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(54) Web slitters with a gaseous passageways bar and/or methods of operating web slitters

(57) A web slitter comprises a bar (1, 13, 19, 23, 28, 35, 39, 44, 50); one or more slitting members (9, 27, 43, 48, 49) which, in use, are held in a position to slit a web (26, 42) as it is drawn over said bar (1, 13, 19, 23, 28, 35, 39, 44, 50); said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) incorporating an outer portion (5,15, 31) with gaseous passageways located under said web; said bar being equipped with or being connectable to means for pressurising gas through said gaseous passageways in order to provide a gaseous cushion between said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) and said web (26, 42); characterised in that said bar further comprises a longitudinal strip which extends width wise under said web; said strip being of a non-porous material; said portion (5, 15) which extends under said web (26, 42) incorporating outside of said strip an array of uniformly distributed gaseous passageways.

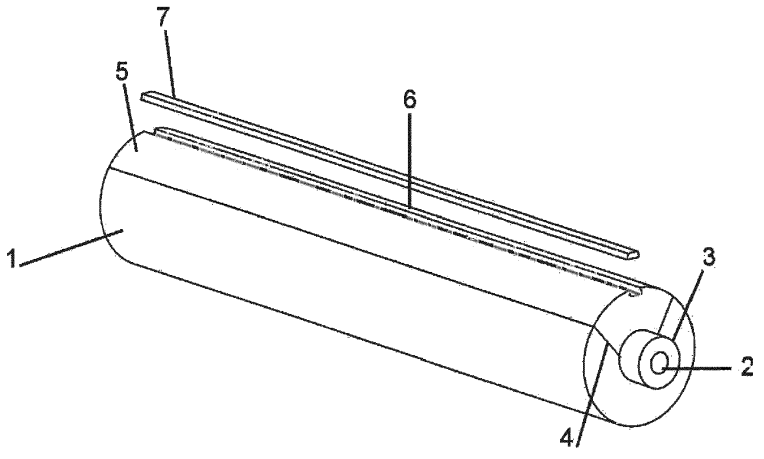

FIGURE 1

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Description

Field of the Invention

[0001] The invention relates to web slitters and methods of operating web slitters.

Background to the Invention and Prior Art known to the Applicants

[0002] The following prior art documents are acknowledged: EP0710531; DE10349890; and GB 1,030,369 (published in 1966).

[0003] EP0710531 fails to disclose any longitudinal strip and DE10349890 only discloses a circumferential trough.

[0004] GB1,030,369 and many existing web slitters employ a grooved roller (also known as a female knife shaft) to facilitate the accurate location of the blade and generally to provide support for the web during the slitting process. Grooved rollers are primarily involved with wrap slitting on primary slitter rewinding machines and may be up to 10-metres wide. Grooved rollers are typically constructed from a solid, nickel-plated mild steel bar which has an array of closely contiguous circumferential grooves machined on the roller's outer surface. The circumferential grooves typically have a 2mm pitch in order to accommodate wide variety of slitting patterns.

[0005] GB1,030,369 shows a static grooved roller with single passageways in each groove. No passageways are provided outside the blade receiving grooves.

[0006] A problem with the dynamic grooved rollers currently in use with razor blade slitting, is that the diameter of a grooved roller is determined by the diameter of the machine rollers required to maintain the web running at the correct speed and tension. It is known that the larger the machine is, the larger the diameter of the machine rollers required. For example, if the machine rollers are 900mm in diameter, then so must be the grooved roller. If the grooved roller were less than 900mm, additional gearing or belts would be required to increase the grooved roller's rotational speed. If the grooved roller were greater than 900mm then additional gearing or belts would be required to decrease the grooved roller's rotational speed.

[0007] Another problem with grooved rollers, currently in use with razor blade slitting, is the extensive set-up time required for the slitting process. This is because the razorblades must not make any contact with the sides or bottom of the circumferential grooves located on the roll's outer surface. Any contact between a razor blade and the grooved roller during the blade's engagement with the web, will cause the razor blade to snap and cause damage to the nickel-plating on the outer surface of the grooved roller. This will cause corrosion and other surface defects, such as chips, which will damage the web as it passes over the grooved roller. Also, the perfect balancing of a large female knife shaft is extremely difficult, and is sometimes not possible at all. Any unbalancing will transmit vibrations throughout the machine whilst it is running. These vibrations may even cause the razor blades to resonate and result in poor edge quality of the divided web portions. The vibration may also lead to the premature failure of the supporting bearings of the female knife shaft.

[0008] Another problem with the female knife shaft is that it is very heavy and therefore difficult to support and manoeuvre, whilst positioned on a primary and/or a secondary rewind machine.

[0009] There are two modern variations of the grooved roller; these are known as a solid stacked female knife shaft, for use with a shear slitting process, and a pneumatic female knife shaft. Both of which, are not commonly used on primary slitter rewinding machines, but are used extensively on secondary slitter rewinding machines.

[0010] The solid stacked female knife shaft is stacked with an array of female knife blocks, which are held in place by clamping rings located at both ends of the shaft. The knives and spacers form or simulate a solid supporting shaft. Unless the web is supported by a shaft solidly stacked with knives and spacers, the web will pull or sag into the voids which results in irregular slit widths.

[0011] The pneumatic female knife shaft has three machined channels, spaced 120° apart around the circumference of the shaft. Each machined channel is fitted with a bladder that is covered with felt strip. Compressed air is channelled into each bladder, which expands and the felt strip applies pressure to the inner diameter of the female knife blocks to hold them in position during the slitting process.

[0012] Therefore, at least one of the following objectives is addressed by certain aspects described hereinafter:

- to provide an effective but lighter weight shaft;
- to achieve excellent slitting quality eg. constant edge quality;
- to increase the number of achievable slitting patterns or even remove any limits to the slitting pattern;
- to reduce the vibration of the blade;
- to reduce the wear of the shaft;
- to reduce the presence of air bubbles;
- to reduce the presence of turbulence around the blade; and
- to simplify the maintenance of the shaft and slitting components.

Summary of the Invention

[0013] In a first broad independent aspect, the invention provides a web slitter comprising a bar; one or more slitting members which, in use, are held in a position to slit a web as it is drawn over said bar; said bar incorporating an outer portion with gaseous passageways located under said web; said bar being equipped with or being connectable to means for pressurising gas through said

gaseous passageways in order to provide a gaseous cushion between said bar and said web; **characterised in that** said bar further comprises a longitudinal strip which extends width wise under said web; said strip being of a non-porous material; said portion which extends under said web incorporating outside of said strip an array of uniformly distributed gaseous passageways.

[0014] By contrast with the prior art gas passageways configuration, the presence of the strip reduces or prevents altogether the development of air bubbles in the vicinity of the blades. Furthermore, providing the gas passageways uniformly distributed throughout the portion allows a substantially equalised air pressure to be applied uniformly to the underside of the web. This would have the effect of improving the quality of the cut, and consequently the quality of rewound packages. Web sag and damage to the web by contact with moving mechanical parts is at worst limited or at best entirely avoided. This may provide a maintenance free bar. Changes of slitting patterns can be carried out simply and easily with accuracy and with reduced machine downtime.

