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[54] **METHOD AND APPARATUS OF PRODUCING A SHEET WITH ORIENTATED FIBERS BY OVERFLOW**

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[58] **Field of Search**.....162/123, 132, 213, 215, 216, 162/325, 336, 292, 295, 341, 342

[56] **References Cited**

UNITED STATES PATENTS

3,654,074	4/1972	Jacquelin	162/215 X
3,205,124	9/1965	Selke	162/216 X
2,319,133	5/1943	Hornbostel	162/215
2,148,613	2/1939	Frost	162/215 X
3,020,189	2/1962	Waggoner	162/292 X
3,201,306	8/1965	Hornbostel, Jr.	162/213

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[57] **ABSTRACT**

A method of and apparatus for producing a nonwoven material from a liquid suspension of fibers in which the suspension is fed to a container, has a gyratory motion applied to it in the container and is fed from the container as an overflow against a receiving band fed past the overflow.

9 Claims, 5 Drawing Figures

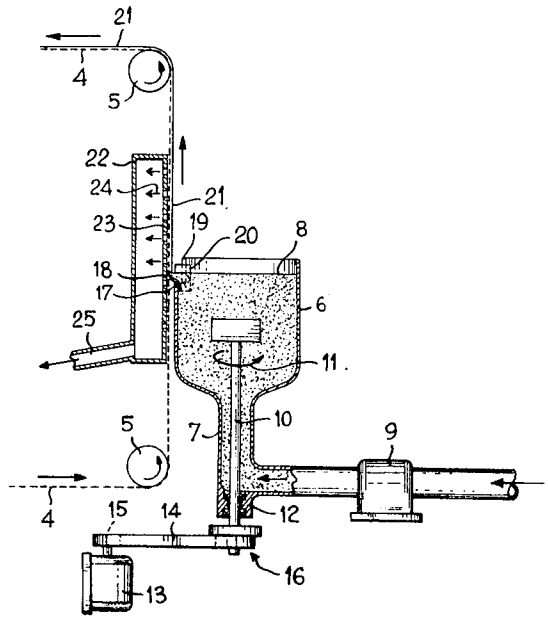
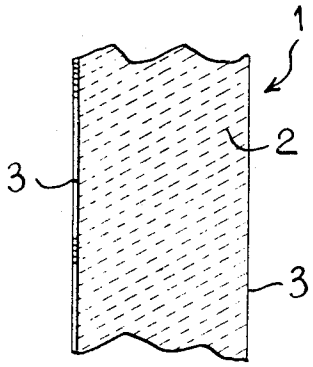


