

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 604 531 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

18.12.1996 Bulletin 1996/51

(21) Application number: **92920069.9**

(22) Date of filing: **16.09.1992**

(51) Int. Cl.⁶: **B31F 1/28**

(86) International application number:
PCT/AU92/00486

(87) International publication number:
WO 93/05957 (01.04.1993 Gazette 1993/09)

(54) **Corrugated paperboard production apparatus**

Wellpappenmaschine

Appareil pour la production de carton ondulé

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL
SE**

(30) Priority: **17.09.1991 AU 8359/91**

(43) Date of publication of application:
06.07.1994 Bulletin 1994/27

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Description

This invention relates to an apparatus for forming paper board structures in which two corrugated mediums are bonded together at their flute tips. A structure of this kind is disclosed in AU-B-567833 which is incorporated herein by reference.

One apparatus for forming such corrugated board structures is disclosed in AU-B-609089 (11926/88) which is also incorporated herein by reference. Additionally there are variations of the basic apparatus as is currently disclosed in AU-B-615,053 which discloses the 4-roll apparatus wherein one of the corrugating rolls functions also as a carrier roll which transfers the bonded mediums to the liner bonding zone and also US-A-4,935,082 which replaces the carrier roll with the toothed belt. The invention as described and defined herein is equally applicable to the variations of the basic apparatus; wherein flute tip to flute tip bonding is required.

One of the major difficulties of producing a paper board structure wherein two corrugated mediums are adequately bonded together at their flute tips, is accurately aligning the peak of the flutes of the corrugated medium along the entire width of the corrugated mediums. The problem arises from the fact that pressure between the flute tips along their entire length causes misalignment thereof.

The present invention is predicated on the discovery that the problem of maintaining the corrugating rolls flute tip to flute tip arises from the fact that the entire board making apparatus can generally lack rigidity. It is thought that the lack of rigidity is mainly attributable to the lack of rigidity in the support frame and also in the corrugating rolls and shafts which twist during operation. Thus as a result of movement of the corrugating rolls and the frame the flute tips of the rolls become misaligned.

The prior art has dealt with the problem of aligning intermeshing corrugating rolls as distinct from the problem of maintaining alignment of corrugating rolls which contact flute tip to flute tip. Indicative of the prior art is US-A-4196046 which discusses the problem of aligning intermeshing corrugating rolls to adjust the clearance between the flutes. The patent describes the use of a pair of meshing helical gears with an axial adjuster attached to one of the gears in order to adjust the clearances between the flutes of the intermeshing corrugating rolls. Since the clearance between the intermeshing rolls can be adjusted, wear and tear on the machine is reduced as well as fracturing of the paper web due to clearance deterioration.

It is an object of this invention to improve and overcome at least some of the problems of the apparatus disclosed in AU-B-609089 and variations of the same as previously discussed and discussed in AU-B-615,053 and US-A-4,935,082 and thus improve the quality of the paper board product and the efficiency of the process.

The present invention provides an improvement in

the basic apparatus and also the variations of the same as previously discussed.

The invention therefore provides in a first aspect a corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips, comprising at least two pairs of corrugating rolls synchronised so that the two fluted mediums are oriented for precise flute tip to flute tip bonding between a central pair of non-meshing corrugating rolls, characterised in that the flute tip to flute tip orientation is maintained by the provision of meshing helical or spur end gears mounted on the corrugating roll trunnions and abutting each end of each of said central pair of non-meshing corrugating rolls.

In a second aspect the present invention provides a corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips comprising at least two pairs of corrugating rolls synchronised so that the two fluted mediums are oriented for precise flute tip to flute tip bonding between a central pair of non-meshing corrugating rolls, characterised in that the flute tip to flute tip orientation is maintained by the provision of large diameter trunnions on each of said non-meshing corrugating rolls with meshing helical or spur end gears adjacent each end of each trunnion of said central pair of non-meshing corrugating rolls.

