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(54) Endless wire for pulp thickener.

(57) A stock thickener for thickening pulp and paper stock, for use in papermaking equipment, includes a pair of spaced-apart rolls (20 and 22), and a single open-mesh or foraminous endless wire (30) trained over the rolls. Stock to be thickened or dewatered is admitted to a region defined by an inside surface of the wire and is carried by the endless wire from one of the rolls to the other. The wire (30) has a width which is greater than the width of the rolls, and guide belts (70) are attached to the portions of the wire which extend beyond the roll faces (72). The guide belts (70) are attached to the wire at their backs by an adhesive (77) and by a continuous thread (75) which extends through the belt from the bottom thereof through the back and through the wire.

FIG-3

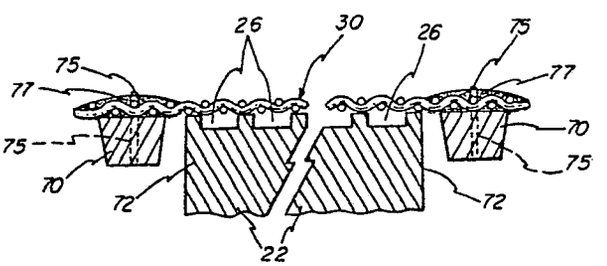
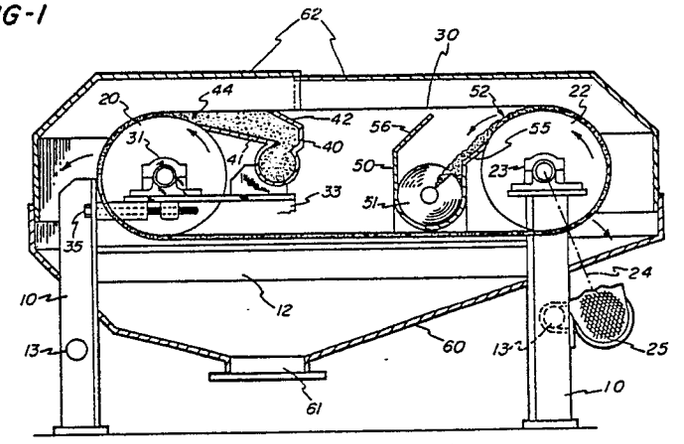


FIG-1



EP 0 341 913 A2

ENDLESS WIRE FOR PULP THICKENER

The invention is related to the apparatus for thickening pulp and paper stock shown in the U. S. Patent of Seifert et al, No. 4,722,793 issued February 2, 1988. This apparatus employs an endless wire rained over a pair of rolls.

The Seifert et al patent discloses that in order to guide an endless wire so that it will travel in a path perpendicular to the axes of the two rolls, the wire may be provided along one or both edges of its inner surface with a strip, e. g. a V-belt, which fits in a peripheral groove in each of the rolls. In the practical development of the apparatus of that patent, however, considerable difficulty was encountered in securing this guiding strip to the wire in a manner which would prevent its separation from the wire under the stresses of use, particularly at the relatively high speeds contemplated for the apparatus, namely speeds as high as 914 meters per minute. While it would be presumed that this would not be a problem in view of the improvements in recent years in the technology of adhesives, no adhesive could be found for securing such a guiding strip to a woven wire which would hold up for a satisfactory period even under prototype laboratory testing conditions.

The forces acting on the wire, to which the guide belts are attached, are not only the centrifugal force due to the weight of the stock carried on the inside wire surface, but also is due to the quantity of water which forms part of the stock which is applied at high velocity by the headbox. A major portion of this water must pass through the wire during its first turn about the roll, and the greatest stresses against the wire and against the guides belts occurs at this location. Further, in the apparatus of the Seifert et al patent, the partially dewatered stock is carried from the first roll to the second roll on the inside surface of the wire, and the wire holds the stock from falling away or being flung out from the surfaces of both of the rolls. For these reasons the wire is subject to forces which tend to bulge it away from the rolls and place both shear and tensile loading on the connection between the wire mesh and the guide belts.