Fig.1



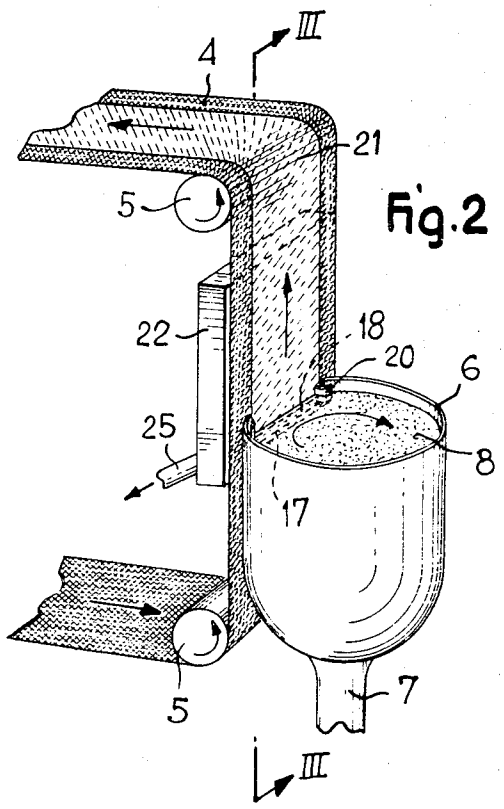


Fig.2

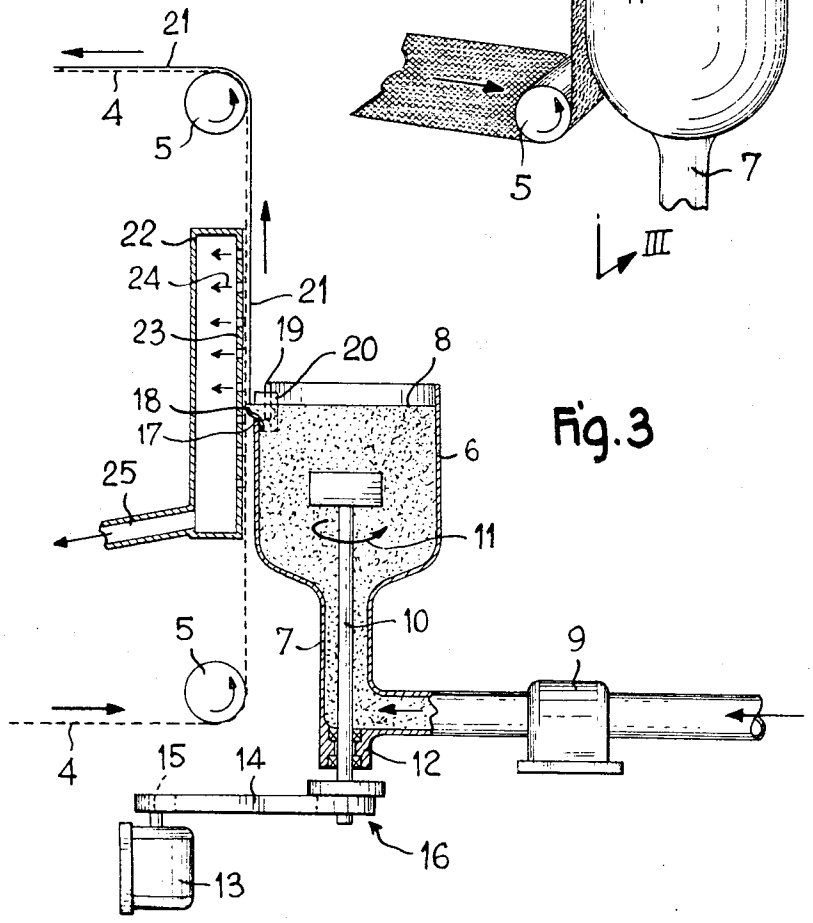


Fig.3

Fig.4

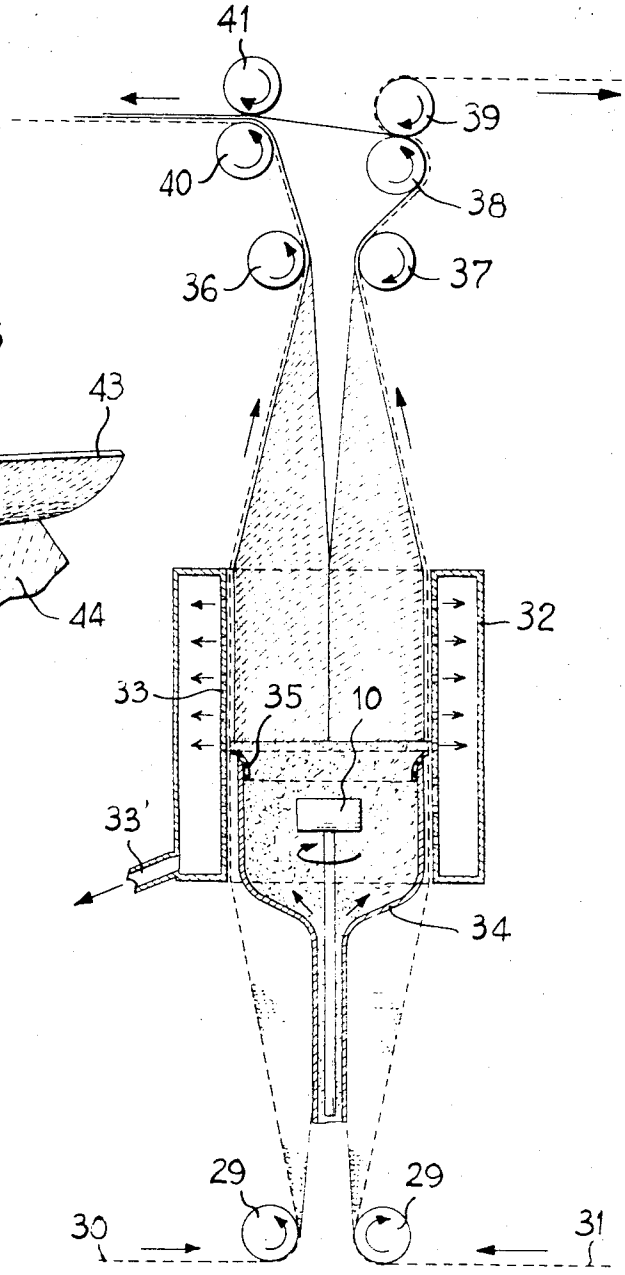
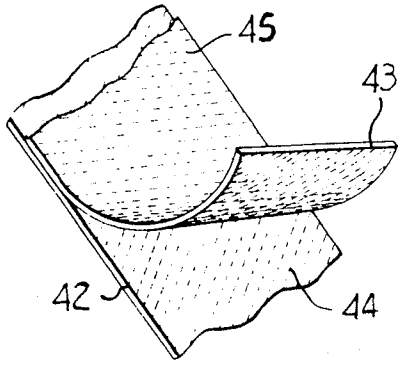