The provision of the co-operating end gears advantageously aids in maintaining identical surface speed at the tips of the flutes to be bonded, thus resulting in the precise alignment of the corrugating rolls to each other. Thus the alignment of the flute tips of the respective corrugated mediums is achieved, which is essential in order to obtain consistent enhancement of board performance and maximum reduction in medium and liner weights. The benefits of providing this type of board structure are set out in AU-B-567,833.

End gears are preferably but not essentially fitted to each end of each pair of central corrugating rolls and consist of one full face gear and one split face gear to allow adjustment of backlash.

It is apparent that the prior art apparatus does not discuss or even suggest the possibility of using end gears in relation to the bonding together of corrugated mediums at their flute tips which align and bond. The prior art is only concerned with the actual corrugating process and intermeshing corrugating rolls.

The end gears are preferably abutting end gears and are preferably installed a short distance from the grooved face of each corrugating roll advantageously assisting in reducing the twisting of shafts. The use of abutting end gears allows the use of conventional vacuum corrugating rolls with standard sized trunnions and minimises the torsional deflection which generally occurs. By providing abutting end gears to both ends of the corrugating rolls the general rigidity of the apparatus and the reduction in the twisting of the shafts is further enhanced.

The end gears may be non-abutting end gears or

can be fitted outside the vacuum collectors and also outside the machine frames. Non-abutting gears can be used when the corrugating rolls have larger trunnions and thus the ability to resist the high torsional stresses arising from the point to point pressure occasioned during the tip to tip bonding process.

The end gears are preferably precision ground so that the intermeshing is precise.

The end gears can be spur gears or helical gears.

The gears may be split. If there are gears provided at each end they are preferably split at each end. The split gear may then mate with a gear of larger face width on the other corrugating roll. This arrangement assists in taking up backlash and allows transmission of at least 50% of the applied torque, thus preventing, further the twisting of the corrugating rolls and shafts.

When the helical gears are used as abutting end gears, the fitting of shims between the end faces of the corrugating rolls and the helical gears may be required when the helical gears are adjusted axially.

If helical gears are fitted to both ends of the roll, the helices on each gear can be opposing to ensure thrust forces cancel each other out. If helical gears are only fitted to one end, additional thrust bearing capacity may be required to counteract the axial thrust created by the helical gears and prevent twisting of the corrugating rolls and shafts out of tip to tip alignment.

A preferred embodiment of this invention will now be described with reference to the drawings:

Figure 1 shows a schematic view of a single facer unit of the kind disclosed in AU-B-609089.

Figure 2 shows a cross-section view of the corrugating rolls with abutting end gears attached.

Figure 1 illustrates a single facer unit of the kind disclosed in Australian Patent AU-B-609089. The corrugating medium, 1 and 2, maintained on mill roll stands (not shown) and generally passed over a preheater (not shown) is fed onto one (items 3 and 5) of a pair of corrugating rolls, 3 and 4 and 5 and 6. The medium, 1 and 2, is corrugated and then adhesive is applied to at least one of the surfaces of 1 or 2, by an adhesive station 7. The corrugated medium, 1 and 2, is then joined together flute tip to flute tip, when brought together by corrugating rolls 4 and 6. The two combined corrugating mediums are fed onto the carrier roll 12 and after glue is applied to the flute tips, they are transported to the bonding zone wherein the liner 9 is brought into contact with the flute tips and heat applied by heater 11. The carrier rolls 12 then transports the combined liner and mediums to a point where the product is fed into an inclined transport conveyor 14 for discharge on to the corrugator bridge.

In accordance with variations of the basic apparatus, it is noted that the carrier roll 12 can be substituted with a toothed belt.