The invention can be described as an improved wire for a high speed type stock thickener for papermaker's stock in which the wire is trained over at least two rolls and the paper stock is applied between the endless wire and at least one of the rolls. The stock is carried on an inside surface of the wire for dewatering at the regions where the stock is carried between the wire and one of the rolls, characterized by the fact that the wire is formed with a width which is greater than the axial face length of the rolls so that a marginal edge of the wire extends beyond the ends of the rolls, and a guide belt is positioned at each marginal edge of the wire so that the belt will run adjacent the ends of the rolls. The guide belt is fastened to the wire by an adhesive bond between the back of the belt and the wire surface in which the bonding glue penetrates the wire openings while forming a chemical bond to the belt, and further characterized by a continuous thread sewn to the belt from the bottom and through the back and into the wire, which thread extends along the length of the belt.

The invention is further characterized by a high speed type stock thickener which employs an endless wire as previously described. Further inventive features include the employment of flexible backing strips which are positioned opposite the belts and sewn to the belt and to the wire and glue bonded in place. The flexible backing strip may comprise a second V-belt in inverted relation to the first V-belt.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a somewhat diagrammatic side view, partly in section, of thickening apparatus with which the invention is used;

Fig. 2 is an end view looking from right to left in Fig. 1 and partly broken away in section;

Fig. 3 is an enlarged fragment of Fig. 2;

Figs. 4 and 5 are enlarged fragmentary sections illustrating modifications of the construction shown in Fig. 3;

Fig. 6 is a view similar to Fig. 5 showing an embodiment of the invention wherein a guide belt is located on each side of the wire;

Fig. 7 is a perspective view similar to Fig. 6 showing a variation in the location of the guide belts on both sides of the wire; and

Figs. 8-12 are views similar to Fig. 4 showing other embodiments of the invention.

Figs. 1-2 illustrate the principal structure of the thickening apparatus described in U. S. Patent No. 4,722,793. It includes a frame comprising two columns 10 and 11 on each side connected by side beams 12 and cross braces 13. The two large rolls 20 and 22 are mounted adjacent opposite ends of the frame, the roll 22 being shown as mounted by pillow block bearings 23 on the tops of columns 10 and 11. This roll 22 is a driven roll, through the belt drive indicated generally at 24 by a motor 25 mounted on the cross brace 13 between the columns 10 and 11. The rolls 20 and 22 may have liquid-impervious outer surfaces, but preferably these surfaces are grooved as indicated by the

helical grooves 26 in Fig. 3.

An endless loop of woven foraminous "wire" 30 is trained around the rolls 20 and 22 and defines therewith a space in which the other operating parts of the apparatus are located. Preferably the wire 30 will consist of any plastic material currently used for paper machine wires, e.g. polyester. Roll 20 has an adjustable mounting on the frame which includes means for tensioning the wire, each of the journals of the roll 20 being mounted by a pillow block 31 on a base 33 which is in turn mounted for sliding movement on the side beam 12. A pair of jack screws 35 connected between bases 33 and the adjacent columns 10 and 11 cause and control this movement to effect corresponding control of the tension in wire 30.

A headbox 40 is mounted on the same base members 33 as the roll 20 so that it maintains a fixed spacing with respect to roll 20. This headbox is shown as of an open type including lower and upper walls 41 and 42 which extend upwardly to define a spout through which stock is discharged into the wedge zone 44 defined by the upper run of wire 30 approaching roll 20 and the surface of the roll itself. The stock to be thickened is fed to the headbox by any convenient feed line (not shown) from the usual stock supply pump (not shown).

At the other end of the space defined by the upper and lower runs of the wire 30 and the rolls 20 and 22 is a trough 50 having a screw conveyor 51 mounted in the bottom thereof for receiving thickened pulp from the surface of roll 22 in the wedge zone 52 defined by the roll surface and the upper run of wire 30 leaving this roll. The trough 50 includes a doctor 55 extending along its downstream edge which removes the thickened pulp from the surface of roll 22. An inclined wall 56 along the front edge of trough 50 prevents this pulp from being thrown beyond the trough, and the screw 51 forces the accumulated pulp to a chute 57 at the back of the machine which leads to the next station in the system.