Fig.5



METHOD AND APPARATUS OF PRODUCING A SHEET WITH ORIENTATED FIBERS BY OVERFLOW

This invention relates to a method whereby a sheet or an element consisting of a uniform system, more particularly of the nonwoven type, can be produced by distributing a liquid, pulpy or fibrous-textured product onto a moving band.

More particularly, the invention relates to a method of producing a sheet or an element consisting of a uniform system, whereby most of the fibers deposited on the band have a substantially oblique orientation in relation to the edges of the sheet or element in order to improve the anisotropic characteristics thereof, and more particularly resistance thereof to tension or compression exerted transversely.

A method has already been proposed for the production of a sheet or element comprising obliquely orientated fibers. In this method, the band moving in a specific direction is brought into contact with the product which is to be distributed and the product receives a movement, one of the components of which is parallel to the plane of the band and perpendicular to the direction of movement thereof.

In other words, the product is forced to move in a different direction from the band, so that when the product comes into contact with the latter the fibers it contains are deposited in an orientation which differs from the directions of movement of both the band and the product.

In this known method, the band is passed through a distribution box containing the product for distribution, which is subjected to turbulent agitation which starts in a very eccentric zone of the box. The disadvantage of this method is that it is impossible suitably to control the movement of the product, the uniformity of which is disturbed by considerable microturbulence. In these conditions it will be apparent that the fibers are deposited haphazardly on the band; and that the density of deposition of the fibers cannot be constant over the entire width of the band, so that the resulting sheet has variations in weight and quality.

With this method it is also impossible conveniently to control the arrangement of the fibers and, in particular, control their orientation.

The properties of sheets or strips having a fibrous texture depend largely on the relative arrangement of the fibers in the system and it is therefore advantageous to be able to determine and, if necessary, modify such arrangement.

With the present invention it is possible to obviate the disadvantages of the known method and obtain paper sheets or webs, or sheets or webs of nonwovens having controllable anisotropic characteristics.

The method according to the invention thus allows the continuous production of a sheet or web of paper or nonwovens element whose fibers have a general oblique orientation in relation to the direction of movement of the band, whereby sheets or webs can be obtained with a transverse resistance greater than the longitudinal resistance. The method also provides good uniformity of the sheet structure in the transverse direction.

To this end, the method according to the invention of distributing a liquid, pulpy or fibrous product in a container on to at least one band moving in a specific direction comprises bringing the band into contact with the product contained in the container and, near the band, imparting to the product a velocity, one of the components of which is parallel to the plane of the band and perpendicular to the direction of movement thereof, the said method being characterized in that the product to be distributed is kept at a predetermined level in the container and its transfer to the band is effected by overflow.

It will be seen that in the zone in which the band and the product are in contact the respective velocities of the band and of the product, if they are not zero, are compounded and the fibers are therefore deposited on the band in a generally oblique orientation in relation to the directions of movement of the band and of the product. Most of the fibers will assume an oblique orientation and the bulk of the fibers may therefore be said to have a preferential orientation.

More particularly, the mass of the product to be distributed is driven with a uniform gyratory movement centered on an axis of symmetry of the container, the wall of which preferably is formed by a surface of revolution.