[0015] In a preferred configuration, the bar incorporates no circumferential grooves. This configuration avoids the risk of the razor blades colliding with the outer surface of the bar.

[0016] Preferably, said gaseous passageways are formed in a portion of inherently porous material. This configuration is particularly advantageous because it improves the distribution of pressurised gas to support the travelling web.

[0017] Preferably, said bar is static when, in use, as the web is drawn over said bar. This configuration removes or at least limits any vibration of the components which interact to slit the web. It also removes the requirement for lubrication whilst the bar is virtually if not entirely maintenance free.

[0018] Preferably, said bar incorporates a strip comprising an inherently deformable material suitable for receiving the tip of a slitting member. This configuration allows the tip to be held by the material in order to reduce vibration. This configuration further improves the edge quality of the slit web.

[0019] Preferably, said material is substantially self-healing as the tip of a slitting member is removed from said region. The term self-healing refers to the mechanical properties of the material in that once it is deformed by the insertion of a slitting member, it returns with little or no plastic deformation having occurred when the slitting member or blade tip is removed from the material. Preferably, said self-healing material is based on silicone material or the like. This configuration is particularly advantageous because it enables multiple engagements of the cutting devices with a material, which holds and stabilises the tips the blades over a period of time, without gradually destroying or breaking down the material. The self-healing strip of this kind also provides in a preferred embodiment a shield to prevent the formation of an air bubble underneath the web.

[0020] Preferably, said bar further comprises a trough disposed within the surface of said porous material and said region of inherently deformable material is provided in said trough. Providing a trough of this kind lends itself to straightforward filling with a deformable material. This configuration is particularly advantageous because the material is easily applicable to the channel via moulding or assembly.

[0021] Preferably, said bar further comprises a trough disposed within the surface of said porous material and a strip disposed in said trough; said strip being a non-porous insert with discrete blade receiving portions. This configuration is particularly advantageous since it combines the benefit of discrete blade receiving portions which are often used for rotary blades and the benefits of an air cushion without any significant amount of air bubbles forming around the cutting area.

[0022] Preferably, said bar is partially cylindrical and said portion is provided on a bowed upper surface of said bar. This configuration is particularly advantageous because it enables the travelling web to flow over the bar in a wrapped configuration. It also provides a particularly compact configuration.

[0023] Preferably, said bar further comprises an air coupling protruding from a side wall of said bar. This configuration is particularly advantageous because it enables the coupling of an external pressurised air supply to the bar or air shaft, which is not engaged with the web in a wrapped configuration.

[0024] Preferably, said portion incorporates a substantially flat surface which, in use, locates under said web. This configuration is particularly advantageous because it provides a gaseous cushion of air, of equal air pressure, to the underside surface of the travelling web. This configuration lifts and supports the web in a way that gives the appearance of the web "sitting-in-air".

[0025] Preferably, said bar further comprises an array of circumferential grooves. This configuration allows the position of the slitting members to be precise whilst the air cushion is uniform either side of the blade.

[0026] Preferably, said bar further comprises a portion of reduced diameter protruding from one end of said bar; said protruding portion houses a fluid coupling means for communicating external fluid into an inner cavity. This configuration is particularly advantageous because it provides a means for housing an air coupling, for communicating an external pressurised air supply, whilst providing an attachment means for the bar to the slitting machine.

[0027] In a second broad independent aspect, the invention provides a method of operating web slitters comprising the steps of:

- providing a bar incorporating an outer portion with gaseous passageways located under a web; said bar being equipped with or being connectable to means for pressurising gas through said gaseous passageways in order to provide a gaseous cushion

between said bar and said web; said portion extending under said web and incorporating an array of gaseous passageways uniformly distributed across said portion; said bar further comprising a longitudinal strip which extends width wise; said strip being of a non-porous material;

- pressurising gas through said gaseous passageways;
- displacing said web across said bar; and
- slitting said web into two or more web portions.

[0028] In a subsidiary aspect in accordance with the invention's second broad independent aspect, the method further comprises the step of immobilising said bar as the web displaces across said bar.

[0029] In a further subsidiary aspect, the method further comprises the step of providing a bar which incorporates a region equipped with an inherently deformable material; and placing the tip of a slitting member at least partially in said material.

[0030] In a further broad independent aspect, the invention provides a web slitter comprising a bar; one or more slitting members which, in use, are held in a position to slit a web as it is drawn over said bar; **characterised in that** said bar incorporates one or more regions equipped with an inherently deformable material suitable for receiving the tip of a slitting member.

Brief Description of the Figures

[0031]

Figure 1 shows an exploded perspective view of a cylindrical air shaft member and self-healing strip.

Figure 2 shows a perspective view of the air shaft member and inner cavity.

Figure 3 shows a perspective view of the air shaft member with a zoomed in view of a tip of a cutting device embedded within the self-healing strip.

Figure 4 shows a cross-sectional view of the air shaft member and supporting cradle being secured to a supporting member.

Figure 5 shows a perspective view of a further embodiment which incorporates an air shaft member with a bowed upper surface and a self-healing strip.

Figure 6 shows a perspective view of a further embodiment which incorporates an air shaft member and protruding air couplings.

Figure 7 shows a side view of a further embodiment which incorporates an air shaft member with a bowed upper surface.

Figure 8 shows a side view of a further embodiment which incorporates an air shaft member engaged with a web.

Figure 9 shows a perspective view of a further embodiment which incorporates a substantially flat air shaft member and a self-healing strip.

Figure 10 shows a perspective view of a further embodiment which incorporates a substantially flat air shaft member and protruding air couplings.

Figure 11 shows a side view of a further embodiment which incorporates a flat air shaft member.

Figure 12 shows a side view of a further embodiment which incorporates a flat air shaft member engaged with a web.

Figure 13 shows a perspective view of a further embodiment which incorporates a cylindrical air shaft member and inner cavity.

Figure 14 shows a perspective view of a further embodiment with a zoomed in view of a blade tip lowered in a position to engage a web.

Figure 15 shows a cross-sectional view of a further embodiment which incorporates an air shaft member and supporting cradle being secured to a supporting member.

Figure 16 shows a plan view and a perspective view of a further embodiment of the invention.

Figure 17 shows a plan view and a perspective view of a further embodiment of the invention.

Detailed Description of the Figures

[0032] Figure 1 shows an air shaft or bar 1 for use in a slitter machine. The air shaft 1 is manufactured from a cylindrical solid stainless steel shaft. The diameters of the protruding annular portions 2 extending centrally from each end of the shaft have a reduced diameter to provide an air port 3 for housing an air coupling means or an air valve. A section 4 of the air shaft 1, extending radially from a central portion of the shaft towards the outer cylindrical surface of the bar 1, is provided along the length of shaft 1. The section is shown to be filled with a porous material 5. This may be typically a porous metal. This metal may be of sintered material. The porous material 5 is shown to extend radially from the centre of the bar to form an elongated quadrant. Bar 1 is machined again to ensure the cylindrical outer surface is accurately round. A linear channel 6 is cut in a longitudinal axial direction along the upper central portion of the porous material 5. Channel 6 is required to accommodate a strip

7 of self-healing plastics material, such as silicone, neoprene or polyurethane or the like. The self-healing strip may not necessarily fully fill the channel - it might be advantageous for it to cover only the bottom surface. The tip of a blade may not necessarily engage with the strip. The strip may advantageously be non-porous so as to act as a means of preventing the formation of air bubbles in the cutting area.

