

(19)



(11)

EP 1 771 622 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
19.01.2011 Bulletin 2011/03

(51) Int Cl.:
D21F 5/02 ^(2006.01) **D21G 9/00** ^(2006.01)
D21G 1/02 ^(2006.01)

(21) Application number: **05756310.8**

(86) International application number:
PCT/FI2005/050231

(22) Date of filing: **22.06.2005**

(87) International publication number:
WO 2006/010793 (02.02.2006 Gazette 2006/05)

(54) **ROLL FOR A WEB FORMING MACHINE**

WALZE FÜR BAHNBILDUNGSMASCHINE

CYLINDRE DE MACHINE FORMANT DES BANDES

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**

(30) Priority: **28.07.2004 FI 20045280**

(43) Date of publication of application:
11.04.2007 Bulletin 2007/15

(73) Proprietor: **Metso Paper, Inc.**
00130 Helsinki (FI)

(72) Inventors:
• **KURKINEN, Leo**
FI-00670 Helsinki (FI)

• **VANNINEN, Rami**
FI-04500 Kellokoski (FI)

(74) Representative: **Lorenz, Markus**
Lorenz & Kollegen
Patentanwälte Partnerschaftsgesellschaft
Alte Ulmer Strasse 2
89522 Heidenheim (DE)

(56) References cited:
DE-A1- 19 542 191 US-A- 3 246 401
US-A- 4 820 947 US-A- 5 837 101

EP 1 771 622 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to a roll for a web forming machine, which roll includes a shell, with end pieces at both ends of it to support the roll rotatably in the web forming machine, which end pieces are arranged to be detachably attached at each end of the shell, and in each of which end pieces there is an end plate with a protruding shaft in it for support in a bearing arrangement.

[0002] In a roll in a modern web forming machine, for example a paper or board machine, the shell and its end pieces are separate pieces. Thus they can be made separately and finally balanced in connection with the assembly of the roll, or afterwards. The known end pieces are manufactured by machining from cast pieces. Due to the manufacturing technique in question, the end piece becomes large and heavy. In addition, there are several labourious stages in manufacture. When the end piece is a single piece, the dimensioning of the end piece and the protruding shaft must take into account the manufacturing-technique limitations of both structures. For example, the casting technique requires the end plate to be dimensioned to be unnecessarily thick. In addition, a cast end piece is poor in terms of vibration. Particularly the protruding shaft bends more than the rest of the roll, which increases vibration in the roll during operation. In practice, the flexibility of the end pieces differs from that of the shell while the end piece also has no damping ability at all.

[0003] A roll for a web forming machine according to the preamble of claim 1 is known from US 4,820,947.

[0004] US 5,837,101 describes a device for threading a paper web from a dryer section to a finishing device situated after the dryer section in the running direction of the web including a rope threading arrangement. A leader strip is separated from the edge of the paper web in the dryer section and the leader strip is directed between a pair of ropes included in the rope threading arrangement. The leader strip is carried to the finishing device on support of the ropes. To effect the transfer of the leader strip from the drying wire to the rope, at the inlet side of the last drying cylinder in the dryer section, a rope gap is formed out of the ropes and the leader strip, which is supported by the drying wire thereat, is transferred by an air blowing into the rope gap.

[0005] From DE 195 42 191 A1 there is known a calendar or smoothing machine comprising roller gaps each formed from a pair of neighbouring rollers and guide rollers forming a deflecting device for a web path between two rollers. The guide roller is supplied with an auxiliary web-guiding device acting radially on a predetermined circumferential section.

[0006] The characteristic features of the roll according to the present invention appear in the accompanying Claim 1. In the roll according to the invention, there is a new type of end piece, which is considerably stiffer than before relative to its weight. Thus the rotational speed of the roll can be increased without vibration becoming too

great. The end piece is formed from several different parts, which are additionally attached to each other in a new way. In practice too, the parts can be dimensioned optimally nearly independently of each other while the finished construction is, in addition, light. Further, various functions can be arranged in the end piece, which in the prior art would be difficult and even impossible to implement.

