1, characterized in that said second perforated section is positioned at an angle with respect to said first flat portion.

3. A contactless web support according to claim 2, characterized in that said angle is substantially 11°.

4. A contactless web support according to any one of claims 1 to 3, characterized by further comprising a second air foil wing extension (61) fixed to the longitudinal edge of said air turn assembly different from the edge to which said first air foil wing extension is fixed, said second wing extension comprising a flat portion (63) extending away from said arcuate surface, and a perforated section (64) adjacent said flat portion.

5. A contactless web support according to any one of claims 1 to 4, characterized by having a plurality of substantially parallel grooves forming labyrinth seals extending around said arcuate surface in a direction in which the web passes thereover.

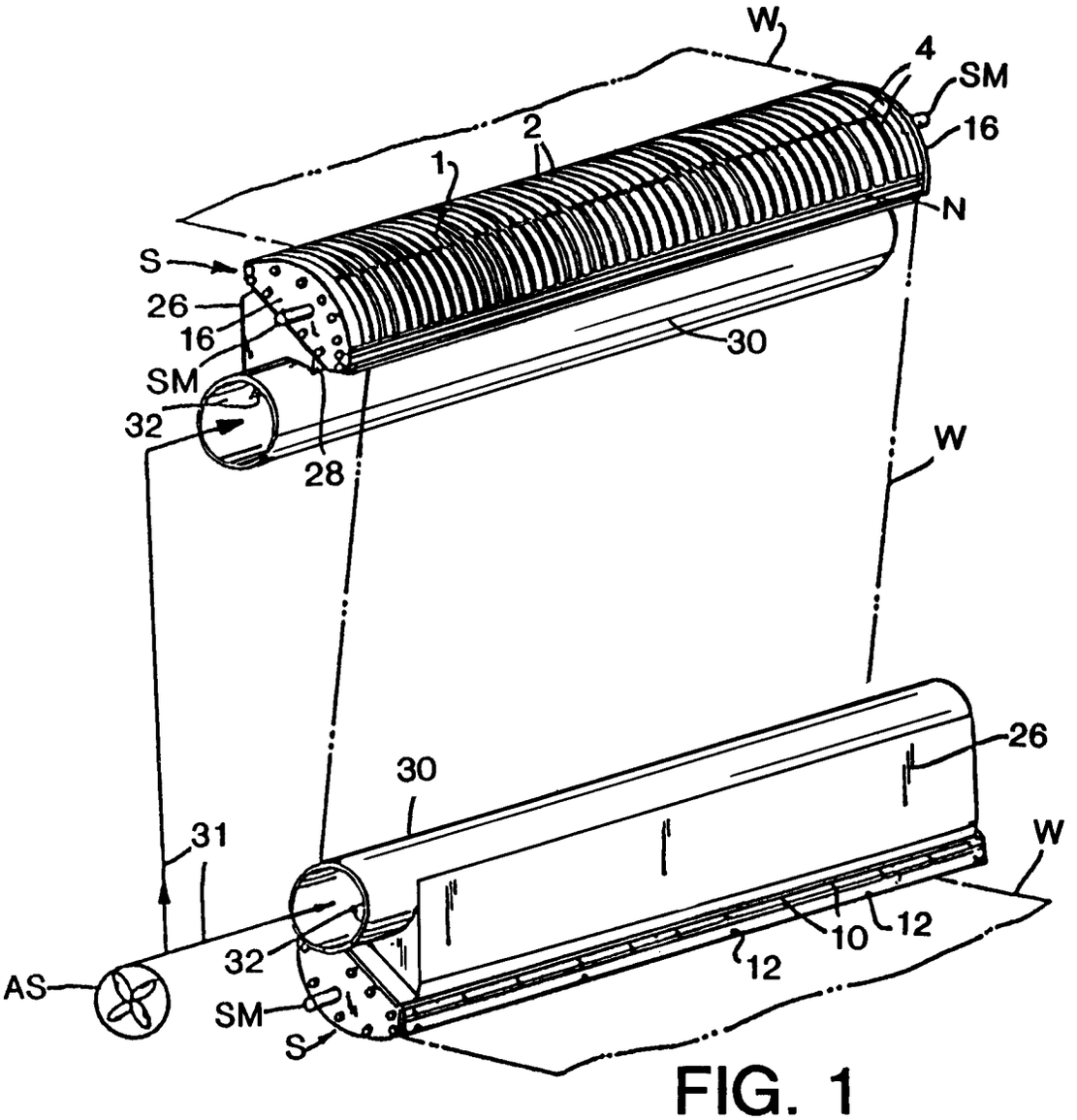
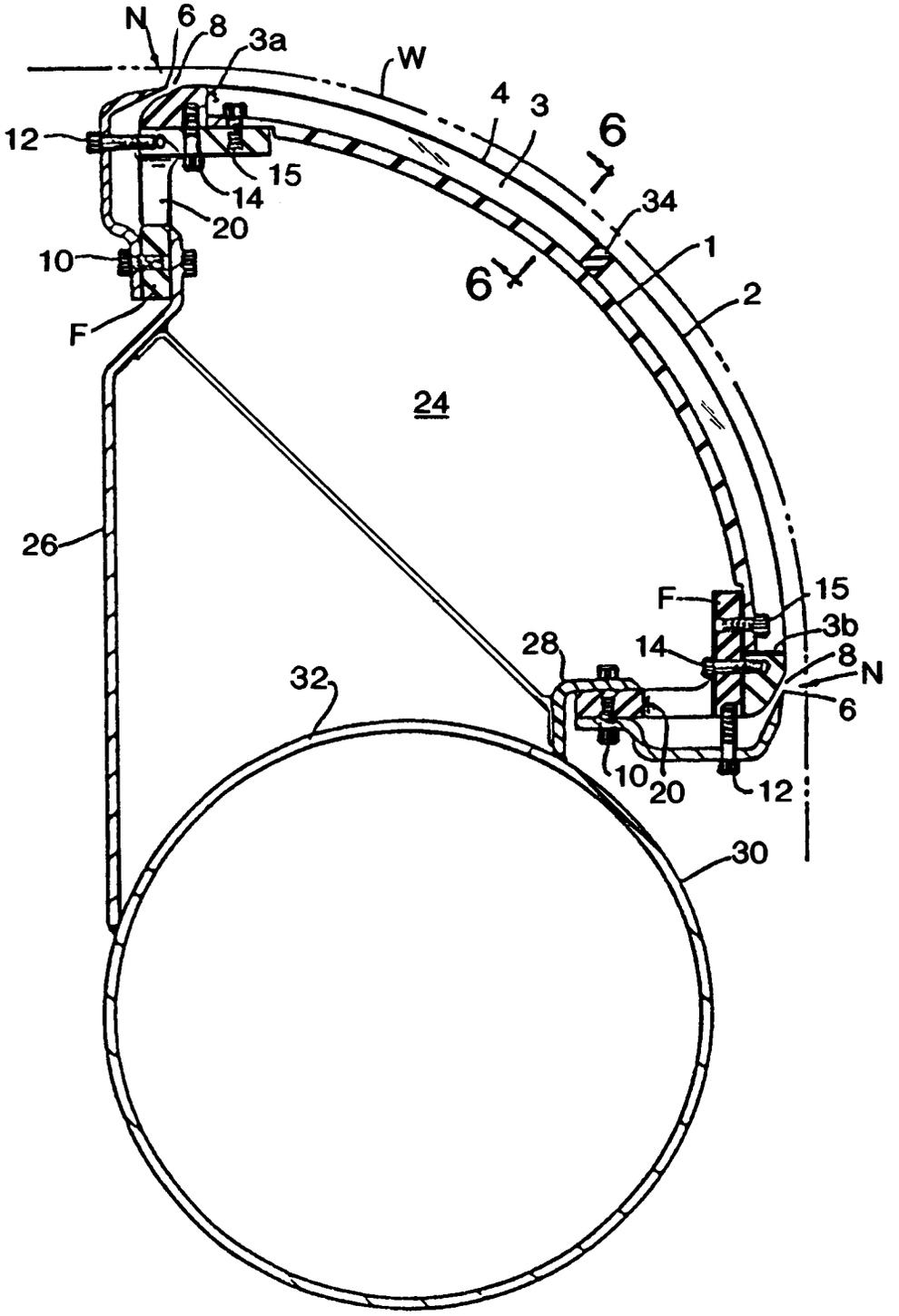