The band used may be a flat band, in which case, since the product to be distributed moves in a circular path, the band will move tangentially to the path of the product. If, on the other hand, the band used is capable of curving transversely over at least part of its length, the path of the product to be distributed will be parallel to the surface of the band.

The method according to the invention could also be used for the simultaneous production of a plurality of sheets, in which case two or more bands will be used.

The invention also relates to apparatus for performing the method according to the invention. The apparatus according to the invention comprises in known manner at least one endless band moving in a specific direction, and a container which is continuously fed with the product for distribution and which has an aperture through which the product is fed to the band, said apparatus comprising guide means which apply the band against the container zone formed with the said aperture, and drive means which impart to the product for distribution a velocity of movement, of which one component near the band is parallel to the plane of the latter and perpendicular to the direction of movement of said band, said apparatus being characterized in that the aperture formed in the container is in the form of a lip or slot of a width equal to or less than the width of the band, said lip or slot being formed in the container wall adjacent the band.

The container is preferably formed by a surface of revolution and it can be fed with the product in the direction of its axis or tangentially to the container wall and perpendicularly to a generatrix thereof.

In the case of a curved band, it will be preferable to use a container in the form of a surface of revolution whose axis is parallel to the band, the container advantageously being fed with the product in the direction of its axis.

Any drive means may be used to impart the velocity of movement to the product, provided that they ensure uniform rotation of the mass of the product about the axis of symmetry of the container. More particularly, a

blade-type agitator may be used disposed on the axis of symmetry of the container.

The invention also relates to a product obtained by the application of the above method and apparatus.

A single sheet or web manufactured according to the invention has a system in which the bulk of the fibers are oriented obliquely with respect to the longitudinal edges of the sheet or web, the fibers having any angle of orientation which is, however, determined by various controllable parameters, the said sheet or web being characterized in that throughout its width it has a constant uniformity of transverse distribution of the product; uniform specific weight and orientation of the fibers; and a constant proportion of long and short fibers.

The apparatus according to the invention can also be used for the manufacture of complex products with a crossed structure, which are produced by superposing two or more single sheets whose fibers are oriented obliquely, the orientation of the fibers of each single sheet being either symmetrical or asymmetrical, with respect to the longitudinal axis of the structure, to the orientation of the fibers in the adjacent single sheet or sheets.

The products having a crossed fiber complex structure have very advantageous properties. The resulting textures are specifically arranged and are uniform and resemble certain woven fabrics. The invention affords the possibility of controlling the arrangement of the fibers in the complex products so that the maximum advantage can be obtained from the fibrous materials used.

A number of exemplified embodiments of the invention will now be described with reference to the accompanying drawings wherein:

FIG. 1 is a detail of a single sheet obtained according to the invention.

FIG. 2 is a diagrammatic perspective view of apparatus for the production of a single sheet of the type shown in FIG. 1.

FIG. 3 is a diagrammatic section on the line 3 — 3 in FIG. 2.

FIG. 4 is a diagrammatic section of an alternative apparatus for the production of a complex structure.

FIG. 5 shows such a complex structure.

In order to simplify the explanation, reference will be made solely to the production of sheets of paper, the basic product being paper pulp. Of course this does not limit the invention, which can be applied to the production of articles from any other material which may be in the form of a liquid, paste or pulp, or fiber.

Referring to FIG. 1, reference 1 denotes a piece of a single sheet or web of paper produced continuously by the method according to the invention, the fibers 2 therein having a general oblique orientation in relation to the longitudinal edges 3.

The type of single sheet or web may be produced, for example, by means of the apparatus shown in FIGS. 2 and 3.

The apparatus shown in FIGS. 2 and 3 comprises a flat band 4 driven continuously and at a specific velocity by known means (not shown). The band 4 may advantageously consist of a fine-mesh metal cloth and is guided, supported and driven by rollers 5 rotated at the same velocity by conventional drive means (not shown).

In the vicinity of a part of the path of the band 4 in which the latter is preferably, but not necessarily, ascending and inclined (in the example illustrated the ascending run of the band is vertical), there is disposed a container 6 which is in the form of a bowl of circular cross section adapted to contain a product such as paper pulp. The bowl 6 is disposed with its axis vertical. At the bottom the bowl continues in the form of a pipeline 7 for continuously supplying paper pulp to the bowl so that the level 8 of paper pulp therein is constant. The bowl can be fed by any suitable known means, e.g., a pump 9 drawing paper pulp from a reservoir and delivering it to the pipeline 7.