[0033] The porous portion of the shaft incorporates an array of closely contiguous gaseous passageways spread through the portion of the shaft in order to produce a uniform gas cushion to support the travelling web. The gaseous passageways are provided under the blade and on either side of the blade to equalise the pressure applied to the web. The passageways are also provided in front of and behind the blade's tip or in front of and behind where self-healing strip 7 is provided. The array of gaseous passageways in effect surrounds the blade in order to equalise the pressure applied to the web.

[0034] Figure 2 shows a cylindrical, internal cavity 8 incorporated within air shaft 1, which axially extends substantially along the centre of the shaft. The internal cavity 8 has a substantially smaller diameter when compared with the outer diameter of air shaft 1. The internal cavity 8 is also known as an air gallery.

[0035] Figure 3 shows a knife blade (such as a razor blade) lowered to penetrate a web. The tip of the interacting razor blade 9, is shown to be embedded within the silicone strip 7 without colliding with air shaft 1.

[0036] Figure 4 shows the air shaft 1 fixed to a cradle 11 and secured to cross beam 10 by one or more screws 12.

[0037] In use, the air shaft is attached to a razor blade slitter machine to support a travelling web across its width during the slitting process. Clean pressurised air is directed through the air coupling means into the air gallery located within the air shaft. The air then filters through the porous material located within the air shaft and escapes under pressure into the surrounding atmosphere. The air then subsequently meets the underside surface of the web and lifts it so there is at least reduced or potentially no contact between the web and the outer surface of the air shaft. When the razor blades are lowered for the slitting process, the tip of each blade will penetrate the web and embed itself into the silicone strip. In this configuration, both ends of the razor blade are fixed so vibration is at least reduced if not entirely eliminated. Therefore, improving the edge quality of the cuts to be made through the web and only the width of the razor blades spacing will limit the width of the divided web strips.

[0038] The air shaft is not a solid member, as in the case of known grooved rollers. The air shaft is hollow and therefore substantially lighter in weight when compared with such grooved rollers. The air shaft is statically mounted onto a slitting machine, in order to limit any vibrations of the cutting blades during the slitting process. Vibrations of blades which in known art often originate from rotating an out of balance heavy grooved roller reduce the edge quality of the portions of divided web and consequently reduce the quality of rewound packages.

[0039] The statically fixed air shaft reduces the potential damage of the travelling web, which may occur when utilising a rotating grooved roller. Therefore, the need is for a grooved roller, which does not rotate, has no Female Knives, is not in contact with the web at any time and has the capacity to hold the tip of the razor blade to remove any vibration avoiding a metal to metal interaction. The advantages of this configuration of the air shaft are:

- The diameter of the air shaft is not controlled by the machine size;
- Allows effective razor blade slitting whilst retaining the benefits of slitting non-abrasive webs whilst using razor blades;
- The air shaft will require no lubrication and is therefore maintenance free;
- There are no costly grooves machined into the air shaft, and there are no female knife blocks;
- Slitting patterns can be changed simply and easily with exacting accuracy and a very small window for machine down time.
- There is no width limitation to the slitting patterns.
- There is no necessity for drive motors or drive belts because the air shaft does not rotate.
- The web will be supported on a cushion of constant equalised air pressure, removing the possibility of the web sagging and causing damage to the web by contact with moving mechanical parts;
- The edge quality will be constant until the razor blades are blunted through prolonged usage. The cut depth of one blade can be increased without affecting the cut depth of other razor blades; and
- The air shaft is fixed, therefore causing no vibration.

[0040] In a further embodiment, the cross-sectional shape of the air shaft incorporates an upper surface formed from a porous material 15. The porous material 15 is bowed or crescent shaped and located upon a shallow, rectangular shaped body member. This embodiment will enable a wrap slitting process, in which the web engages a configuration of razor blades. Figure 5 shows the embodiment of the air shaft, which is generally indicated by 13. A channel or trough 14 is cut in an axial direction along the upper central portion of the porous material 15. The channel 14 is required to accommodate a strip of self-healing plastics material 16. The air shaft is shown to incorporate a pressurised air coupling 17 located at one end of side wall 18. Figure 6 shows another embodiment of an air shaft 19, which shows air couplings 20 and 22 respectively located at proximal and distal ends of sidewall 21. Figure 7 shows a side view of the embodiment of the air shaft. Figure 8 shows a further side view of the air shaft 23 located between two machine rollers 24 and 25. The two machine rollers 24 and 25 are transporting a web 26 over the air shaft 23, whilst a cutting

device 27 is engaged with the web 26 during the slitting process.

[0041] In a further embodiment, the air shaft, the upper surface of the shaft is formed from a porous material and is substantially flat. The flat surface enables the web, supported by the shaft, to "sit in the air" as such. The flat upper surface is necessary to ensure the air pressure is equally applied across the underside surface of the web. This embodiment will enable the wrap slitting process with a configuration of razor blades. Figure 9 shows an embodiment of an air shaft 28 which incorporates a flat upper surface 29, formed from a porous material 31. The flat upper surface is located upon a shallow, rectangular shaped body member. A channel 30 is cut in an axial direction along the central portion of the flat porous material 31. Channel 30 is required to accommodate a strip of self-healing material 32. The air shaft is shown to incorporate a pressurised air coupling 33 located at one end of wall 34. Figure 10 shows a further embodiment of the air shaft incorporating a substantially flat upper surface 35, which shows air couplings 36 and 37 located at respective ends of wall 38. Figure 11 shows a side view of the air shaft. Figure 12 shows a side view of the air shaft incorporating an upper flat surface located between two machine rollers 40 and 41. The two machine rollers 40 and 41 are transporting a web 42 over the air shaft 39, whilst a cutting device 43 is engaged with the web 42 during the slitting process. The figure shows the web 42 "sitting in air" as it passes over the air shaft 39.

[0042] In a further embodiment, the air shaft incorporates a section substantially along the length of the shaft and filled with a porous material, which incorporates an array of blade receiving grooves, cut circumferentially across at least the upper arc of the porous material. The air shaft has an internal cavity, which extends substantially along the centre of the shaft. The internal cavity has a substantially smaller diameter when compared with the outer diameter of the air shaft. This embodiment differs from the previous embodiments in that there is no silicone strip located along the upper arc of the porous material. Figure 13 shows an embodiment of an air shaft 44 which is substantially cylindrical. Clean pressurised air is directed through the air port 45 into the internal cavity 46, also known as an air gallery. The air filters through the porous material 47 and escapes into the surrounding atmosphere. The air then subsequently meets the underside surface of the web and tends to lift it so there is no contact between the web and the outer surface of air shaft 44. Figure 14 shows an array of razor blades 48 and 49 in a lowered position to engage a web, only the tip of each blade will penetrate the web and enter one of the circumferential grooves located on the porous material.