[0007] In the following, the invention is examined in detail with reference to the accompanying drawing showing some embodiments of the invention, in which

Figure 1a shows an axonometric view of the roll according to the invention,
 Figure 1b shows the end piece of the roll according to the invention,
 Figure 2 shows a partial cross-section of the end piece of the roll according to the invention,
 Figure 3 shows a partial cross-section of part of the roll according to the invention,
 Figure 4 shows a cross-section of a second embodiment of the end piece according to the invention,
 Figure 5a shows a partial cross-section of the rope sheave of the roll according to the invention,
 Figure 5b shows an axonometric view of the rope sheave of Figure 5a,
 Figure 6 shows a cross-section of a second embodiment of the rope sheave of the roll according to the invention.

[0008] Figure 1 shows the roll according to the invention, which is intended for a web forming machine. Usually, the web forming machine is a paper or board machine, in which the roll is used, for example, as a guide or nip roll. Generally, the roll includes a shell 10 with end pieces 11 at both of its ends, for supporting the roll rotatably in bearing arrangements 12 in the web forming machine. The shell can be a cast shell or a shell made from a sheet material. The shell can also have surface treatment or a cover. Figure 1b shows the end piece 11 according to the invention, which is generally fitted detachably onto each end of the shell. In the end piece 11, there is an end plate 13 with a protruding shaft 14 in it for the bearing arrangement. In the end plate 13, there are also holes 15 for attachment bolts 16. There are more holes than are required for the attachment bolts, so that balancing bolts and/or masses can be attached to them at suitable positions.

[0009] Figure 2 shows the end piece 11, which includes a separate inner piece 17, in greater detail. In the inner piece 17, there is an internal hole 18 corresponding to the protruding shaft 14, for attaching the protruding shaft 14. In addition, the end plate 13 is supported on the inner piece 17 by at least one plate piece 19. Thus the various parts of the end piece can be manufactured separately, thus avoiding casting and machining large pieces. In addition, the parts can even be made in different

ways and from different materials. Thus allowance can be made, for example, for stresses arising from the loading, or for surface roughness requirements.

[0010] In the embodiment of Figure 2, the end piece 13, the protruding shaft 14, and the inner piece 17 are separately machined bodies of revolution. Thus their manufacture is simple and they can be dimensioned precisely for their operating purposes. For example, the tolerance between the parts can be made accurately. Mainly thanks to the plate piece, a thin end plate can be used, which will substantially reduce the weight of the end piece. Despite the thin structures, the end piece is stiff, because the various parts form a cell structure. Other advantageous features of the cell structure are presented later. In Figure 2 the protruding shaft 14 and the inner piece 17 are fitted to each other with a shrink-fit joint. Thus their mutual positioning is retained precisely and the protruding shaft can, if necessary, be replaced. This is thus preferably a question of a force-fit joint, in which force is transmitted with the aid of the friction in the joint surfaces. If necessary, it is also possible to use other forms of joint, such as a keyed joint.

[0011] The plate piece is manufactured from one or more plate parts and the end plate and the inner piece are arranged coaxially relative to each other. Thus it is easy to attach the various parts to each other while the finished end piece is accurate in shape and its dimensions, which reduces the need for finishing machining and also facilitates the balancing of the roll.

[0012] In the end piece 11 shown in Figure 2, the end plate 13 is a circular plate, in which there is an installation hole 20 for the inner piece 17. Thus it is easy to align the end plate 13 and the inner piece 17 with each other. In addition, the plate piece 19 is arranged to extend to the opposite end of the inner piece 17 and to that with the end plate 13. Thus, together with the end plate and the inner piece, the plate piece forms a conical triangular cell, the totality of which is extremely stiff, despite the thin structures. The free length of the protruding shaft is also substantially reduced. In other words, the protruding shaft and the entire end piece deflect considerably less than the known construction, which also reduces vibration in the roll.

