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(54) A corrugating roll

(57) In a corrugating machine comprising upper and lower fluted corrugating rolls (10) and (11), a glue applicator roll (15) and a pressure roll (17), a nip (13) is formed between the corrugating rolls (10) and (11). At the nip, the pressure applied to the sheet medium (12) to be corrugated is relieved or reduced relative to that applied to it before and after the nip (13). This may be done by flattening out the top dead centre region of each peak (22) and/or deepening each trough (23). The relief of pressure avoids excessive crush and weakening of the medium.

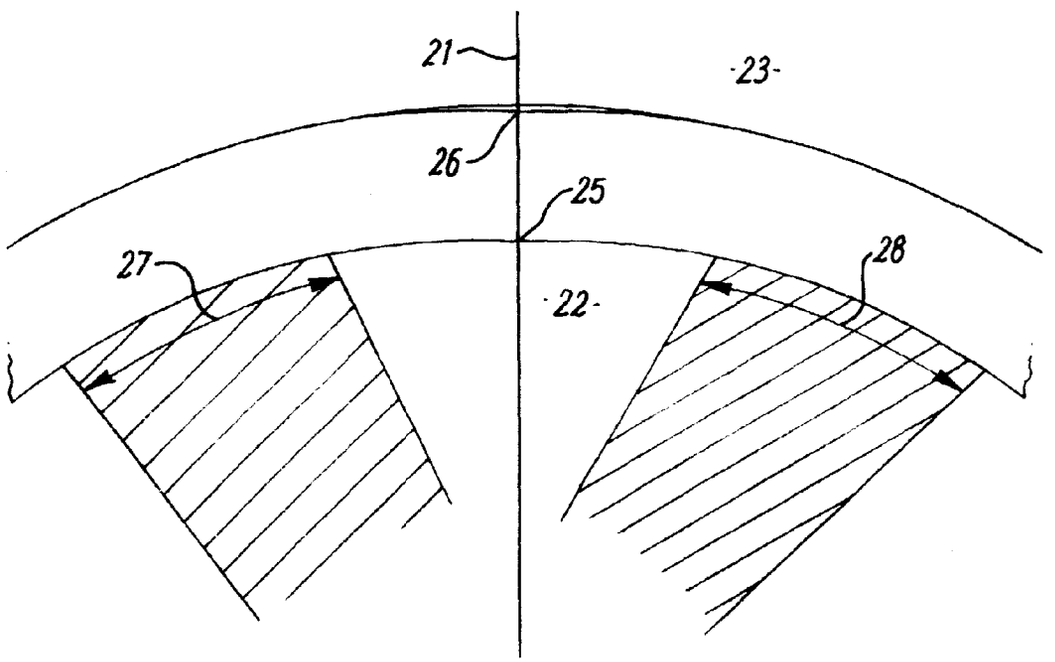

FIG 4

EP 0 872 333 A1

Description

THIS INVENTION concerns fluted corrugating rolls which in a corrugating machine co-operate with each other to produce a corrugated sheet, and particularly through not exclusively to produce corrugated paper board which may be single or double faced with a plain sheet.

In the production of, for example, single-faced corrugated paperboard, a first paper sheet is fed into a nip between upper and lower enmeshed corrugating rolls which are held together under pressure and rotating at, for example, 350 metres per minute, linear speed. Steam is circulated within the corrugating rolls to raise the temperature to approximately 180°C and the corrugated medium is formed by an "ironing" action at the nip. The fluted or corrugated paper is then held to the surface of the second corrugating roll for example by pressure or vacuum, and is, carried close to the surface of a glue roll upon which a film of glue is present. Thus the tips of the formed corrugated paper are dipped into the film of glue on the glue roll before continuing around the second corrugating roll to be then bonded with a flat liner sheet under pressure and heat applied at a further nip between the second corrugating roll and a pressure roll. The so-formed single-faced corrugated board then passes over a heating device to cure the glue.

The fluted surface profile of each corrugating roll and its interface, in mesh, with the flutes of the other corrugating roll are arranged conventionally as a compromise to accommodate different paper thicknesses. The actual profile interface between any two rolls is usually appropriate only for one specific thickness of paper but will tolerate different thicknesses within a certain range. Papers of low thickness present a reduced cross-sectional area of paper to cushion the pressure between the two corrugating rolls at the nip or point of formation, the greatest point of pressure being at or about centre line or top dead centre of the profile of one flute. This results in the paper becoming crushed or compacted at the top dead centre of the flute making the formed corrugated paper weaker at each tip and rendering it difficult for glue subsequently to penetrate the paper. Such profiles, especially on thinner papers produce heavy pressure lines on the finished single faced board. In extreme cases this can result in a finished board of unacceptable quality. Heavy pressure lines and cutting of the paper can result from the conventional method of production, and this problem has become particularly evident when starting up production with new rolls.