Figure 2 illustrates an embodiment of the present invention, wherein end gears 15A and 15B and 16A and

16B are fixed to the corrugating rolls 4 and 6 of the single facer unit which are the corrugating rolls which align and bond the corrugated medium in flute tip to flute tip arrangement. This embodiment illustrates the use of the split spur gears 15A and 15B and 16A and 16B abutting the corrugating rolls 4 and 6. It should be noted that in order to maximise the rigidity of the apparatus and the reduction of twisting in the aligning corrugating rolls, end gears should be placed at each end of the aligning corrugating rolls. The end gears 15A and 15B and 16A and 16B in this embodiment fit within the space between the vacuum collector 17 and the corrugating rolls 6 and 4. It should be noted that if repetitive wear patterns on the corrugating rolls are not acceptable, space can be allowed so all four corrugating rolls may be able to move axially relative to each other. The vacuum collectors 17 and connections therefrom to the corrugating rolls 4 and 6 can pass through the end gears 15A, 15B, 16A and 16B to communicate with the corrugating rolls 6 and 4. The vacuum collectors 17 are spring-loaded by spring arrangement 19 to ensure a secure but resilient contact between the end gears (15A, 15B, 16A and 16B) and the vacuum collector system 17.

The end gears need not always abut the corrugating rolls and this is dependent on the diameter of the corrugating rolls with larger diameter shafts. In larger diameter rolls, which can be used when flutes of greater height and lower flute pitch are required, the end gears need not abut the rolls and can be even housed outside of the main housing. Furthermore, when vacuum is not used to assist in retaining and carrying the cardboard on the corrugating roll and the alternative fingers are used, it is possible to separate the end gears away from the corrugating rolls, since larger rolls can be used.

In order to produce a particular flute, for example that disclosed in Australian Patent No. 567833, the diameter of the corrugating rolls and shafts may be limited in order to produce the desired flute pitch and depth. In these cases it may be necessary to abut the end gears in order to maximise the rigidity of the apparatus.

Furthermore, the face width of split spur gear 16A is extended to assist in taking up backlash and allow transmission of the applied torque. Generally the face width of the end gears is governed by the braking torque required which as a general rule is at least three (3) times the drive torque created. End gear 16A and 16B is driven by its cooperation with end gears 15A and 15B and drives the carrier rolls 12 via a ring gear (not shown) attached to the carrier roll 12. Similarly the end gears can drive a toothed belt if used.

The end gears 15A and 15B and 16A and 16B may be fixed to the shafts of the corrugating rolls 4 and 6 by any locking assembly, for example multi-taper lock sleeves, item 21. The only requirement of the locking assembly is that the gears are precisely retained in position to transmit high peripheral forces without circumferential movement.

To secure the split gears 15A and 15B to each other fixing screws 20 may be used which also allow for adjustment of the gears relative to each other in order to reduce backlash. Similarly fixing screws 20 can also be incorporated on split gears 16A and 16B. The end gears 15A, 15B, 16A and 16B depending on their proximity to the corrugating rolls may have a shroud (not shown) shielding the board being processed and preventing entanglement of the board in the rotating end gears.

It is noted that whilst the end gears must be applied to at least the corrugating rolls which are directly involved in flute-tip to flute-tip bonding, end gears can be applied to other rolls such as carrier rolls, or toothed belt mechanisms.

The frame 18 may also be reinforced and/or improved in order to increase frame rigidity and thus generally greater apparatus rigidity.

The above improvements to existing machinery, aid and assist in providing a better board product, and produces the board product more efficiently resulting in reduced machine wear and raw material use.

Claims

1. A corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips, comprising two pairs of corrugating rolls (3,4;5,6) synchronised so that the two fluted mediums are oriented for precise flute tip to flute tip bonding between a central pair of non-meshing corrugating rolls (4,6), characterised in that the flute tip to flute tip orientation is maintained by the provision of meshing helical or spur end gears (15A, 15B, 16A, 16B) mounted on the corrugating roll trunnions and abutting each end of each of said central pair of non-meshing corrugating rolls (4,6).
2. A corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips comprising two pairs of corrugating rolls (3,4;5,6) synchronised so that the two fluted mediums are oriented for precise flute tip to flute tip bonding between a central pair of non-meshing corrugating rolls (4,6), characterised in that the flute tip to flute tip orientation is maintained by the provision of large diameter trunnions on each of said non-meshing corrugating rolls with meshing helical or spur end gears (15A, 15B, 16A, 16B) adjacent each end of each trunnion of said central pair of non-meshing corrugating rolls (4,6).
3. The apparatus according to either of claims 1 or 2, wherein the surface speeds of the corrugating rolls (4,6) whose flutes are precisely aligned tip to tip are non-meshing have identical surface speeds.
4. The apparatus according to any one of the preced-

ing claims wherein at least one end gear is split.