In the operation of this apparatus, the pulp suspension to be thickened is constantly supplied to the wedge zone 44 from the headbox 40, and since a substantial volume of water will be forced through the wire before the wire reaches the roll 20, the resulting partially dewatered pulp is trapped between the wire 30 and the portion of the surface of roll 20 wrapped thereby. Proper control of wire tension contributes to the effectiveness of the initial dewatering of the suspension in the wedge zone 44 as the pulp travels therefrom around the surface of roll 20.

It is desirable that the wire tension not be so high as to make it difficult for the preliminarily thickened suspension to enter the space between the wire and the surface of roll 20. Thus if the wire tension is comparatively low, e. g. 1-40 lbs. per linear inch (0.15 to 5.9 Kg/cm), the pulp which has been subjected to initial dewatering as it approaches the small end of the wedge zone 44 will be more readily trapped between the wire and the roll 20 than if the wire is very tight.

The wire 30 serves as a filter that holds and carries the fiber on its inner surface against the action of centrifugal force, which is the major factor causing dewatering of the retained pulp at wire speeds of 640-914 meters per minute using rolls 20 and 22 which are 24 inches in diameter. The white water expressed through the wire is thrown into a trough 60 which extends under both rolls 20 and 22 and is provided with a drain outlet 61. A two-piece hood 62 is mounted on the frame above the apparatus as a whole, and it fits into the top of the trough 60 so that any water hitting the inner surface of this hood will drip therefrom into the trough.

It is important, particularly in view of the high wire speeds contemplated by the invention, and due to the forces against the wire, that the wire 30 be guided such that it travels along a course perpendicular to the axes of these two rolls. This guiding action is achieved by means of a pair of V-belts 70 adjacent opposite side edges of the inside surface of the wire 30.

While these belts could fit into grooves in the surfaces of rolls 20 and 22, as disclosed in U. S. Patent No. 4,722,793, preferred results have been obtained with the wire sufficiently wider than the axial dimensions of rolls 20 and 22 to locate these belts in overhanging relation with the ends of the faces of rolls 20 and 22, as shown in Fig. 3, so that each of these roll ends acts as a shoulder 72 which will engage the inner side surface of the adjacent belt 70 if the wire should drift to one side or the other.

In the development of the apparatus shown in Fig. 1, it was discovered that a combination of gluing and stitching would secure the belts to the wire and successfully withstand the stresses applied in test operations. This connection would last as long as the useful life of the endless wire itself. Good results have been obtained using a belt of the V-belt shape as shown in Fig. 3, formed of polyvinyl chloride, with a radial dimension of 1.59 cm and a thickness ranging from 2.22 cm to 1.71 cm.

It is important that the stitching 75 comprise a thread or line of sufficient strength, and particularly toughness, to withstand the repeated bending and flexing of the belt 70 as they travel around the rolls 20 and 22, and the thread must also be highly water resistant. From these standpoints, satisfactory results have been obtained using woven or monofilament 50 lb. (23 Kg) test fishing line, but

other types of thread or wire of comparable mechanical attributes could be used, as well as other forms of mechanical conventions, such as rivets.

In addition to the stitching 75, it has been found desirable to provide a glued connection between each belt 70 and the wire 30. More specifically, before attaching a belt to the wire, the outer edge portion of the wire is impregnated with urethane adhesive over a band approximately 3.8 cm wide which extends to and includes the outer edge of the wire, as indicated at 77 in Fig. 3.

After this adhesive material has dried, the wide edge of the belt 70 is glued thereto, preferably with an adhesive which will chemically bond the belt with the adhesive, impregnated strip of the wire. Adhesives found satisfactory for this purpose are those sold under the trade name "PU Adhesive" by Sigling America, Inc., Englewood, N.J., U.S.A., and under the trade name "Rema S.C.-2000" by Rema Division of Remaco, Northvale, N.J., U.S.A., in each case using the hardener recommended by the manufacturer with the adhesive. The joint is then completed by stitching the belt to the wire, as by means of a sewing machine such as is used in shoe-making operations.