[0013] The plate piece according to the invention is thus arranged as a cone. In the embodiment of Figure 2, the conic angle α opens towards the shell. In practice, the conic angle α is 45° - 140°, preferably 55° - 130°. Thus sufficient support is created for the protruding shaft, while the total length of the end piece remains reasonable. An increase in the diameter of the shell will naturally increase the conic angle. The dimension of the inner piece is, for its part, limited by the joint between it and the protruding shaft. Figure 4 shows a second embodiment of the end piece 11 according to the invention. In this case, the end plate 13 is in fact a circular ring 21 and the end piece 11 includes a second plate piece 22. In practice, the second plate piece 22 is thus arranged as part of the end plate 13. In addition to the above, the conic angle formed by

the plate piece is, in this case, arranged to open away from the shell. This avoids the effect of the end piece in lengthening the roll, so that the roll can be fitted in even cramped positions. In other words, the roll can be made as short as possible. In Figure 4, the end piece 11 is arranged to be attached to a special ring piece 23, to which the shell of the roll is intended to be attached. Thus nearly the entire end piece can be fitted inside the shell and the bearing arrangement attached to the very end of the protruding shaft. Thus the free length of the protruding shaft is short and correspondingly the deflection of the protruding shaft is small. The term free length refers to the distance between the bearing arrangement and the first support point of the end plate, over which the protruding shaft can deflect. On the other hand, the bearing arrangement too permits a slight variation in the axial angle of the protruding shaft. The same reference numbers are used for functionally similar components.

[0014] In addition to stiffness and lightness, the cell structure can also be exploited to create damping or insulating in the end piece. Even a purely air-filled end piece will insulate, for example, from the evaporation of heat in a dryer cylinder better than a solid-cast end piece. By arranging the end piece to be gas-tight, other gases or a mixture of them can be used. On the other hand, when using solid or foam materials, not only insulation but also effective damping will be created. For example, extruded foam can be easily led into the cell structure while the foam will fill even the smallest recesses evenly. Figure 2 shows an end piece 11 filled with a foam-like material 24. Thus in general a damping and/or insulating material is arranged in the space delimited by the end plate, the inner piece, and the plate piece, which is impossible in the prior art. When the foam adheres to the delimiting parts, it will further reinforce the structure of the end piece.

[0015] Figure 3 shows a combination of the embodiments described above, in which two plate pieces 19 and 22 are used, but with the conical angle opening towards the shell. In this embodiment too, the use of the conical end piece 11 reduces by nearly half the free length of the protruding shaft 14. In addition, the protruding shaft 14 shown extends through the bearing arrangement 12 and has a keyway 25 for a drive motor or gearbox. In many modern web forming machines rope threading is used in addition, to carry the web-threading tail through the web forming machine when starting production. For the rope, a rope sheave is used in connection with many rolls, and carries the rope according to the shell. For the new type of end piece, the roll according to the invention includes a rope sheave, which is arranged to extend axially from the free length of the protruding shaft to the end plate. According to Figure 3, the plate piece 19 then remains inside the rope sheave 26. On the other hand, some conventional rope sheave can be used in connection with the roll shown in Figure 4.

[0016] The rope sheave 26 according to the invention includes a bearing 27, which is arranged around the pro-

truding shaft 14, but mechanically separate from it. In practice, the rope sheave thus has its own bearing, the inner ring of which is fitted around, but separate from the protruding shaft. The inner ring 28 of the bearing 27 thus does not move and is here supported by a separate support 29 on the plinth 30 of the bearing arrangement 12. In the outer ring 31 of the bearing 27 there are correspondingly attachment bolts 38, by means of which the sheet-material rope sheave 26 is attached to the bearing 27. Thus various rope sheaves of different sizes can be attached to the bearing. Thanks to the separate bearing, between tail threadings, the rope and the rope sheave with it can rotate at a crawl while the roll rotates at production speed. This saves energy and particularly the rope and the bearing of the rope sheave.