5. The apparatus according to claim 4, wherein one gear on one corrugating roll has a wider face and the split end gear co-operates with said wider face gear so as to assist in taking up backlash.
6. The apparatus according to any one of the preceding claims which comprises a vacuum collector (17), a space is provided between said vacuum collector (17) and two corrugating rolls (4,6) and said end gears (15A, 15B, 16A, 16B) are fitted in said space.
7. The apparatus according to any one of the preceding claims which comprises a carrier roll and end gears are also applied to said carrier roll.
8. The apparatus according to any one of the preceding claims wherein the end gears (15A, 15B, 16A, 16B) reduce torsional stress in the shafts of the corrugating rolls (3,4;5,6).

Patentansprüche

1. Eine Wellpappenmaschine, die in der Lage ist Wellpappen zu formen, die zwei geriffelte Medien aufweisen, die an den Wellenspitzen miteinander verklebt sind, enthaltend zwei Paar Riffelwalzen (3,4; 5,6), die synchronisiert sind, so daß die zwei geriffelten Medien für exakte Verbindung Wellenspitze-zu-Wellenspitze zwischen einem zentralen Paar nicht kämmender Riffelwalzen (4,6) orientiert werden, dadurch gekennzeichnet, daß die Orientierung Wellenspitze-zu-Wellenspitze durch die Bereitstellung von kämmenden Schrägstirn- oder Geradstirnrädern (15A, 15B, 16A, 16B) aufrechterhalten wird, die an den Riffelwalzen-Lagerzapfen montiert sind und an jedes Ende jeder Walze des besagten zentralen Paares nicht kämmender Riffelwalzen (4,6) angrenzen.
2. Eine Wellpappenmaschine, die in der Lage ist Wellpappen zu formen, die zwei geriffelte Medien aufweisen, die an den Wellenspitzen miteinander verklebt sind, enthaltend zwei Paar Riffelwalzen (3,4; 5,6), die synchronisiert sind, so daß die zwei geriffelten Medien für exakte Verbindung Wellenspitze-zu-Wellenspitze zwischen einem zentralen Paar nicht kämmender Riffelwalzen (4,6) orientiert werden, dadurch gekennzeichnet, daß die Orientierung Wellenspitze-zu-Wellenspitze durch die Bereitstellung von Lagerzapfen an jeder der besagten nicht kämmenden Riffelwalzen mit kämmenden Schrägstirn- oder Geradstirnrädern (15A, 15B, 16A, 16B) aufrechterhalten wird, die an jedes Ende jedes Lagerzapfens des besagten zentralen Paares nicht kämmender Riffelwalzen (4,6) angrenzen.

3. Die Maschine nach beiden der Ansprüche 1 oder 2, worin die Oberflächengeschwindigkeiten der Riffelwalzen (4,6), deren Riffel präzise Spitze-zu-Spitze ausgerichtet sind, nicht kämmend sind und identische Oberflächengeschwindigkeiten haben.

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4. Die Maschine nach irgendeinem der vorausgehenden Ansprüche, worin wenigstens ein Endzahnrad geteilt ist.

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5. Die Maschine nach Anspruch 4, worin ein Zahnrad an einer Riffelwalze eine breitere Kopfflanke aufweist und das geteilte Endzahnrad mit dem besagten Zahnrad breiterer Kopfflanke zusammenarbeitet, um beim Ausgleich von Flankenspiel behilflich zu sein.