The wire 30 is sufficiently wider than the axial length of the faces of rolls 20 and 22 to provide overhanging marginal portions of the wire at both ends of the rolls which will carry the belts 70. With a belt of the cross sectional dimensions noted above, satisfactory results have been obtained with the wire 7.50 cm wider than the length of each of the rolls, and with a strip of wire 0.634 cm wide extending beyond each belt, thereby providing a total clearance of 1.3 cm for each of the rolls between the pair of belts 70. Thus so long as the wire runs in a straight line, there may be no contact between either roll and either of the belts 70, but if the belt should wander slightly to one side or the other, engagement between the end of a roll and the inclined adjacent surface of one of the belts 70 will result in a camming action causing the belt to return to substantially centered relation with both rolls.

The strips of adhesive 77 extending to the outer edges of the wire strengthen and protect these portions of the wire from fraying in use and contribute to the useful life of each wire.

Figs. 4-12 illustrate modified constructions which embody the invention as described above. Thus in Fig. 4, a strip 80 of reinforcing material, which may be of the same elastomeric material as the belt 70 but somewhat greater width, is positioned on the opposite side of the wire 30 from the belt 70. The stitching 81 traverses both the belt 70 and the reinforcing strip 80 to secure these two elements together through the wire. The junction between these parts may also be reinforced by impregnating the portion of the wire underlying the strip 80 with glue, as indicated at 77.

The construction shown in Fig. 5 is similar to that in Fig. 4 except that the guide belt 85 includes a V-belt section 86 and marginal flanges 87 which cooperate with the wider portion of the V-section 86 to provide an increased area of contact with the wire 30. In addition, a strip 80 of reinforcing material of the same width as the maximum width of belt 85 is positioned on the opposite side of the wire 30 as in Fig. 4. The stitching 88 traverses both the V-section 86 of belt 85 and its side flanges portions as well as the reinforcing strip 80 and the wire. As in Fig. 4, it is desirable to reinforce the interconnection between these parts by impregnating the portion of the wire between the strip 80 and belt 85 with glue.

Fig. 6 shows the application of the invention to a wire 30 which may be used with either side outermost. A second belt 90 of the same cross sectional configuration as the belt 85 is placed on the other side of the wire from the belt 85, and the two belts are fastened to each other and the wire by stitching 92 which traverses all three elements as shown. The interconnection between the two belts is also be reinforced by impregnating the portion of wire therebetween with glue.

Fig. 7 illustrates a modification of the invention wherein guide belts 85 and 90 are provided on both sides of the wire but in offset relation, and with the connection between each of these belts and the wire provided with a reinforcing strip 80 as described in connection with Figs. 4 and 5. Fig. 7 also illustrates both of belts 85 and 90 as provided with multiple V-shaped slits 95 for relieving the tension and compression forces during use. With belts on both sides of the wire loop, the peripheral dimension of the belt on the outside of the wire will be greater than that of the inside belt, but this relationship will be reversed when the wire is turned inside out. The slits 95 cooperate with the elastomeric properties of the belts to compensate for these dimensional differences, and similar slits should be provided in the belts 85 and 90 in Fig. 6.

Fig. 8 shows a form of the invention wherein the guiding V-belt 100 includes a flange portion 101 on only one side thereof, and the belt is secured to the wire 30 by superimposing the flange 101 on a marginal strip of the wire 30 and securing these overlying layers together by stitching 102, preferably reinforced by glue impregnating the portion of the wire in contact with belt flange 101. It will be understood that this construction is duplicated at the other side of the wire.

In Fig. 9, the wire 30 is provided at each side with a guide belt 110 formed by rolling a marginal strip of wire on itself into the form of a V-belt. This rolled portion of the wire is secured together by

means of stitching 111, and its formation may also be aided bv a center core, preferably of elastomeric material and V-shape in section.

Fig. 10 shows a form of the invention similar to that in Fig. 9 except that the core 115 is a V-belt, and it is secured to the edge of the wire 30 by wrapping it in a marginal strip of the wire, with the resulting assembly secured together and to the wire by stitching 116.