[0043] Figure 15 shows an air shaft 50 located on a cradle member 51. The air shaft 50 and cradle 51 are shown to be attached to a cross beam 52 via one or more bolts 53.

[0044] Figure 16 shows an air shaft 54 with a porous material portion 55 and a longitudinal trough 56 extending width wise to accommodate a non-porous metal insert 57. The non-porous metal insert incorporates discrete rotary blade receiving recesses such as recess 58. Figure 17 shows the interaction of a blade 59 and the metal insert. Rectangular portion or strip 60 extends across the air bar and incorporates porous material such as sintered metal through which the air exits the air shaft.

Claims

1. A web slitter comprising a bar (1, 13, 19, 23, 28, 35, 39, 44, 50); one or more slitting members (9, 27, 43, 48, 49) which, in use, are held in a position to slit a web (26, 42) as it is drawn over said bar (1, 13, 19, 23, 28, 35, 39, 44, 50); said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) incorporating an outer portion (5,15, 31) with gaseous passageways located under said web; said bar being equipped with or being connectable to means for pressurising gas through said gaseous passageways in order to provide a gaseous cushion between said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) and said web (26, 42); **characterised in that** said bar further comprises a longitudinal strip which extends width wise under said web; said strip being of a non-porous material; said portion (5, 15) which extends under said web (26, 42) incorporating outside of said strip an array of uniformly distributed gaseous passageways.

2. A web slitter according to claim 1, wherein said gaseous passageways are formed in a portion (5, 15) of inherently porous material.

3. A web slitter according to either of the preceding claims, wherein said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) is static when, in use, as the web is drawn over said bar.

4. A web slitter according to any of the preceding claims, wherein said strip (6, 7, 14, 16, 30, 32) is of an inherently deformable material suitable for receiving the tip of a slitting member (9, 27, 43, 48, 49).

5. A web slitter according to claim 4, wherein said material is substantially self-healing as the tip of a slitting member (9, 27, 43, 48, 49) is removed from said region.

6. A web slitter according to claim 5, wherein said self-healing material is based on silicone material or the like.

7. A web slitter in accordance with any of the preceding claims, wherein said bar (1, 13, 19, 23, 28, 35, 39, 44) further comprises a trough (6, 14, 30) disposed within the surface of said porous material (5) and a strip (6, 7, 14, 16, 30, 32) of inherently deformable

material is provided in said trough (6, 14, 30).

8. A web slitter according to any of claim 1-6, wherein said bar further comprises a trough disposed within the surface of said porous material and a strip disposed in said trough; said strip being a non-porous insert with discrete blade receiving portions.

9. A web slitter in accordance with any of the preceding claims, wherein said bar (13, 19, 23) is partially cylindrical and said portion is provided on a bowed upper surface of said bar.

10. A web slitter in accordance with any of the preceding claims, wherein said bar (13, 19, 28, 35) further comprising an air coupling (17, 20, 22, 33, 34, 36, 37) protruding from a side wall (18, 21, 38) of said bar (1).

11. A web slitter in accordance with any of claims 1-8, and 10, wherein said portion (31) incorporates a substantially flat surface which, in use, locates under said web.

12. A web slitter in accordance with any of the preceding claims, wherein said bar (44) further comprises an array of circumferential grooves.

13. A method of operating web slitters comprising the steps of:

- providing a bar (1, 13, 19, 23, 28, 35, 39, 44, 50) incorporating an outer portion (5,15, 31) with gaseous passageways located under a web (26, 42); said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) being equipped with or being connectable to means for pressurising gas through said gaseous passageways in order to provide a gaseous cushion between said bar (1, 13, 19, 23, 28, 35, 39, 44, 50) and said web; said portion (5, 15) extending under said web and incorporating an array of gaseous passageways uniformly distributed across said portion; said bar further comprising a longitudinal strip which extends width wise; said strip being of a non-porous material;
- pressurising gas through said gaseous passageways;
- displacing said web across said bar; and
- slitting said web into two or more web portions.

14. A method according to claim 13, further comprising the step of immobilising said bar as the web displaces across said bar.

15. A method according to either claim 13 or claim 14, further comprising the step of providing a bar which incorporates a region (6, 7, 14, 16, 30, 32) equipped with an inherently deformable material; and placing the tip of a slitting member (9, 27, 43, 48, 49) at least partially in said material.