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6. Die Maschine nach irgendeinem der vorausgehenden Ansprüche, die einen Unterdrucksammler (17) aufweist, ein Zwischenraum ist zwischen besagtem Unterdrucksammler (17) und zwei Riffelwalzen (4,6) vorgesehen, und besagte Endzahnräder (15A,15B,16A,16B) sind in den besagten Zwischenraum montiert.

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7. Die Maschine nach irgendeinem der vorausgehenden Ansprüche, die eine Trägerwalze umfaßt, und Endzahnräder werden an der besagten Trägerwalze ebenfalls angewandt.

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8. Die Maschine nach irgendeinem der vorausgehenden Ansprüche, worin die Endzahnräder (15A,15B,16A,16B) Drehbeanspruchung in den Wellen der Riffelwalzen (3,4,5,6) reduzieren.

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Revendications

1. Un appareil pour la production de carton ondulé capable de produire des cartons ondulés comportant deux média à cannelures collés l'un à l'autre au niveau des sommets des cannelures, comprenant deux paires de rouleaux à onduler (3,4;5,6) synchronisés de telle manière que les deux média à cannelures soient orientés en vue d'un encollage précis de sommet de cannelure à sommet de cannelure entre une paire centrale de rouleaux à onduler sans engrenage (4,6), caractérisé par le fait que l'orientation d'un sommet de cannelure par rapport à l'autre est maintenue constante grâce à des engrenages hélicoïdaux ou à roue droite (15A,15B,16A,16B) montés sur les tourillons des rouleaux à onduler et aboutant chaque extrémité de chacune desdites paires centrales des rouleaux à onduler sans engrenage (4,6).

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2. Un appareil pour la production de carton ondulé capable de produire des cartons ondulés comportant deux média à cannelures collés l'un à l'autre au niveau des sommets des cannelures, comprenant

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deux paires de rouleaux à onduler (3,4;5,6) synchronisés de telle manière que les deux média à cannelures soient orientés en vue d'un encollage précis de sommet de cannelure à sommet de cannelure entre une paire centrale de rouleaux à onduler sans engrenage (4,6), caractérisé par le fait que l'orientation d'un sommet de cannelure par rapport à l'autre est maintenue constante grâce à des tourillons de grand diamètre montés sur chacun desdits rouleaux à onduler sans engrenage, les engrenages hélicoïdaux ou à roue droite (15A,15B,16A,16B) étant adjacents à chaque extrémité de chaque tourillon de ladite paire centrale de rouleaux à onduler sans engrenage (4,6).

3. Un appareil ainsi revendiqué à l'une quelconque des revendications 1 ou 2, dans lequel les vitesses de surface des rouleaux à onduler (4,6) dont les cannelures sont alignées avec précision sommet contre sommet sont identiques.