Figs. 11 and 12 show two other forms of guiding belt which may be secured along each edge of the wire 30. In Fig. 11, the guiding belt 120 is of right angled form, and it is secured to the edge of the wire by folding a marginal strip of wire around it and by stitching 121 as shown. Preferably the overlying strip of wire will be impregnated with glue at the time of assembly. The guide belt 125 in Fig. 12 is of rectangular section and is similarly partially enclosed by a strip of wire 30 to which it is secured by stitching 126, with the aid of adhesive impregnating that portion of the wire which is contact with belt 125.

Claims

1. An open mesh endless wire for use as the stock supporting and conveying component in a high speed stock thickener in which the wire (30) runs over spaced-apart rolls (20,22), and in which the rolls are formed with a guide shoulder, such as an end wall (72), for coaction with a guide belt (70) on the wire, and in which, in operation, paper stock to be thickened is carried along the inside surface of the wire and between the wire and the outside surface of the rolls, characterized by a first fastener in the form of a bonding adhesive (77) between the back of the guide belt (70) and the adjacent wire surface which penetrates the open wire meshes and forms a bond between the belt (70) and the wire (30), and a second fastener in the form of a continuous thread (75) sewn through the belt and into the wire.

2. A stock thickener which employs an open mesh endless wire (30) in which the wire runs over spaced-apart rolls (20,22), and in which the rolls are formed with a guide shoulder, such as an end wall (72), for coaction with a guide belt (70) on the wire, and in which, in operation, paper stock to be thickened is carried along the inside surface of the wire and between the wire and the outside surface of the rolls, characterized by a first fastener in the form of a bonding adhesive (77) between the back of the guide belt (70) and the adjacent wire surface which penetrates the open wire meshes and forms a bond between the belt (70) and the wire (30), and a second fastener in the form of a continuous thread (75) sewn through the belt and into the wire.

3. The wire of claim 1, or the stock thickener of claim 2, characterized by the fact that the wire (30) is formed with a width which exceeds the axial length of the rolls (20,22), with a marginal edge of the wire which extends beyond the end faces (72) of the rolls, and the wire has two guide belts (70), one each secured to the wire at one of the marginal edges.

4. The wire or the stock thickener according to any preceding claim, in which the continuous thread (75) extends through the bottom of the belt (70) and through the back of the or each belt into the wire and extends the length of the or each belt.

5. The wire or the stock thickener according to any preceding claim, further characterized by a reinforcing flexible backing strip (80) positioned on the opposite surface of the wire (30) from the or each belt (70) and the first and second fasteners (77,75) joining the backing strip to the wire as a unit with the or each belt.

6. The wire or the stock thickener according to any preceding claim, in which the or each belt includes a pair (85,90) of belt portions attached to the wire in back-to-back relation so that the wire may be run with either side out.