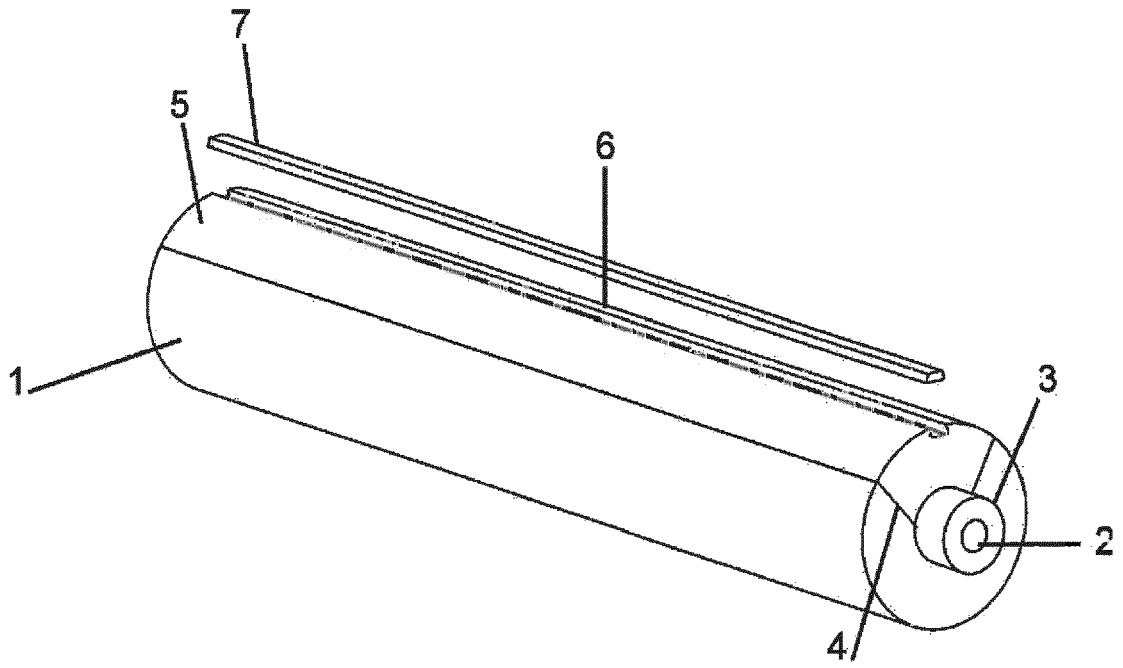


FIGURE 1

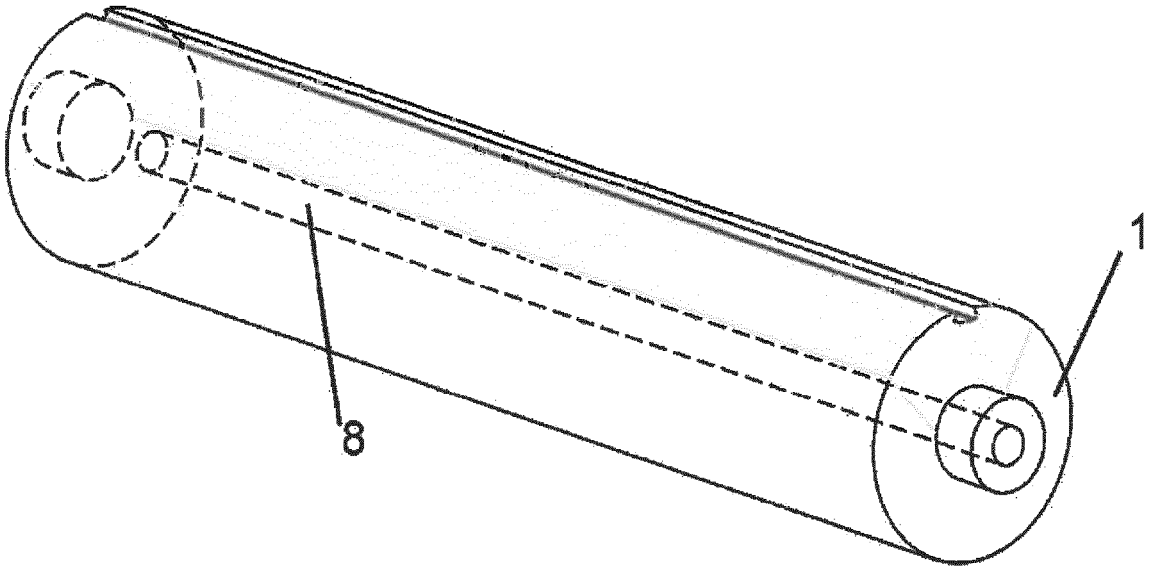


FIGURE 2

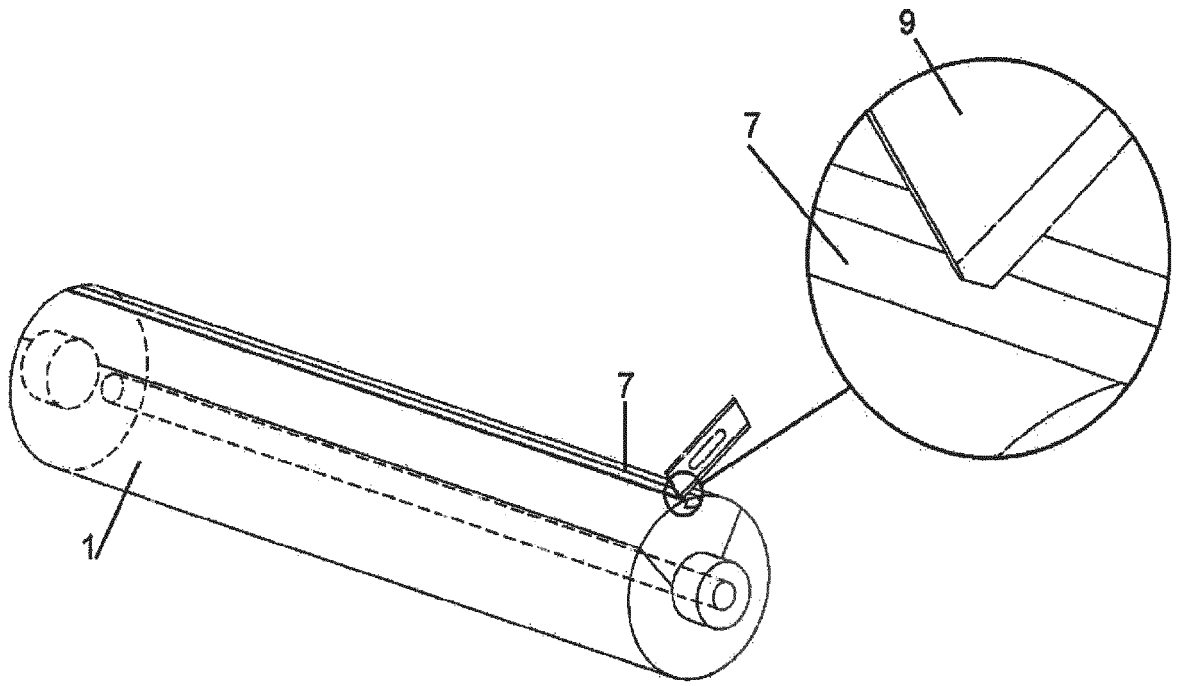


FIGURE 3

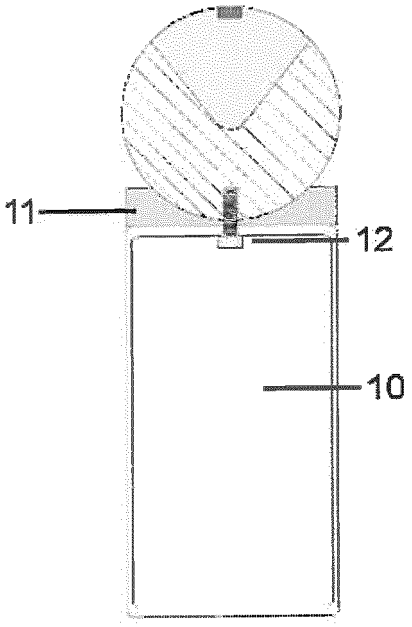


FIGURE 4

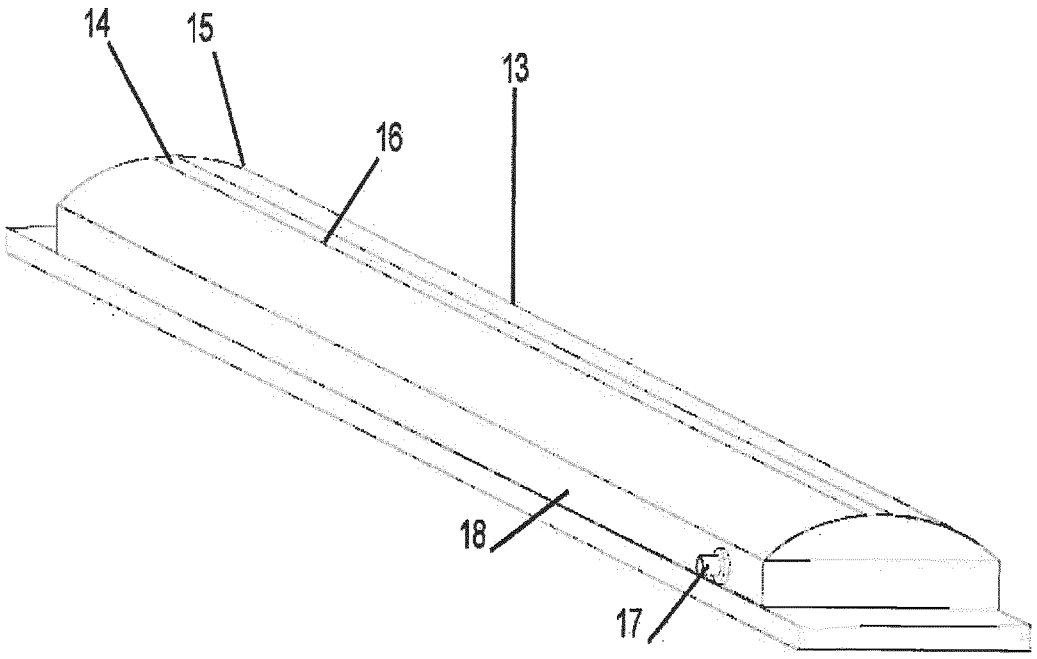


FIGURE 5

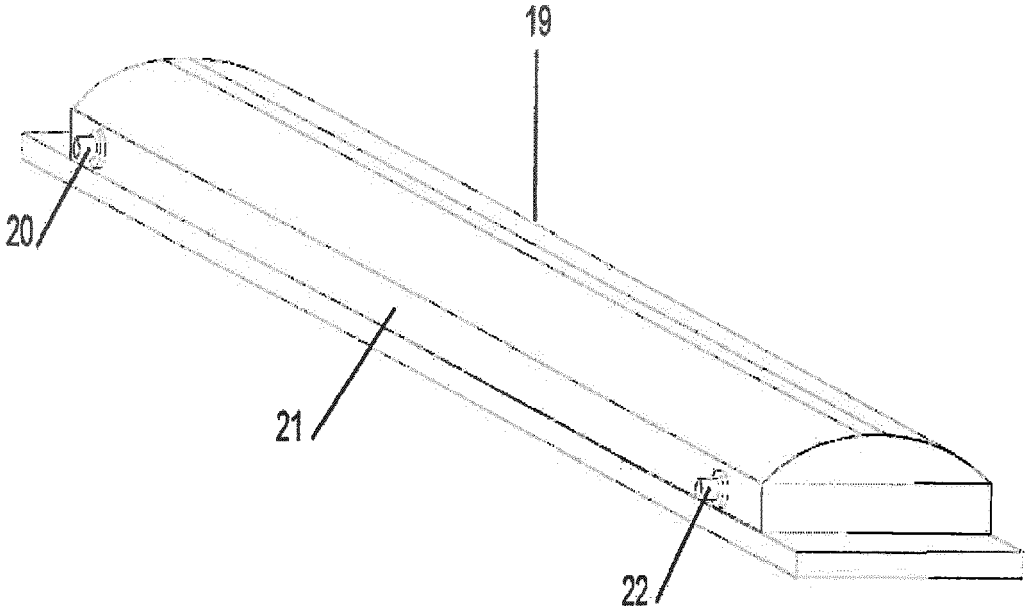