To reduce or remove this difficulty it is necessary to reduce the pressure applied to the paper in the region of the centre line or top dead centre of the fluted profile.

According to the present invention there is provided a corrugating roll having a curvilinear fluted circumferential surface defining consecutive peaks and troughs, and adapted to be paired in mesh with another such roll to form a nip through which a flat sheet medium may be passed to become corrugated; characterised in that the geometry of the curvilinear fluted roll surface is such as to relieve or reduce pressure applied to the medium by the flute at its centre line relative to that applied by the same flute before and/or after the centre line.

Preferably the radius of curvature of each peak of the fluted surface is greater in the region of its top dead centre than elsewhere thereon.

Alternatively, or in addition the radius of curvature of each trough of the fluted roll surface is less in the region of its bottom dead centre then elsewhere thereon.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 illustrates a typical apparatus for producing single-faced corrugated board comprising a stack consisting of a pair of meshed corrugating rolls and a pressure roll, and a glue roll;

Fig. 2 is an enlarged end view of the two corrugating rolls at the nip therebetween;

Fig. 3 is a further enlarged view of part of Fig. 1 in the immediate region of the nip;

Fig. 4 is a still further enlarged view of the nip illustrating, diagrammatically, an example of the present invention;

Fig. 5 is an enlarged view of a part of the apparatus of Fig. 1 where the second of the two corrugating rolls passes close to the glue roll;

and Fig. 6 is an enlarged view of part of the apparatus of Fig. 1 where the second corrugating roll passes close to the pressure roll.

In Fig. 1 the corrugating rolls 10 and 11 receive between them a first sheet 12 of paper board which is thus corrugated at the nip 13 formed by the enmeshed flutes of the two corrugating rolls 10 and 11. The corrugated board is then carried around the surface of the second corrugating roll 11, the tips of the corrugated board passing through a film 14 (Fig. 5) of glue disposed around the cylindrical surface of the glue roll 15 such that a predetermined quantity of glue is applied along the entire length of each tip of the corrugated board.

A plain liner sheet 16 is carried around the pressure roll 17 and passes through a further nip 18 between the second corrugating roll 11 and the pressure roll 17 to be joined by bonding to the glue-faced tips of the corrugated board 12. Thus, a single-faced corrugated board 20 is produced and this is subsequently passed over heating means (not shown) to cure the glue.

Referring now to Fig. 2, in a conventional corrugating machine the enmeshed fluted surfaces of the rolls 10 and 11 come together at their closest point at a centre

line 21 of a corresponding peak 22 and trough 23 of the fluted surface, whereat considerable pressure is applied to the paper sheet which, thus causes excess compaction thereof. Fig. 3 illustrates in exaggerated form how, conventionally, the maximum pressure is applied at top dead centre with less or no pressure applied to the board in those regions 24 of the profile between the consecutive pairs of peaks and troughs.

Referring now to Fig. 4, in which is illustrated a corrugating roll fluted profile in accordance with the invention, at the top dead centre line 21 the peak 22 of the flute of the second corrugating roll 11 is flattened out at 25 and the corresponding trough 23 between peaks of the corrugating roll 10, may be of increased depth locally at 26. The result is that at the top dead centre line position of the two rolls, the pressure applied to the paper sheet is relieved or reduced relative to the pressure applied by the same flute in regions 27 and 28 "before and after" top dead centre line, respectively. The enlarged space thus provided by the flattened peaks 22 and, if included, the corresponding deepened troughs 23 prevents the paper from being compressed in that region.

The modified peak and trough geometry relieves pressure with the paper about top dead centre of the flute during formation of the corrugated sheet. Thus, the high pressure contact area is displaced from top dead centre to two regions 27 and 28 equally spaced on opposite sides of top dead centre 21 and since these two regions 27 and 28 in combination are larger than the single high pressure point with a conventional flute profile, the force exerted on the sheet generally and in a specific region, is reduced, thus in turn reducing damage and crushing of the paper.

By reducing the paper compaction at the nip of the corrugating roll pair this results in improved glue transfer where the tips of the paper dip into the glue film 14 on the roll 15 as can be seen in Fig. 5. In turn, the improved transfer of glue produces ultimately a stronger bond at higher speeds of production.