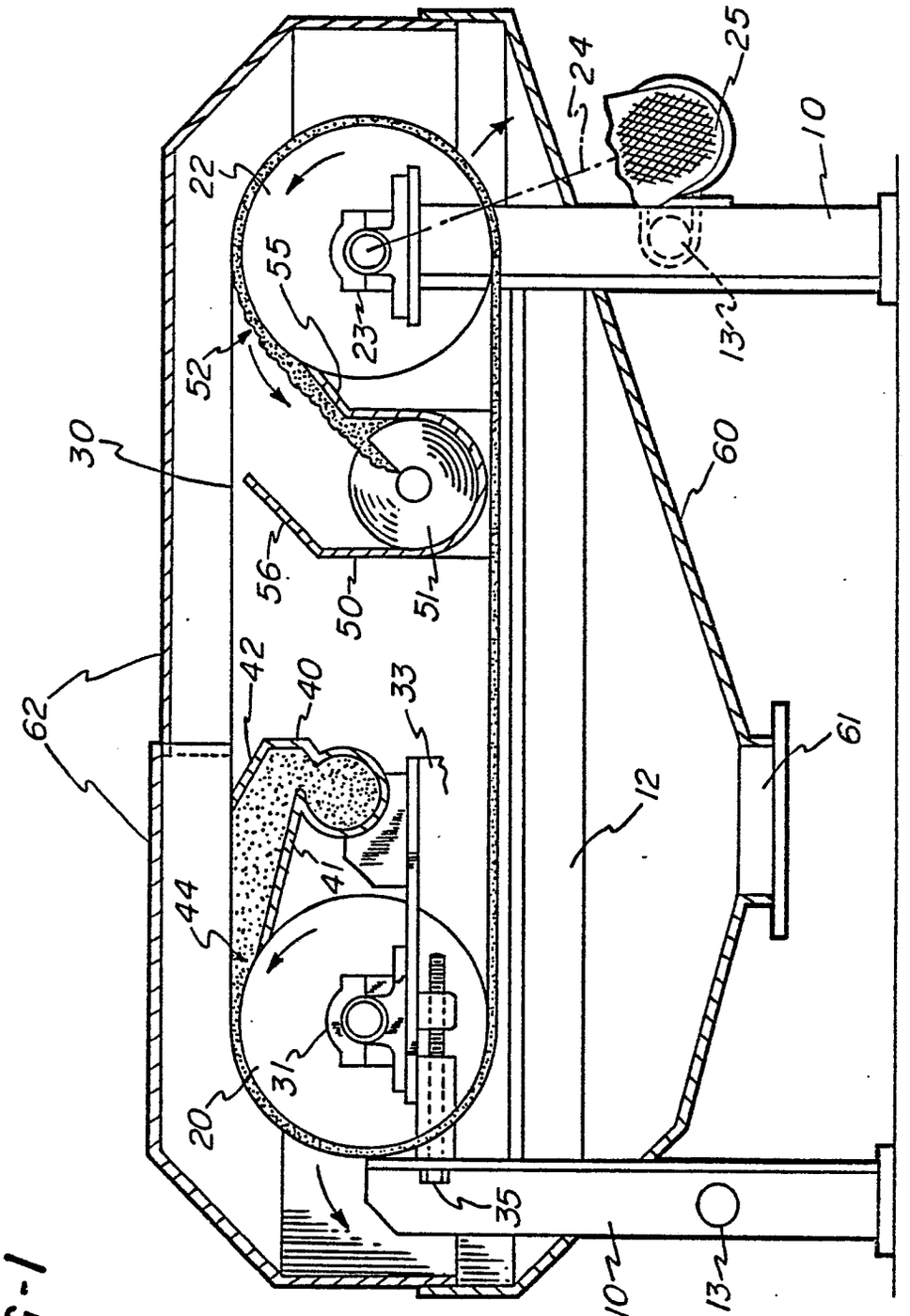


FIG-1

FIG-2

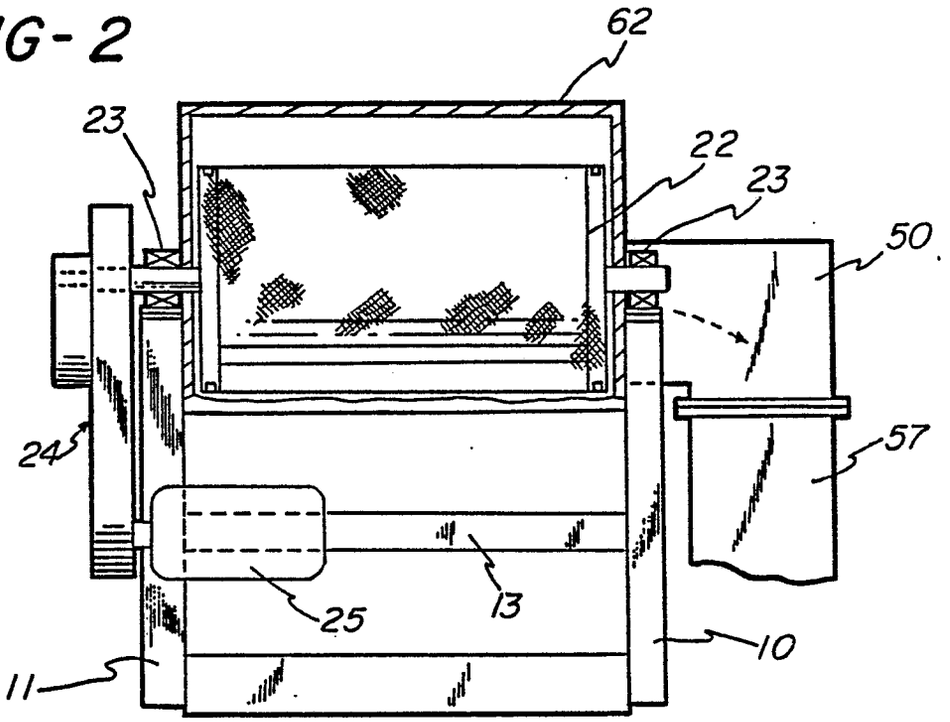

62
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