FIGURE 6

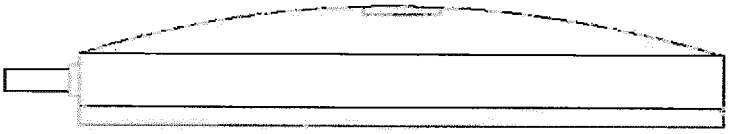
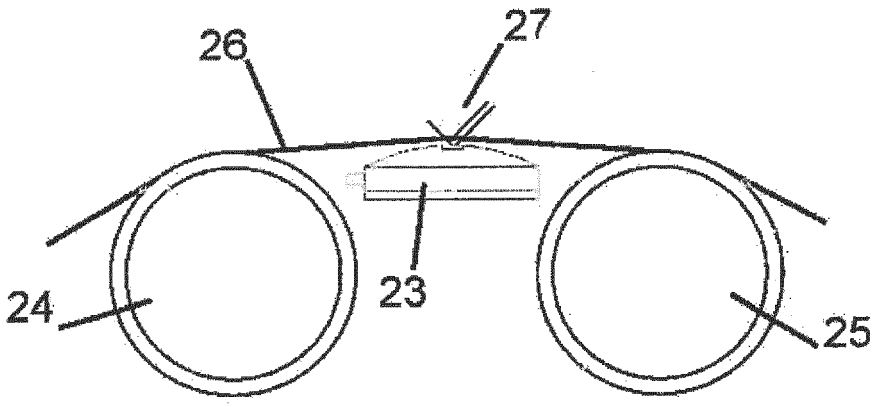


FIGURE 7



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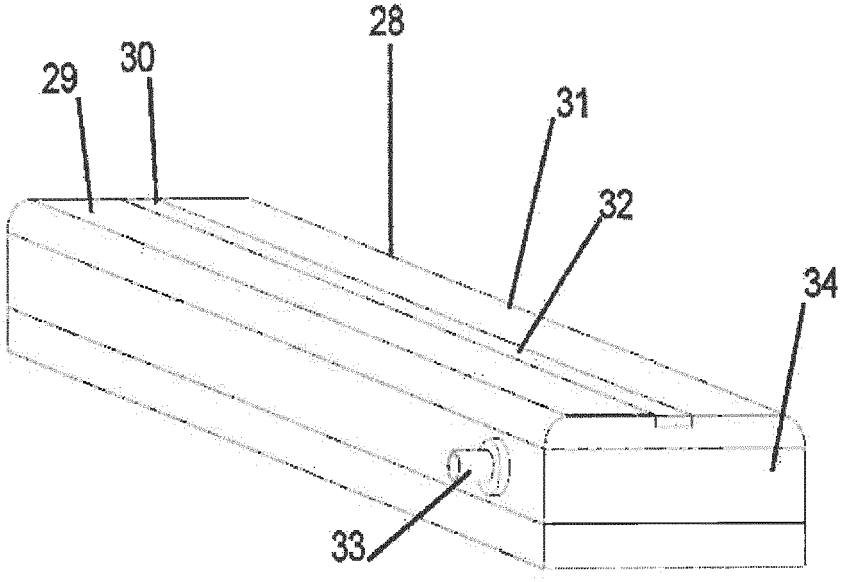


FIGURE 9

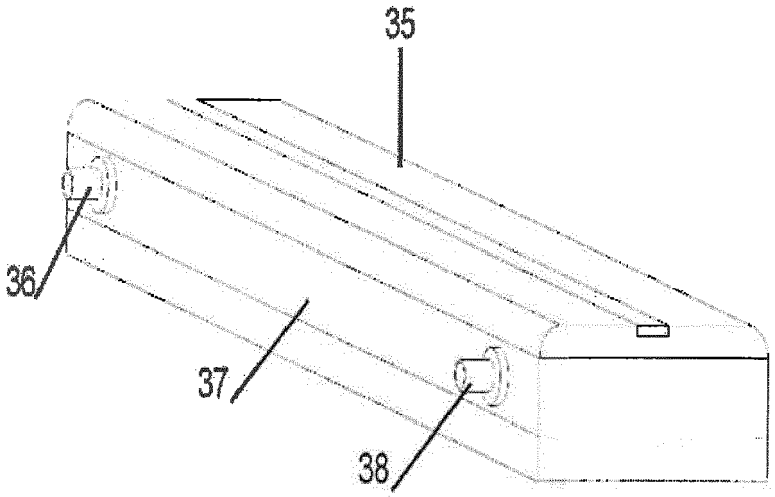
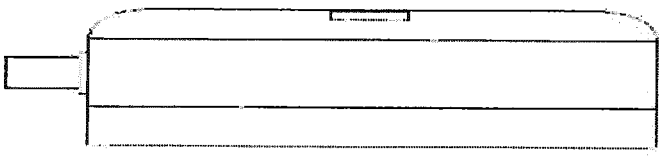