A bladed rotary agitator 10 (see FIG. 3) is mounted on the axis of the bowl 6 and its rotation causes the mass of paper pulp to move in a circular path indicated by the arrow 11. The shaft of the agitator 10 is mounted rotatably (e.g., by means of bearings) in a support 12 rigidly connected to the wall of the pipeline 7, conventional sealing means, such as gaskets, being provided between the bore of the support 12 and the agitator shaft in order to prevent any leakage of the paper pulp flowing through the pipeline 7. The outer end of the shaft of the agitator 10 is connected to a motor 13 for its drive; the transmission of the movement from the motor to the shaft can be via any known means, e.g., a belt 14 connecting a pulley 15 of the motor to a change-speed device 16 mounted at the end of the agitator shaft and providing a progressive speed change. The change-speed device 16 allows the agitator to be driven at different speed so that different speeds can be transmitted to the mass of paper pulp in the bowl 6. That part of the top edge of the bowl 6 which is in contact with the band 4 has a slot or lip 17 of a length equal to or less than the width of the band and the edge of which is at a lower level than the level 8 of the pulp in the bowl. A flexible seal or doctor 18 formed, for example, by a sheet of flexible plastics material, is fixed over the entire length of the slot or lip so as to bear in contact by its free edge and — as a result of the thrust of the pulp in the bowl — against the band 4. Since the latter is driven with an ascending movement, it will tend to push back the free edge of the seal 18 against the action of the pulp and the seal will therefore remain in the inclined position shown in FIG. 3. In this position, the edge of the seal rubbing against the band is at a lower level than the level 8 of the pulp in the bowl 6 and there will therefore be a constant overflow of pulp onto the band 4 above the seal 18.

Since the bowl is of circular section, the edge of the slot or lip will of course have a curvature (which will be slight in the case of a bowl of large radius) and the vertical edges 19 of the lip or slot will be withdrawn in relation to the band. To compensate for this distance from the vertical edges of the slot and prevent leakages of pulp in these zones as far as possible, any suitable arrangement can be adopted, e.g., the edges 19 can be bent in the direction of the band or else, as shown in FIG. 3, the ends 20 of the seal 18 can be so profiled that they are applied against the band and have a height extending beyond the level 8 of the pulp in the bowl. At all events, the main thing is that the gyratory movement of the pulp in the bowl should not be appreciably counteracted in the vicinity of these zones by the profile adopted for the walls of the bowl or for the ends of the seal.

The constant overflow of pulp above the seal **18** combined with the movement of the band allows a sheet **21** to form thereon. For drainage purposes, the band slides along a filter chamber **22** provided with a grating or a porous wall **23** which is in contact with the band. Liquid passes into the filter chamber in the direction of the arrows **24** and is discharged via a pipe **25** at the base of the chamber **22**. Generally, the centrifugal force driving the pulp when it is deposited on the band **4** is sufficient to give good evacuation of the liquid, but the chamber could be evacuated in known manner to accelerate the deposition of the fibers on the band and the discharge of the liquid. The wall **23** of the chamber advantageously forms a support for the band **4** in the overflow zone of the pulp, thus giving a specific relative position of the band and of the bowl **6**.

In this way, the fibers are fixed on the cloth of the band in an oblique orientation arising out of the combination of the velocity of movement of the cloth and the velocity of movement of the pulp near the cloth.

FIG. **4** shows an alternative embodiment of the method according to the invention.

In this embodiment, two facing bands **30** and **31** are used and are guided by support rollers **29**. In this case, the bands consist of a flexible mesh metal cloth capable of deformation such that the cloth can undergo considerable deformation. The ascending runs of the cloths enter a filter chamber **32** of a structure comparable to the chamber **22** in FIG. **3**, except that it is of cylindrical shape, the inner filtering wall **33** having a circular section of a length equal to twice the width of a band **30** or **31**. In contact with this inner wall, the bands **30** and **31** experience deformation and assume the cylindrical shape of the wall, the edges of the bands rejoining along a generatrix of said wall. A pipe **33'** at the base of the chamber **32** discharges the filtered liquid.