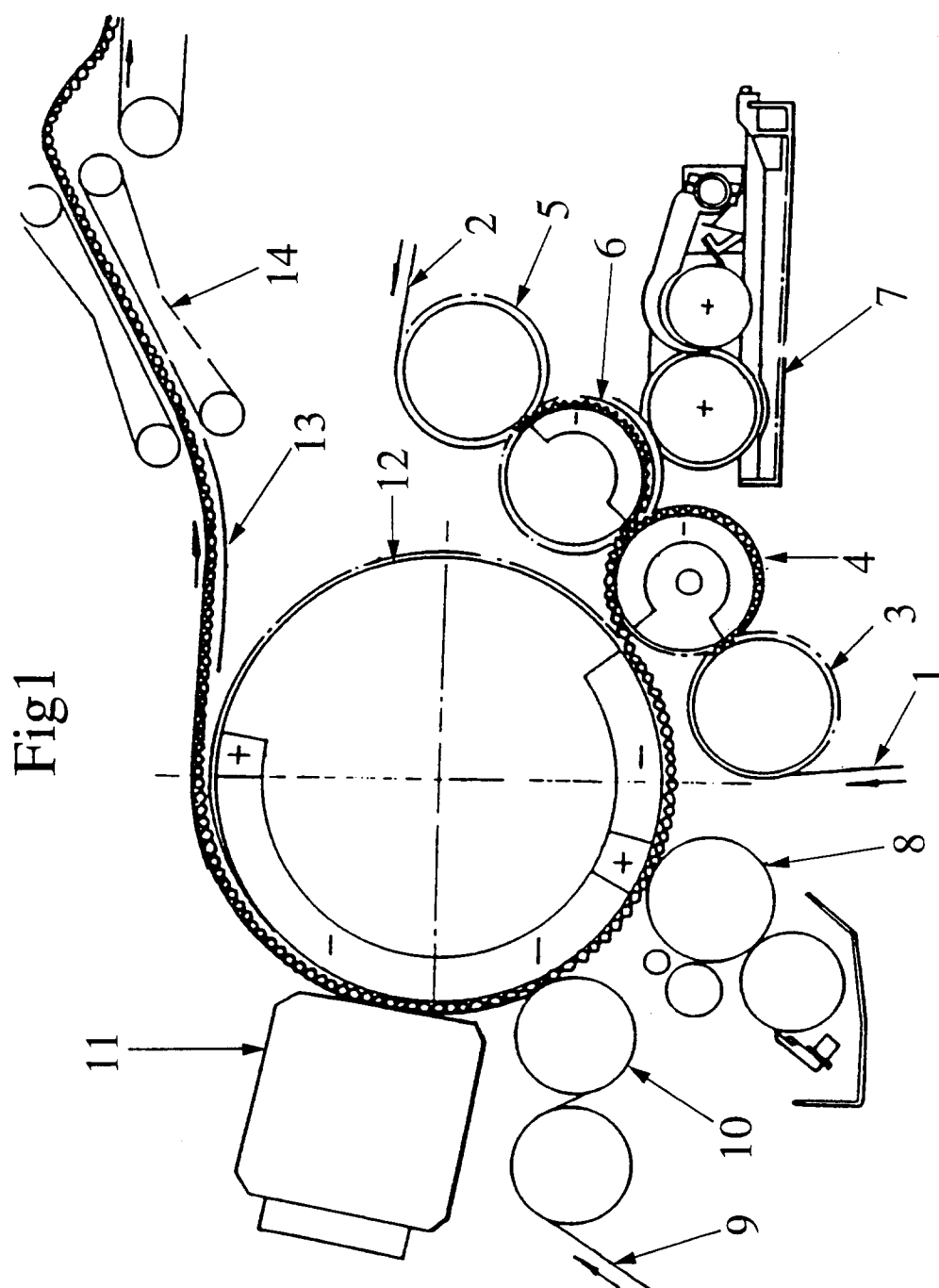
4. Un appareil ainsi revendiqué à l'une quelconque des revendications précédentes dans lequel au moins l'un des engrenages d'extrémité est fendu.

5. Un appareil ainsi revendiqué à la revendication 4 dans lequel l'un des engrenages de l'un des rouleaux à onduler possède un côté élargi et l'engrenage d'extrémité fendu opère de concert avec ledit engrenage à côté élargi afin de contribuer à absorber le jeu de transmission.

6. Un appareil ainsi revendiqué à l'une quelconque des revendications précédentes, qui comprend une pompe à vide (17), dans lequel est aménagé un espacement entre ladite pompe à vide (17) et les deux rouleaux à onduler (4,6), et dans lequel lesdits engrenages d'extrémité (15A,15B,16A,16B) sont montés à l'intérieur dudit espacement.

7. Un appareil ainsi revendiqué à l'une quelconque des revendications précédentes, qui comprend un rouleau de support et dans lequel les engrenages d'extrémité sont également appliqués au rouleau de support susmentionné.

8. Un appareil ainsi revendiqué à l'une quelconque des revendications précédentes, dans lequel les engrenages d'extrémité (15A,15B,16A,16B) réduisent la contrainte de torsion au niveau des arbres des rouleaux à onduler (3,4;5,6).