Considering now the further nip 18 (Fig. 6) in which the plain liner sheet 16 is bonded to the glued and fluted sheet 12, the relieved peak 22 of each flute has the effect of widening the area of contact between the fluted sheet 12 and the plain sheet 16 at the nip 18. The area has been increased from a single line to a zone illustrated, for example, at 33. If the relieved peak is by way of an actual recess or dimple i.e. a localised reversal of the curvature, this can be selected to match the circumferential form of the pressure roll 17 to achieve, in effect, a rolling action between rolls 11 and 17.

The increased surface area of contact at the bonding position reduces pressure lines and increases bond strength.

Thus, by effectively changing the profile of each flute at or about its top dead centre three advantages are achieved namely, reduction of crush, improved transfer of glue and a stronger and wider area of bond. These advantages are particularly noticeable when using papers of reduced thickness. The corrugating industry is moving towards increased use of thinner and thus cheaper papers in order to reduce overall production costs. Such thinner papers usually have a higher content of recycled material with shorter fibre lengths and are therefore more susceptible to crush damage and cracking when formed on conventional profiles. Thus the improved profile geometry in accordance with this invention more readily accommodates the current trend towards the use of thinner papers.

It will be understood that the reduced crush may be achieved by, in effect, flattening (or increasing the radius) or recessing of the peak, or localised deepening (or relieving) of the corresponding trough at or about the same position, or a predetermined combination of the two factors. The essential aspect of the present invention is to replace a single pressure point with pressure areas disposed on opposite sides respectively of the centre line.

While the invention is particularly applicable to the use of paper board, nevertheless corrugation of other sheet media will benefit from reduced and controlled pressure applied at and about the nip. Also, if a so-called "double-backed" corrugated medium is to be produced, i.e. with a plain liner sheet on both faces of the corrugated sheet, the reduced crush and improved bond provided by the present invention is beneficial for both faces.

Claims

1. A corrugating roll having a curvilinear fluted circumferential surface defining consecutive peaks and troughs, and adapted to be paired in mesh with another such roll to form a nip through which a flat sheet medium may be passed to become corrugated; characterised in that the geometry of the curvilinear fluted roll surface is such as to relieve or reduce pressure applied to the medium by the flute at its centre line relative to that applied by the same flute before and/or after the centre.

2. A corrugating roll according to Claim 1, wherein the radius of curvature of each peak of the fluted surface is greater in the region of its top dead centre than elsewhere thereon.

3. A corrugating roll according to Claim 1 or Claim 2, wherein the radius of curvature of each trough of the fluted roll surface is less in the region of its bottom dead centre than elsewhere thereon.

4. A corrugating roll according to Claim 1 or Claim 2, wherein the surface of each peak of the fluted roll surface is recessed in the region of its top dead centre.

5. A corrugating roll according to Claim 1 or Claim 3, wherein the curvature of each trough of the fluted roll surface is deeper in the region of its bottom dead centre.

6. A corrugating roll according to Claim 1, wherein each peak of the fluted roll surface includes a dimple or recess in the region of its top dead centre i. e. a localised reversal of the curvature thereof.

7. A corrugating roll according to any preceding claim, in combination with another such roll in a corrugating machine to form a nip through which a sheet medium may become corrugated, and in combination with a glue applicator roll adapted to apply glue to the tips of the corrugated medium, and in combination with a pressure roll around which a liner sheet is carried and passed through a further nip between one of the corrugator rolls and the pressure roll to be joined by bonding to the glue-faced tips of the corrugated sheet thus to produce a single faced corrugated board.