Inside the cylindrical chamber **32** is a bowl **34** for the pulp, which is similar to the bowl **6** in FIG. **2**, except that it does not have any slot or lip. The top edge of the bowl **34** is provided with a seal **35** in frictional contact with the bands **30** and **31**. The constant level of pulp in the bowl is situated above the free edge of the seal, so that there is a continuous overflow of pulp onto the entire chamber periphery. On leaving the cylindrical chamber **32**, the bands resume their flat shape and pass over guide rollers **36 – 37** and entrain the sheets of paper. One of the sheets is brought onto the other by being guided between the rollers **38** and **39** and then **40** and **41**; the band **30** provided with the other sheet passes between the latter rollers **40** and **41**. In this way, a complex structure consisting of two superposed sheets is obtained at the output of the rollers **40** and **41**. A structure of this kind is illustrated in FIG. **5**.

The complex structure comprises two sheets **42** and **43**, the first of which is similar to sheet **1** in FIG. **1** and has fibers **44** oriented obliquely and ascending from left to right looking at the drawing.

The sheet **42**, on the other hand, has fibers **43** which are oriented and ascend from right to left. The superposition of these two sheets therefore gives an article having a crossed structure.

The orientation of the fibers of sheet **43** may or may not be symmetrical to the orientation of the fibers of sheet **42** in relation to the longitudinal axis of the structure. The resistance of such a crossed structure in the transverse direction is very much better than that of paper produced by conventional methods and if required it may even be greater than the resistance in the longitudinal direction.

Of course it will be apparent that the apparatus shown in FIG. **4** can be used for the production of just one sheet or more than two sheets simultaneously, depending upon whether a single curved band or more than two is/are used.

This description has been given by way of example without any limiting force and it will be apparent that additions or modifications can be made without thereby departing from the scope of the invention which is to be interpreted in its widest sense.

For example, when a bowl such as **6** is used, the supply at the bottom and mechanical agitation of the product could be replaced by admitting the product under pressure and tangentially to the wall of the container, e.g., via a horizontal pipe disposed in the central part of the bowl.

What is claimed is:

1. A method for distributing a pasty, pulpy or fibrous-textured liquid product to form a uniform product in which fibers are oriented; the method comprising steps of

introducing the product into a container,

maintaining the product at a predetermined level in the container,

providing a band moving in a vertical direction,

passing the band vertically adjacent an outlet in the container,

distributing the product onto the band by overflowing the product from the outlet of the container,

imparting to the overflowing product a velocity in the vicinity of the band with one component of said velocity vertical and another component of said velocity horizontal.

2. The method of claim **1** with

having the band flat,

imparting said velocity to the product in the container as a uniform gyratory movement,

having the band contact the product tangentially.

3. The method of claim **1** with

providing the band of a deformable material to assume over part of its length a curved cross section,

imparting said velocity to the product in the container as a uniform gyratory movement,

having the band contact the product along said curved cross section.

4. Apparatus for distributing a pasty, pulpy or fibrous-textured liquid product to form a uniform product in which fibers are oriented; the apparatus comprising in combination

a container,

feed means for feeding continuously the product for the container,

the container provided with an outlet for removing the product therefrom by overflow of the product over the container outlet,

guide means defining a vertical path for a band which path includes a portion adjacent to the outlet,

the container provided with drive means located centrally in the container for imparting to the product a velocity in the vicinity of the outlet with one component of said velocity vertical adjacent the

outlet and another component of said velocity horizontal adjacent the outlet,
the outlet including an opening extending transversely of said band and having a width no greater than said band.

5. Apparatus according to claim 4 with
the opening having an edge,
the edge provided with at least one seal for contact with the band.

6. Apparatus according to claim 5 with
the container having a wall,
the wall formed substantially as a surface of revolution.

7. Apparatus according to claim 6 with
said surface of revolution having an axis,
the container provided with an inlet opening on the axis,
said feed means including said inlet opening.

8. Apparatus according to claim 6 with
said surface of revolution having an axis,
the wall provided with an inlet opening substantially perpendicular to the axis,
said feed means including said inlet opening.

9. Apparatus according to claim 6 with
the band deformable to assume over part of its length a cross section which is an arc of a cylinder,
the cylinder having generatrixes parallel to the path of the band adjacent the outlet.

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