FIGURE 10



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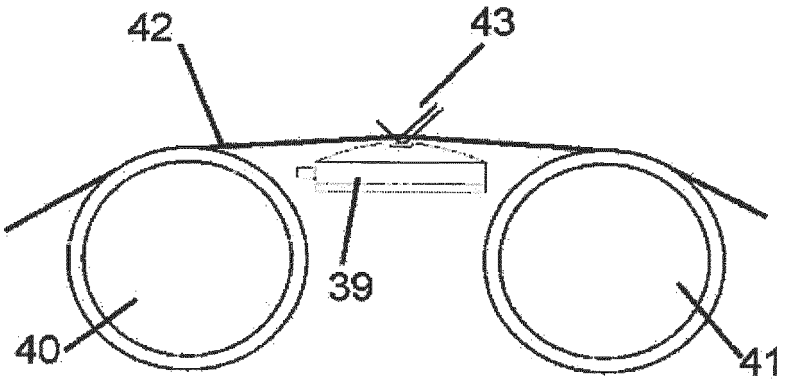

FIGURE 12

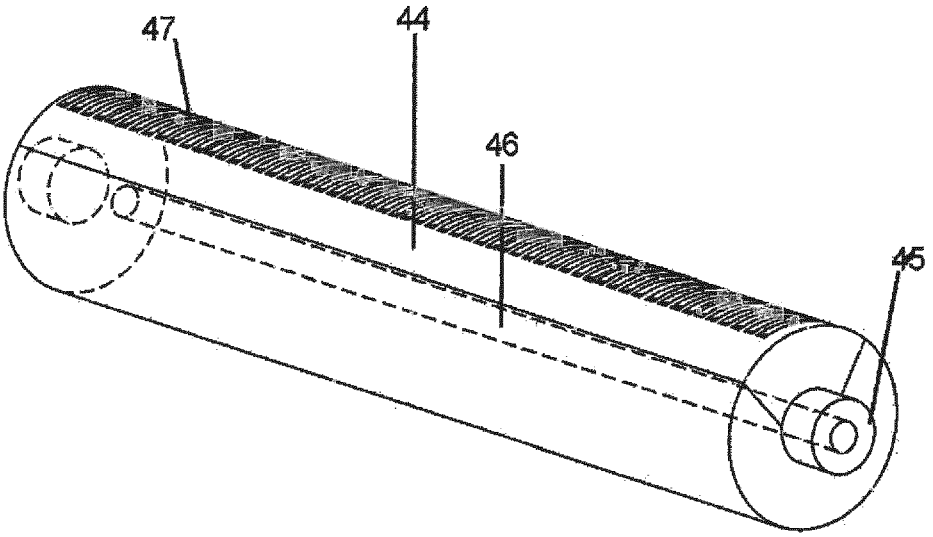

FIGURE 13

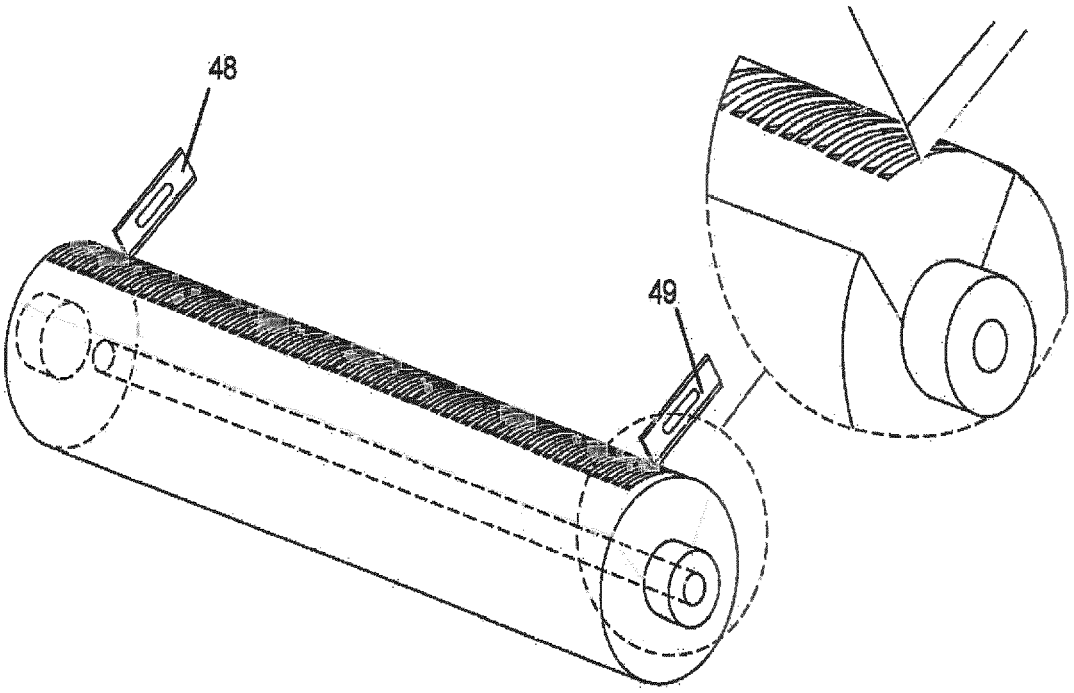

FIGURE 14

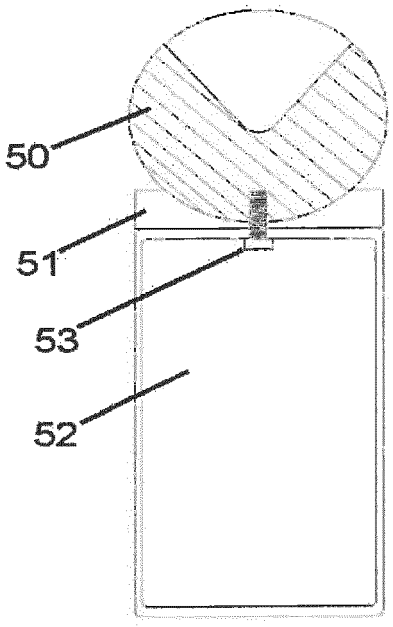

FIGURE 15

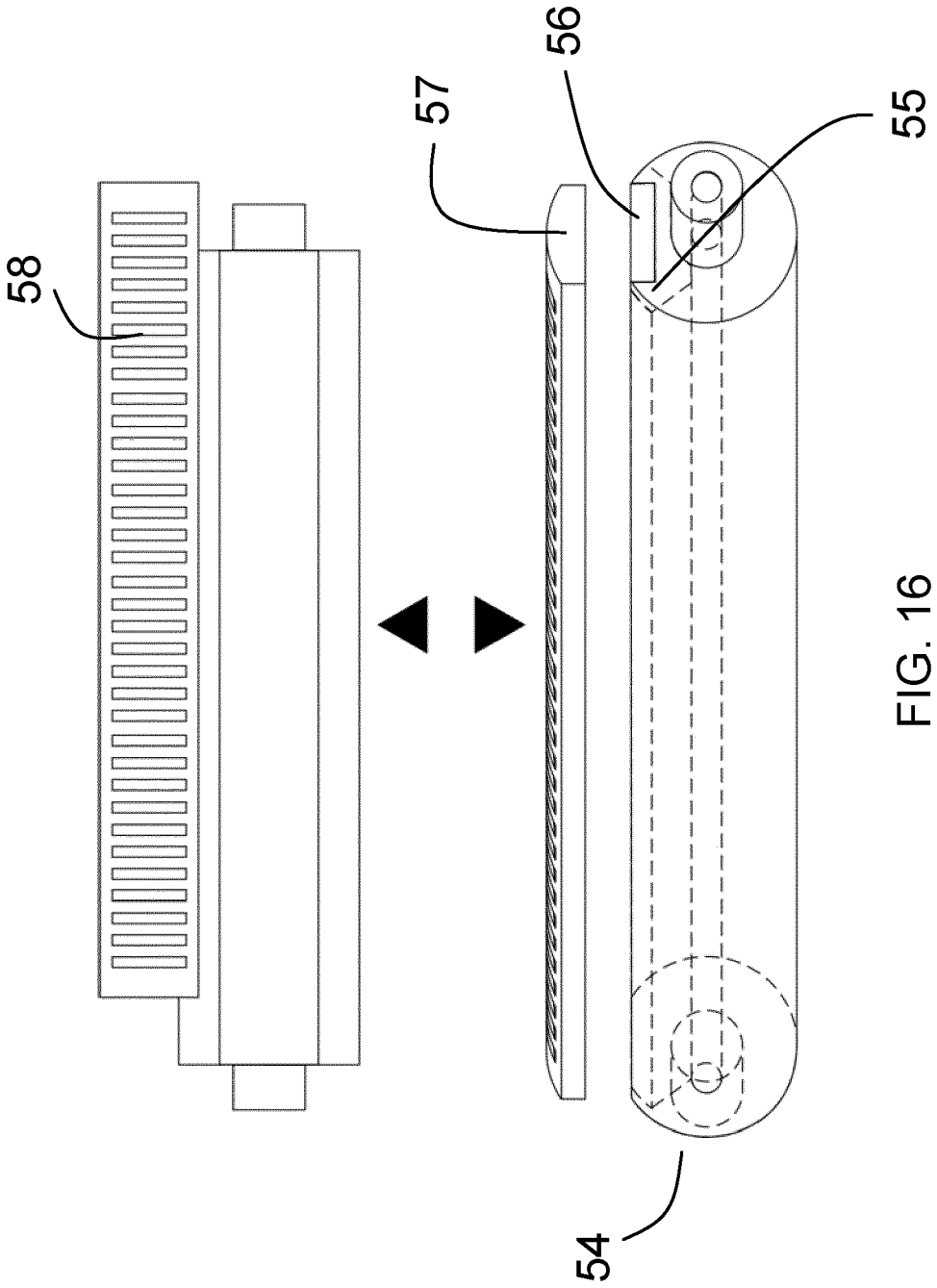

FIG. 16

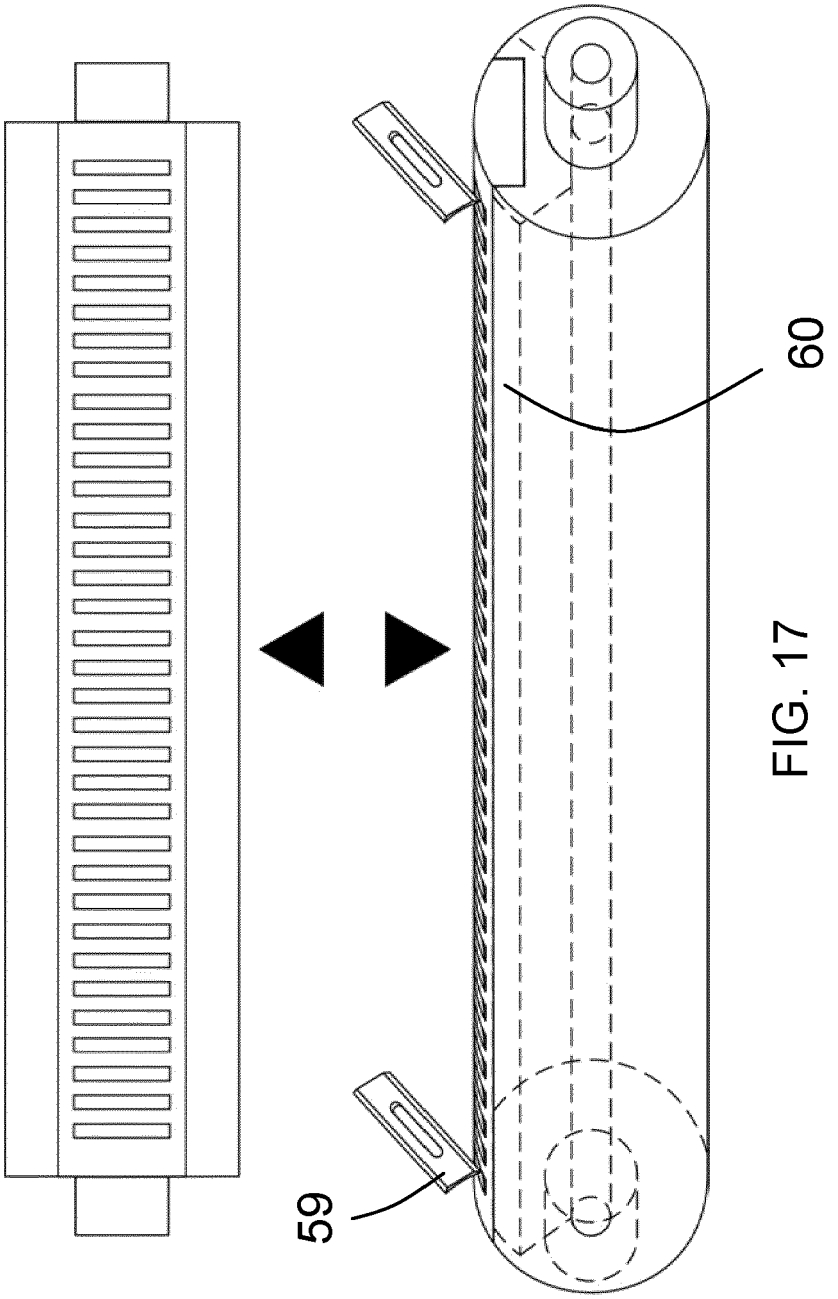

FIG. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 6055

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 0 710 531 A1 (EASTMAN KODAK CO [US]) 8 May 1996 (1996-05-08) * column 5, line 1 - column 7, line 53; figures 1-8 *	1-15	INV. B26D7/20 B65H23/24
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B26D
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 July 2012	Maier, Michael

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