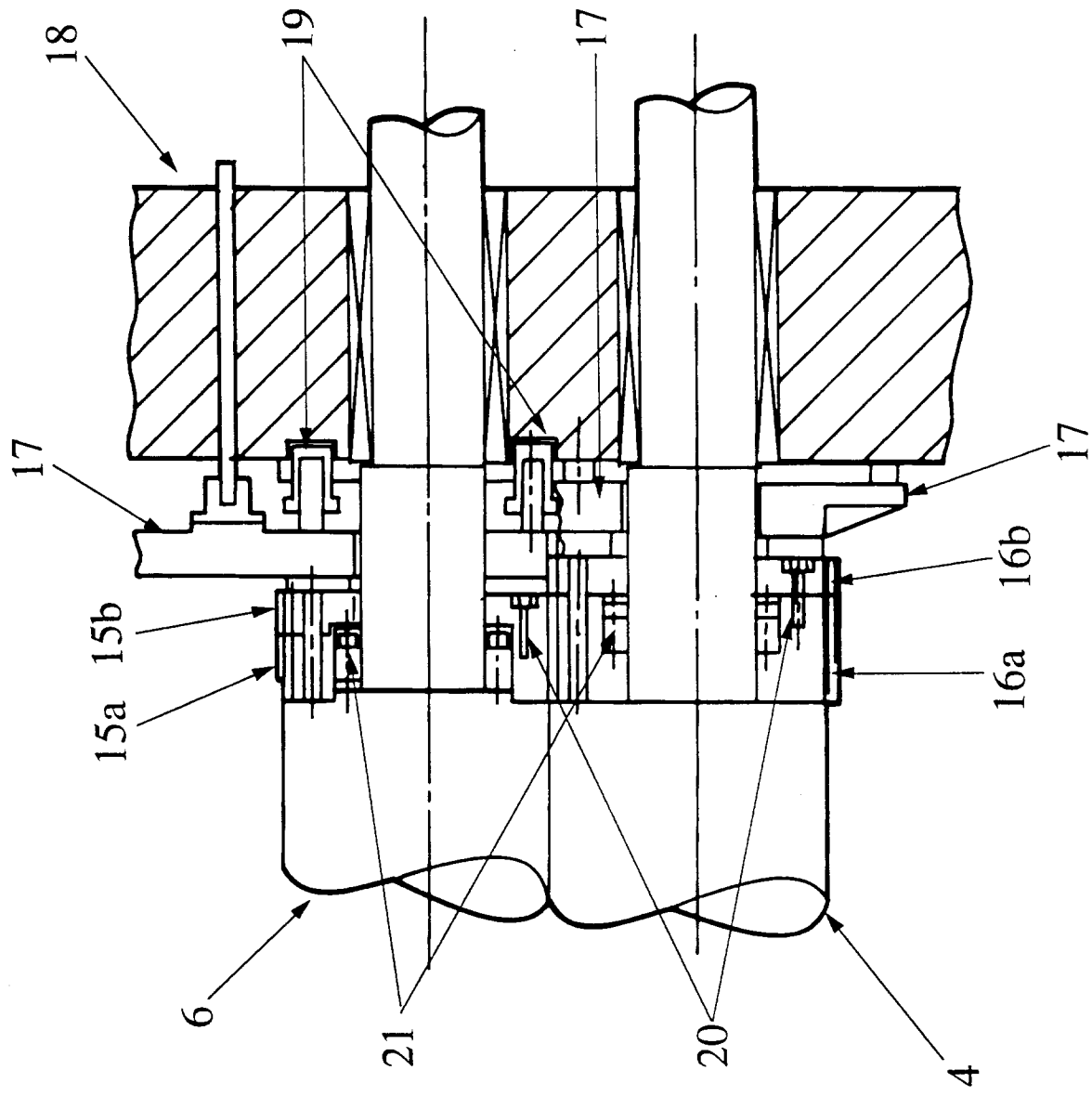


Fig 2