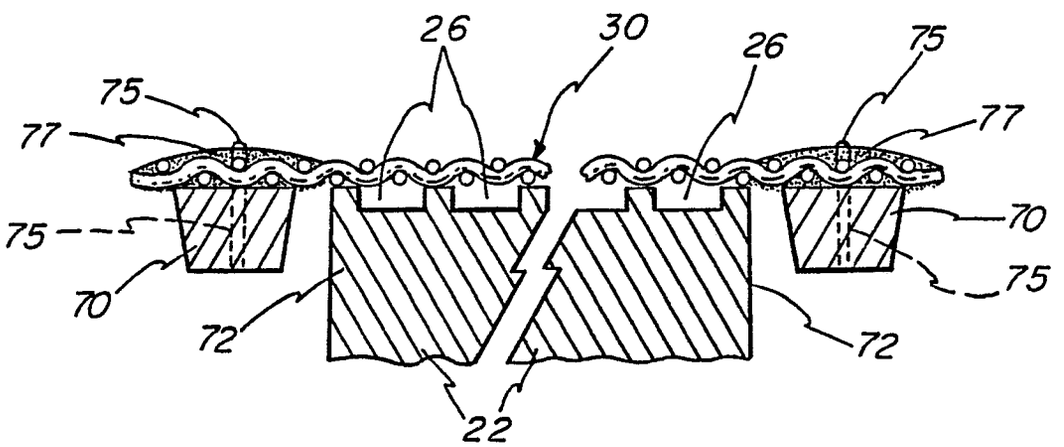
FIG-3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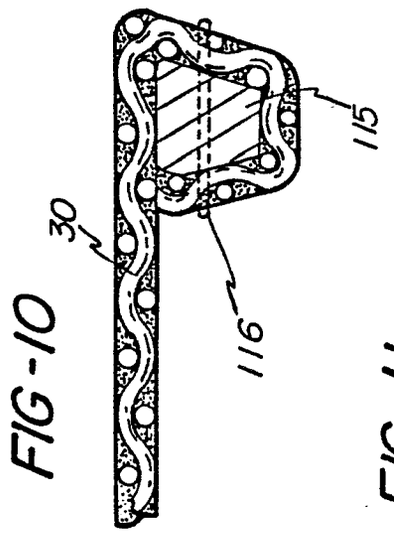