[0017] According to the invention, the part of the rope sheave 26 shaped according to the end piece 11 is a spun plate part 32. Thus a piece with a precise shape and dimensions, which has additionally good loadability, is created from a sheet material. Thus, despite the one-sided bearing arrangement, the rope sheave maintains its position and shape well. In addition, the plate part 32 includes a roll-formed portion 33 having a groove 35 for the rope. According to the invention, the portion 33 is of the same sheet material as the plate part 32 or the separate additional part 34 attached to the plate part 32. In Figures 3 and 5a, the groove 35 for the rope is finally formed by roll forming in the spun plate part 32. In the embodiment in question, the diameter of the rope sheave is about 450 mm. Correspondingly, Figure 6 shows another embodiment of the rope sheave, which is intended particularly for large rope sheaves. In this case, a separate roll-formed additional part 34 is used, being attached to the spun plate part 32. Figure 6 shows two plate parts 32 and 32', the inner one of which can even be omitted in practice. Radial support plates can be used to stiffen the rope sheave. In Figure 6, the support plates 36 are attached to the outer plate part 32. The rope sheave shown is designed with a diameter of 1830 mm and the plate parts 32 and 32' used in it have a thickness of 2 - 3 mm. Thus even a large rope sheave will be light, but stiff. In practice, the mass of the rope sheave according to the invention is only one quarter of that of known rope sheaves. In addition, the smooth shape and closed structure effectively prevent dirtying of the rope sheave. The rope sheave according to the invention can also be used in connection with rolls equipped with conventional end pieces.

[0018] When using an end piece according to the invention in the manufacture of a new roll, the roll can be dimensioned for a higher rotation speed than previously, without vibration problems. The end piece according to the invention can also be placed in existing rolls. In the method according to the invention, the roll is first detached from the web forming machine, after which the end pieces are removed from the shell. End pieces according to the invention are then attached to the shell and finally the roll is reattached to the web forming ma-

chine. In addition, prior to installation the roll can be balanced and, for example, surfaced. Using the method in question, a roll, which can be rotated at a higher speed than before, is created rapidly and economically. Thus in rebuilds the replacement of the end pieces will be sufficient, assuming that the other components, such as the drive motors and bearing arrangements are suitable for increasing the speed. When manufacturing new rolls, the end pieces are attached to the shell and the roll is installed in the web forming machine.

[0019] The vibration of a new or refurbished roll can be brought under control, for example, by minimizing deflection. In the end pieces according to the invention, the length of the protruding shaft has been clearly shortened by arranging the plate piece to be conical and by extending the inner piece of the plate piece from the end opposite to the end plate. This creates a triangular cell structure, which is stiff and additionally supports the protruding shaft effectively. The properties of the end piece can be further altered or improved by arranging damping and/or insulation in the end piece. Figure 2 shows in addition a feed-through pipe 37, through which leads to measuring devices, for example, can be taken inside the roll. On the other hand, it is also possible to install measuring devices, or their auxiliary devices, such as telemetric devices' transmitters (not shown) inside the cell structure.

[0020] The cast parts, for example, the inner piece and the protruding shaft, are made by traditional methods by casting and machining. In the manufacture of the plate piece, however, laser cutting, spinning, and/or roll-forming are used. In manufacture, it is even possible to use thin sheet material, with a thickness of less than 3 mm. Besides being shapable, sheet material can be laser-welded with good results. According to the invention, the plate piece is indeed attached to the inner piece and to the end plate by laser-welding. The weld point is shown by small arrows in Figures 2 and 4. In practice, the plate piece can also be made from several different parts by welding, though it is preferably to make small plate pieces from a single sheet. The methods described above are also applied in the manufacture of the rope sheave, which rope sheave is attached by bearings separately from the protruding shaft. The vibration of a totality created in this manner will be small and the rope sheave will be precisely supported.

[0021] The roll according to the invention and particularly its end piece is light but stiff compared to a corresponding cast piece. By using a light but stiff end piece, the dimensioned speed of a roll can be increased by as much as 5 - 20 %. This largely due to the new type of end piece, by means of which the entire roll is made stiffer than before. The specific frequency of the roll then increases, when its vibration sensitivity decreases. In tested rolls, the specific frequency has increased by 5 - 10 %, in some cases by as much as 20 %. In addition, the protruding shaft can be selected with more freedom than before, so that it is possible to use smaller shaft diameters than previously. At the same time, the choice of bearing

becomes freer. In addition to the above, the cellular end piece is considerably cheaper to manufacture than a cast piece while it can incorporate damping, insulation, or both.