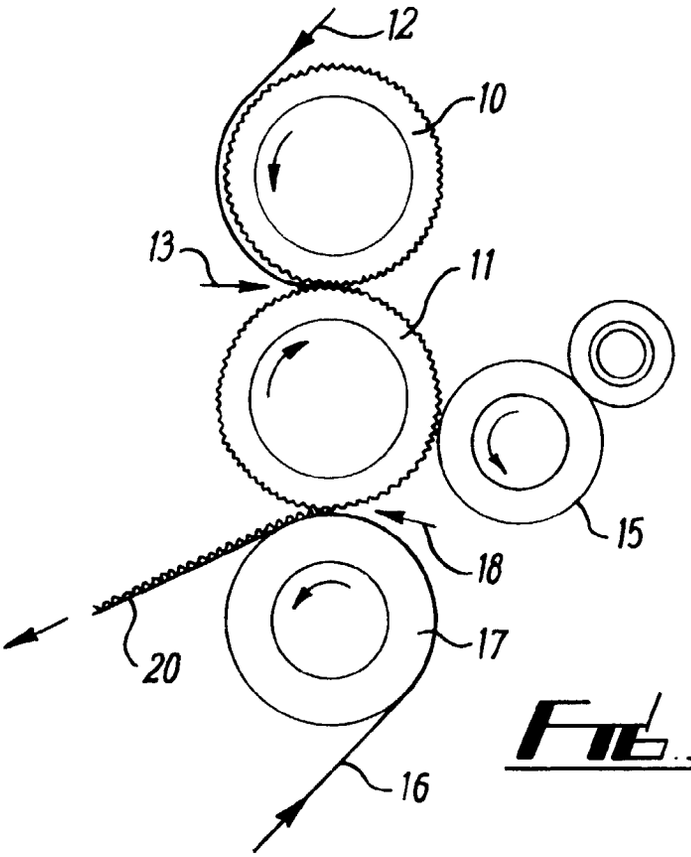

FIG. 1

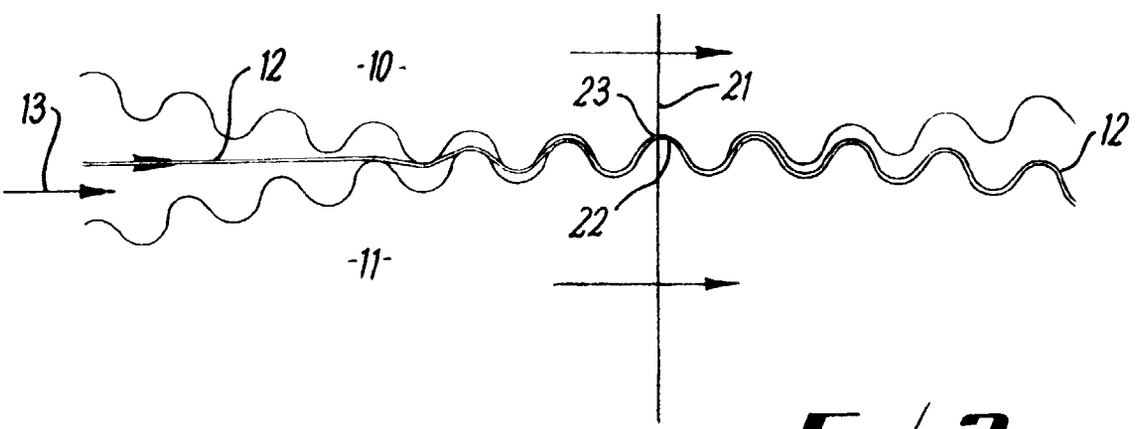

FIG. 2

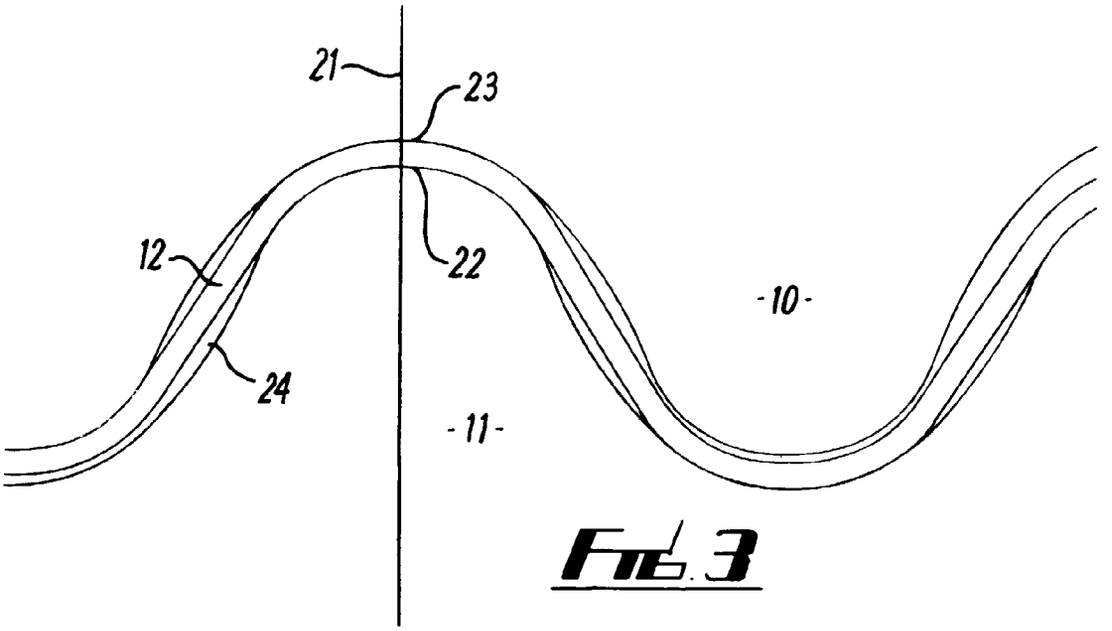

FIG. 3

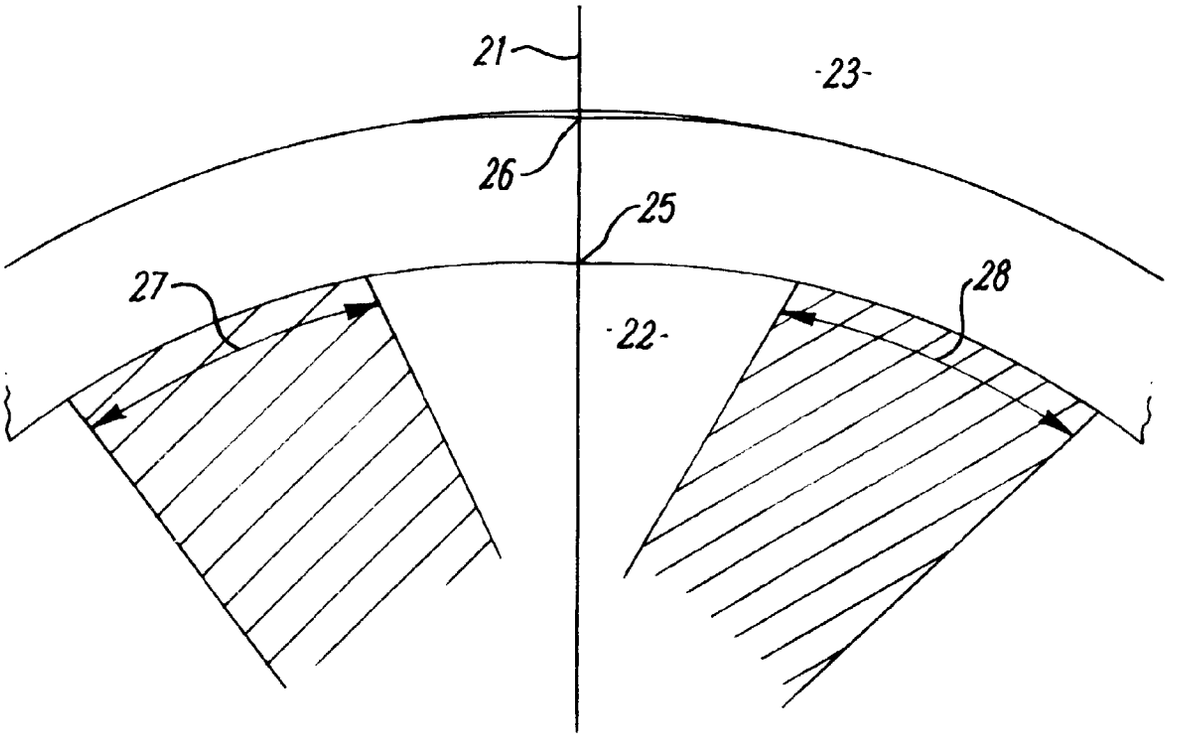

FIG 4

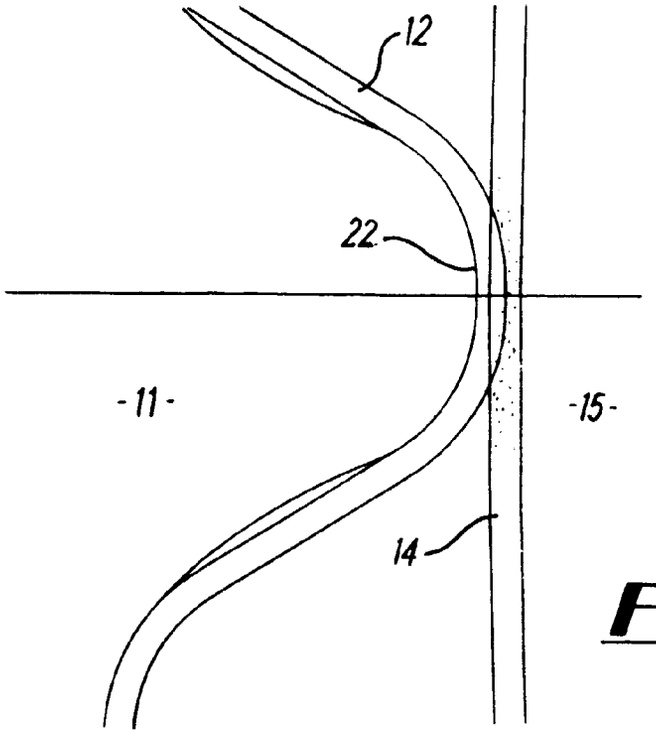

FIG. 5

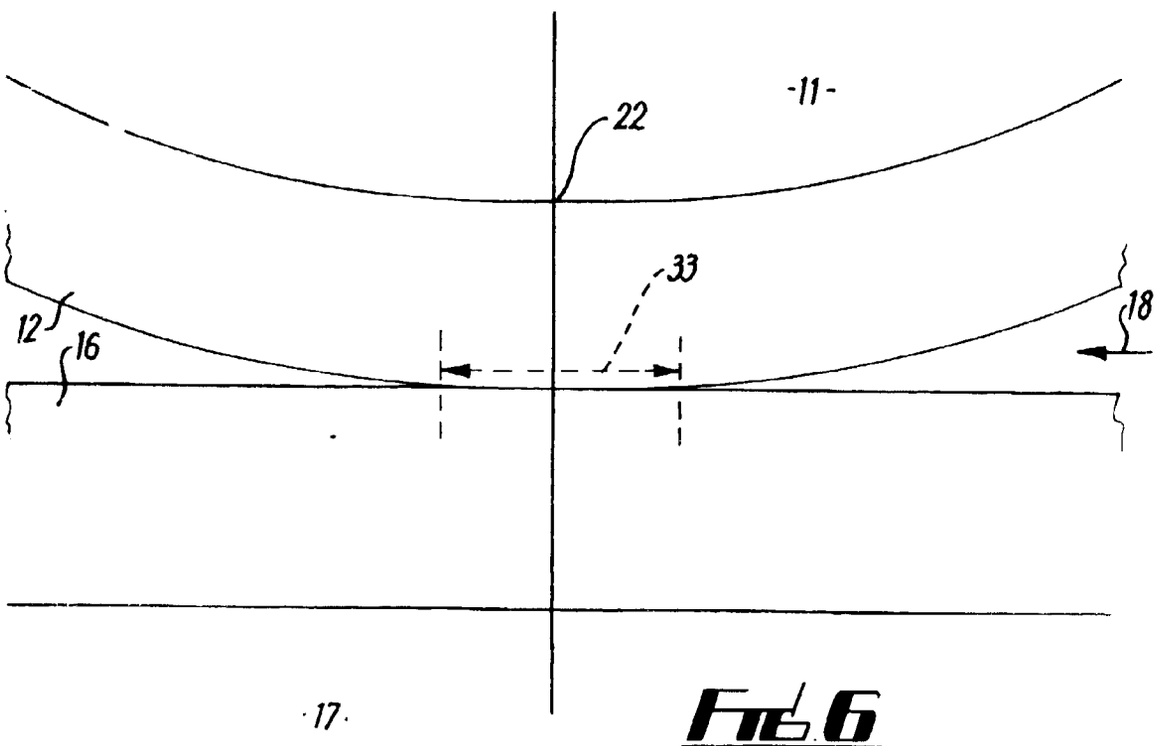

FIG 6

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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 2997

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)
A	EP 0 681 909 A (MITSUBISHI HEAVY IND LTD) 15 November 1995	1	B31F1/00 B31F1/28
A	EP 0 577 970 A (MITSUBISHI HEAVY IND LTD) 12 January 1994	1	
A	FR 2 241 657 A (HARRIS INTERTYPE CORP) 21 March 1975	1	
A	FR 2 344 401 A (BHS BAYERISCHE BERG) 14 October 1977	1	
A	US 3 671 361 A (MORRISON WALTER C) 20 June 1972	1	
A	EP 0 098 936 A (PETERS MASCHF WERNER H K) 25 January 1984	1	
T	US 5 626 709 A (KEENY THOMAS R) 6 May 1997	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B31F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 July 1998	Roberts, P

CATEGORY OF CITED DOCUMENTS

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