FIG-10

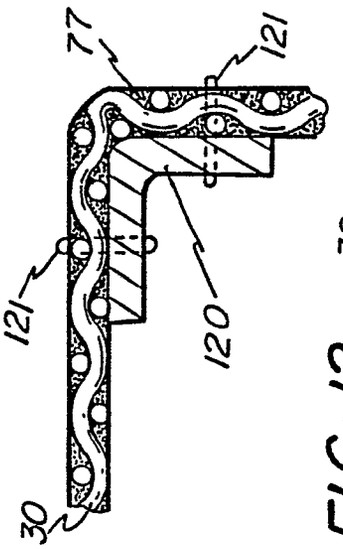

FIG-11

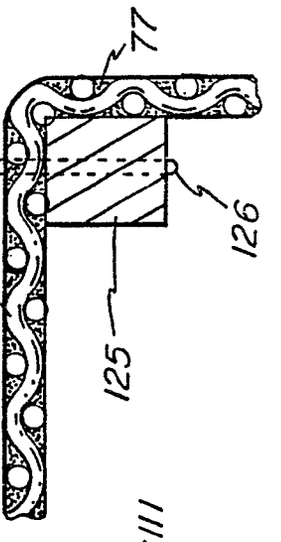

FIG-12

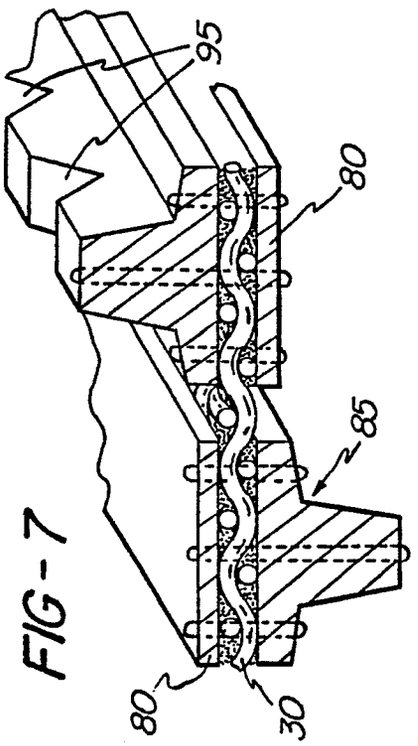

FIG-7

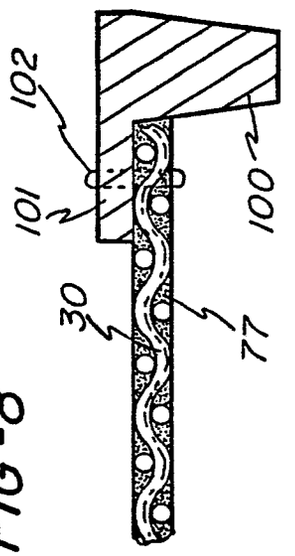

FIG-8

FIG-9

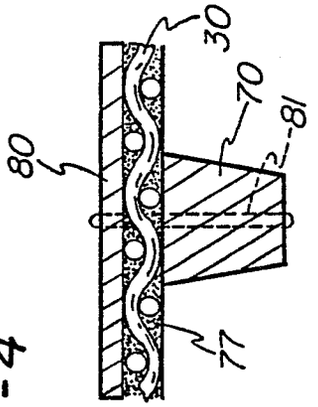

FIG-4

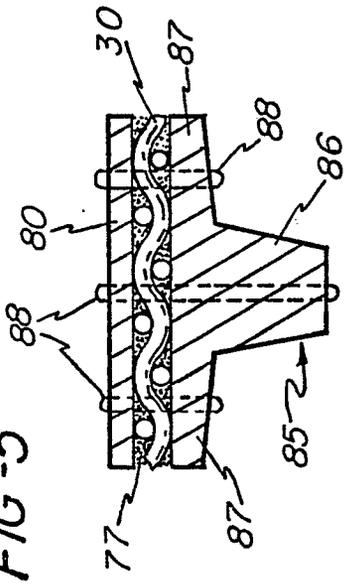

FIG-5

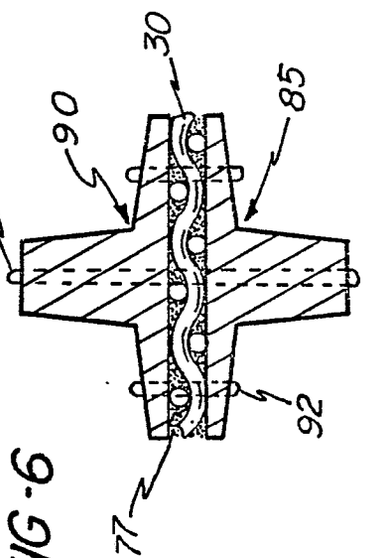

FIG-6