Claims

1. Roll for a web forming machine, which roll includes a shell (10), with end pieces (11) at both ends of it to support the roll rotatably in bearing arrangements (12) in the web forming machine, which end pieces (11) are arranged to be detachably attached at each end of the shell (10), and in each of which end pieces (11) there is an end plate (13) with a protruding shaft (14) in it for support in a bearing arrangement (12), **characterized in that** the end piece (11) includes a separate inner piece (17), in which there is an internal hole (18) corresponding to the protruding shaft (14) for attachment, and on which inner piece (17) the end plate (13) is supported by at least one plate piece (19), **in that** an installation hole (20) is arranged in the end plate (13) for the inner piece (17), and the plate piece (19) is arranged to extend to the opposite end of the inner piece (17) to the end plate (13), and **in that** the plate piece (19) is arranged conically, the conical angle α being 45 - 140°, preferably 55 - 130°.
2. Roll according to Claim 1, **characterized in that** the end plate (13), the protruding shaft (14), and the inner piece (17) are separately machined bodies of revolution.
3. Roll according to Claim 1 or 2, **characterized in that** the plate piece (19) is arranged in such a way that the end plate (13) and the inner piece (17) are coaxially relative to each other in the end piece (11).
4. Roll according to any of Claims 1 - 3, **characterized in that** the end piece (11) includes a second plate piece (22), which is arranged as part of the end plate (13).
5. Roll according to any of Claims 1 - 4, **characterized in that** a damping and/or insulating material (24) is arranged in the space delimited by the end plate (13), the inner piece (17), and the plate piece (19).
6. Roll according to any of Claims 1 - 5, **characterized in that** the roll includes a rope sheave (26), which is arranged to extend axially over the free length of the protruding shaft (14) to the end plate (13).
7. Roll according to Claim 6, **characterized in that** the rope sheave (26) includes a bearing (27), which is arranged around the protruding shaft (14), the bearing (27) having an inner ring (28) which is fitted around and which is separate from the protruding

shaft (14), the bearing (27) having an outer ring (31) to which the rope sheave (26) is attached.

8. Roll according to Claim 6 or 7, **characterized in that** the rope sheave (26) is made of sheet material and has a plate part (32), the plate part (32) having a groove (35) for the rope.

9. Roll according to Claim 8, **characterized in that** the plate part (32) includes a roll-formed portion (33) for the rope, which portion (33) is of the same sheet material as the plate part (32), or is a separate additional part (34) attached to the plate part (32).

Patentansprüche

1. Walze für eine Bahnbildungsmaschine, welche einen Mantel (10) mit Endstücken (11) an beiden Seiten desselben aufweist, um die Walze drehbar in Lageranordnungen (12) in der Bahnbildungsmaschine zu halten, wobei die Endstücke (11) so ausgebildet sind, dass sie abnehmbar an jedem Ende des Mantels (10) angebracht sind, wobei in jedem Endstück (11) eine Endplatte (13) mit einer vorstehenden Welle (14) in derselben zur Lagerung in einer Lageranordnung (12) vorgesehen ist, **dadurch gekennzeichnet, dass** das Endstück (11) ein separates inneres Teil (17) aufweist, in welchem sich eine innere Bohrung (18) befindet, die zur Anbringung der vorstehenden Welle (14) mit derselben korrespondiert, wobei auf dem inneren Teil (17) die Endplatte (13) mittels wenigstens eines Plattenteils (19) gehalten ist, dass in der Endplatte (13) eine Einbaubohrung (20) für das innere Teil (17) angeordnet ist und das Plattenteil (19) so angeordnet ist, dass es sich zu dem gegenüberliegenden Ende des inneren Teils (17) und zu der Endplatte (13) erstreckt, und dass das Plattenteil (19) konisch angeordnet ist, wobei der konische Winkel α 45° bis 140°, vorzugsweise 55° bis 130°, beträgt.
2. Walze nach Anspruch 1, **dadurch gekennzeichnet, dass** die Endplatte (13), die vorstehende Welle (14) und das innere Teil (17) separate, maschinell bearbeitete Rotationskörper sinkt.
3. Walze nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Plattenteil (19) auf eine solche Art und Weise angeordnet ist, dass die Endplatte (13) und das innere Teil (17) in dem Endstück (11) relativ zueinander koaxial sind.
4. Walze nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Endstück (11) ein zweites Plattenteil (22) aufweist, welches als Teil der Endplatte (13) angeordnet ist.