FIG. 1


N
6
8
3a
W
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3
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14
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34
10
1
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2
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3b
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FIG. 2

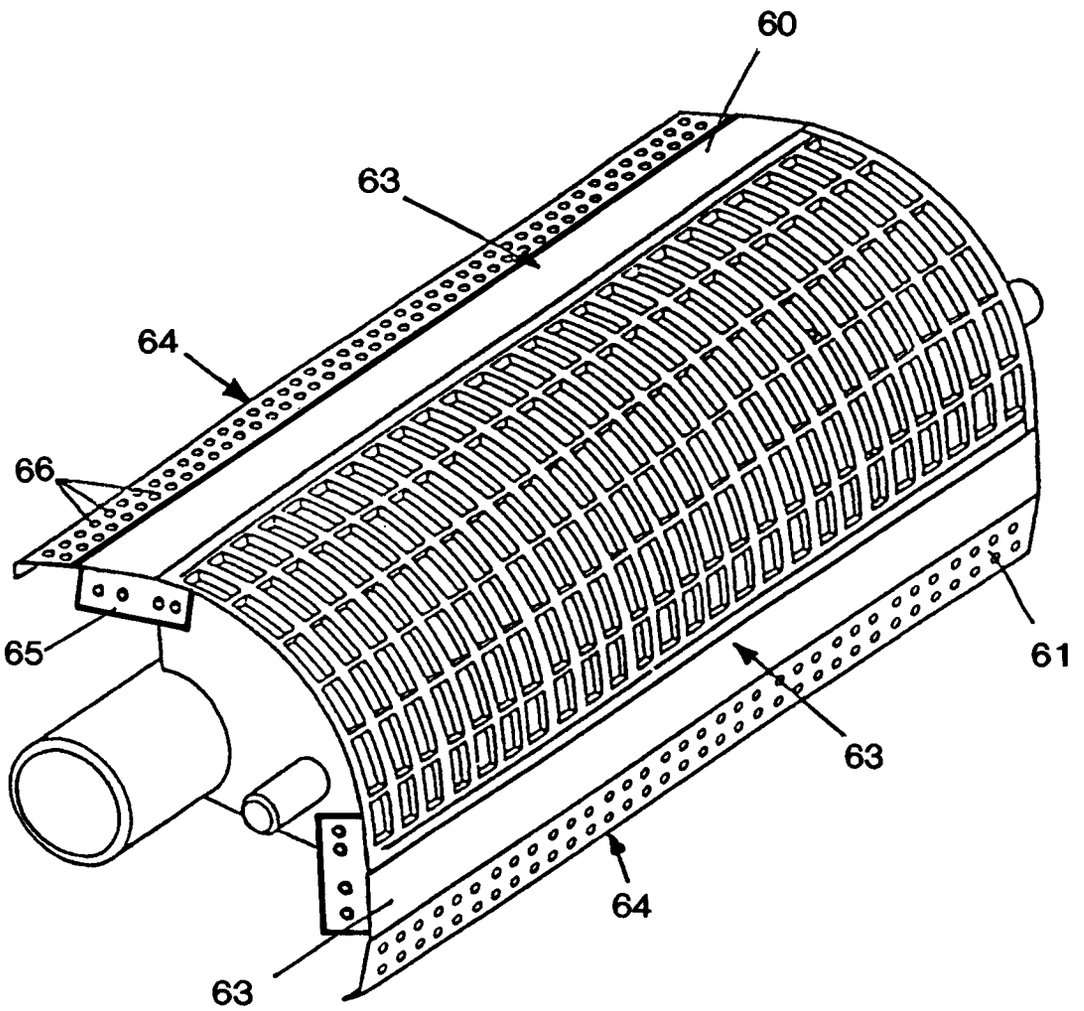


FIG. 3

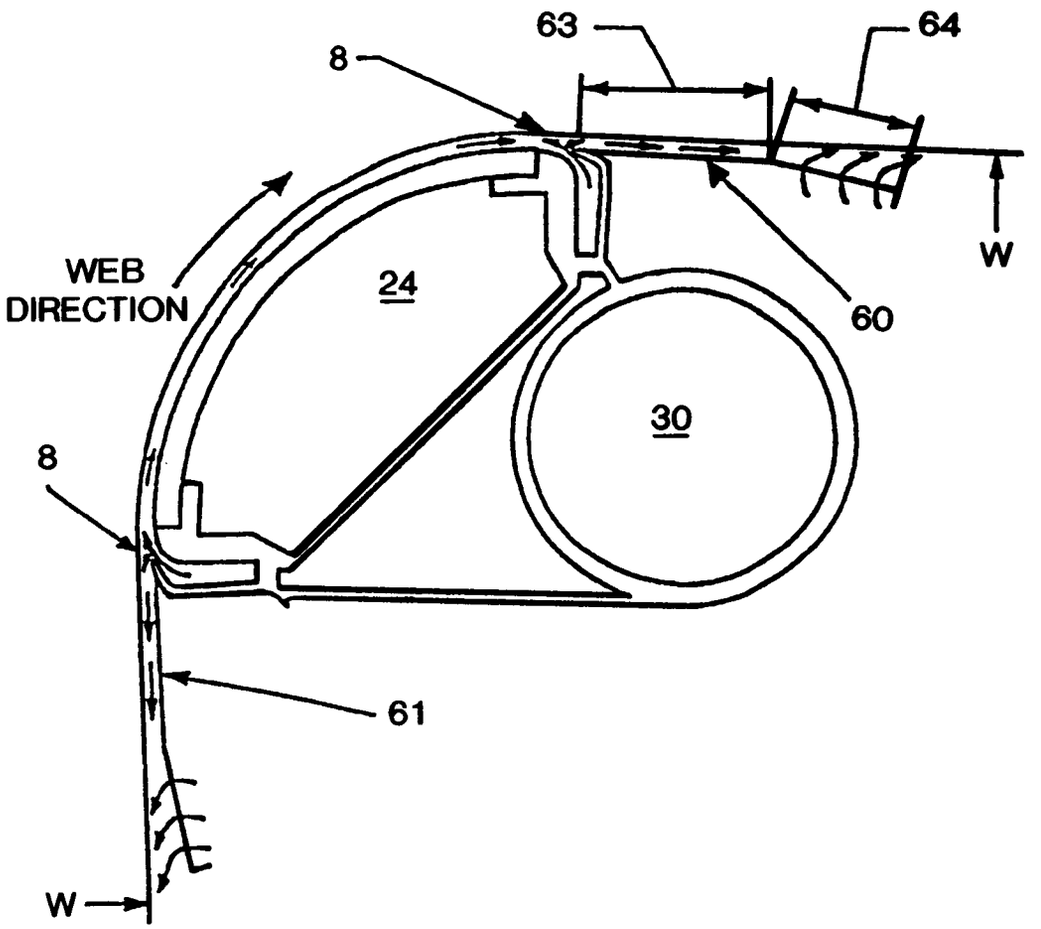


FIG. 4

FIG. 5

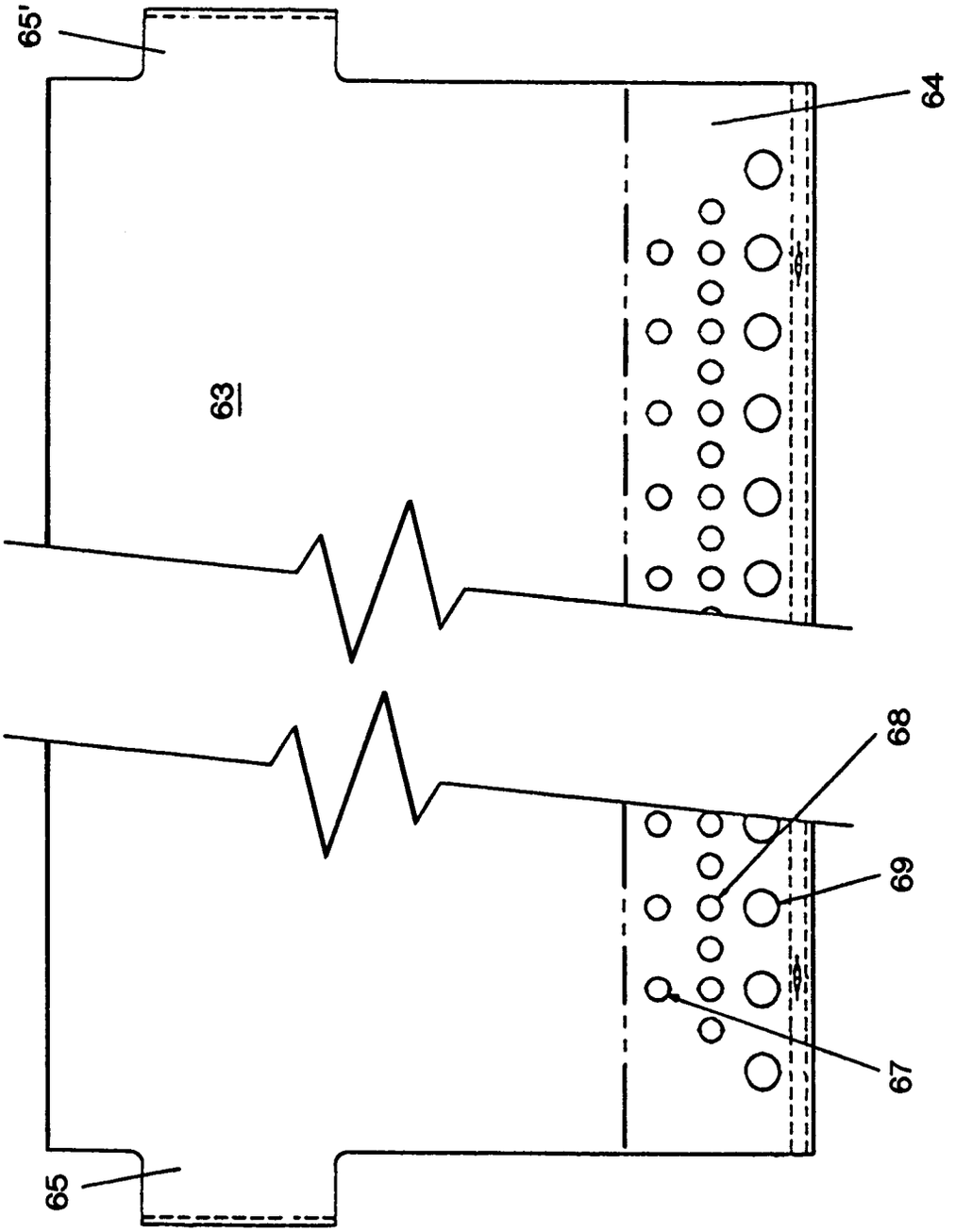
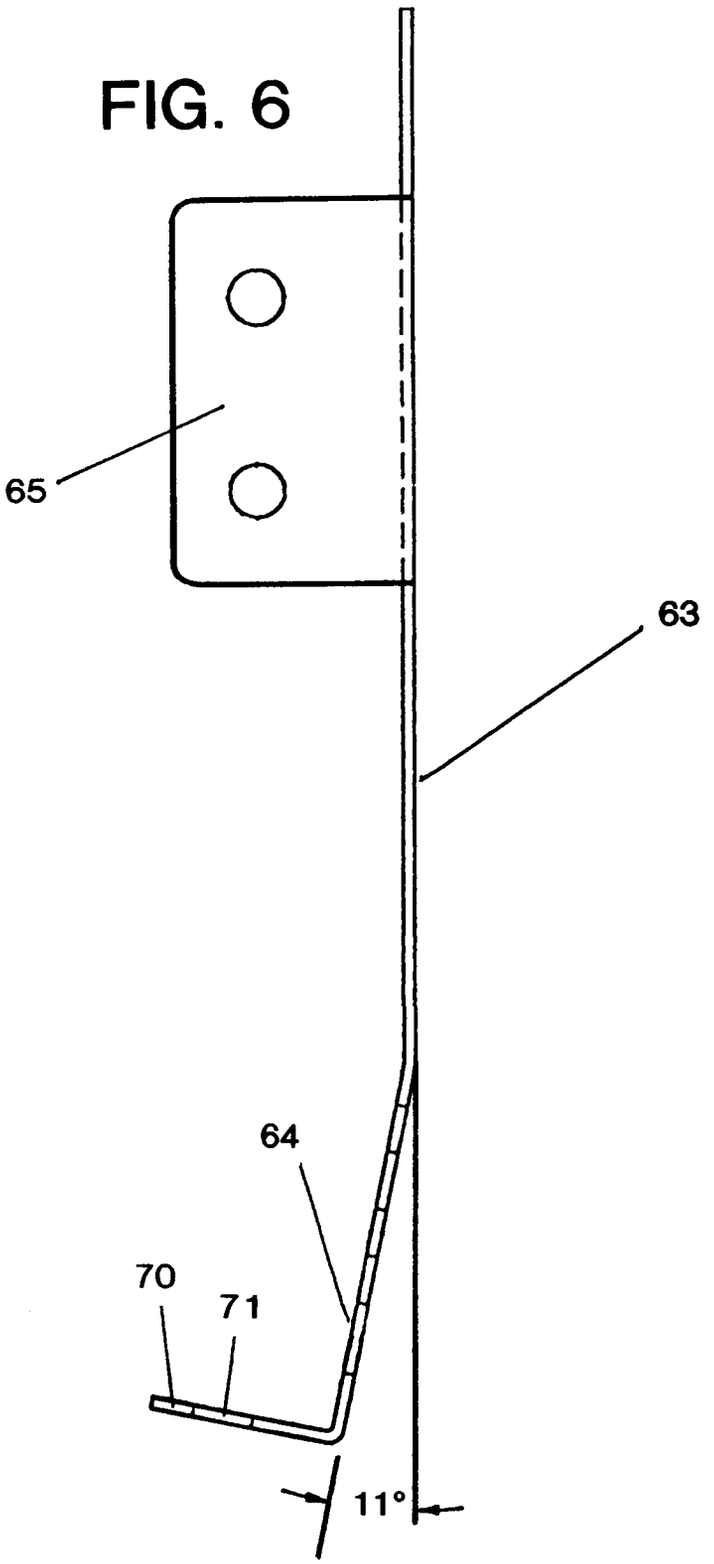


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 1853

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.6)
D,A	US-A-4 182 472 (W.R. GRACE & CO.)	1	B65H23/24
A	GB-A-1 307 695 (ILFORD LIMITED) * the whole document *	1,3	
A	US-A-3 127 080 (AKTIEBOLAGET SVENSKA FLAKTFABRIKEN) * the whole document *	1,3	
A	EP-A-0 568 301 (W.R. GRACE & CO.-CONN.) * abstract; figures 4 - 14B *	1,2	
A	US-A-5 242 095 (ADVANCE SYSTEMS, INC.)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 June 1995	Thibaut, E

CATEGORY OF CITED DOCUMENTS

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