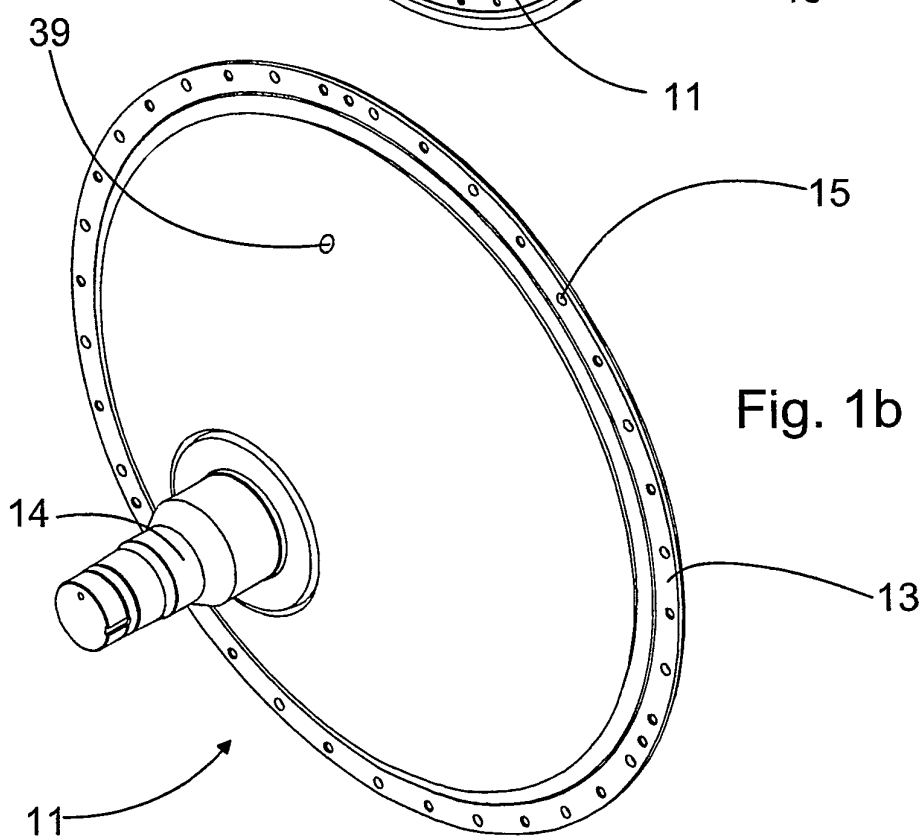
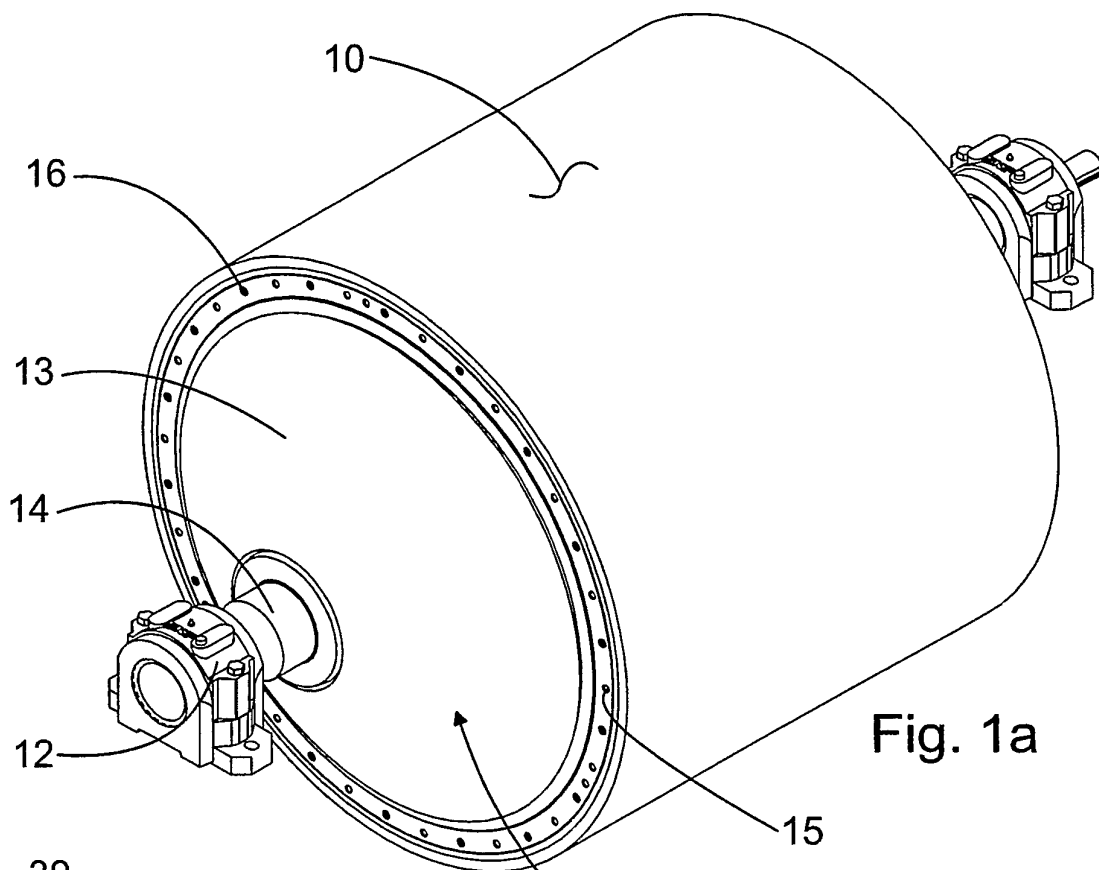
5. Walze nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** ein Dämpfungs- und/oder Isolationsmaterial (24) in dem durch die Endplatte (13), das innere Teil (17) und das Plattenteil (19) begrenzten Raum angeordnet ist.
6. Walze nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Walze eine Seilscheibe (26) aufweist, welche so angeordnet ist, dass sie sich axial über die freie Länge der vorstehenden Welle (14) zu der Endplatte (13) erstreckt.
7. Walze nach Anspruch 6, **dadurch gekennzeichnet, dass** die Seilscheibe (26) ein Lager (27) aufweist, welches um die vorstehende Welle (14) angeordnet ist, wobei das Lager (27) einen inneren Ring (28) aufweist, welcher um die vorstehende Welle (14) herum angeordnet und separat von derselben ist, und wobei das Lager (27) einen äußeren Ring (31) aufweist, an welchem die Seilscheibe (26) angebracht ist.
8. Walze nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** die Seilscheibe (26) aus einem plattenförmigen Material bzw. einem Blechmaterial hergestellt ist und ein Plattenteil (32) aufweist, wobei das Plattenteil (32) eine Nut (35) für das Seil aufweist.
9. Walze nach Anspruch 8, **dadurch gekennzeichnet, dass** das Plattenteil (32) einen rollgeformten Abschnitt (33) für das Seil aufweist, wobei der Abschnitt (33) aus demselben plattenförmigen Material wie das Plattenteil (32) besteht oder ein separates, zusätzliches, an dem Plattenteil (32) angebrachtes Teil (34) ist.

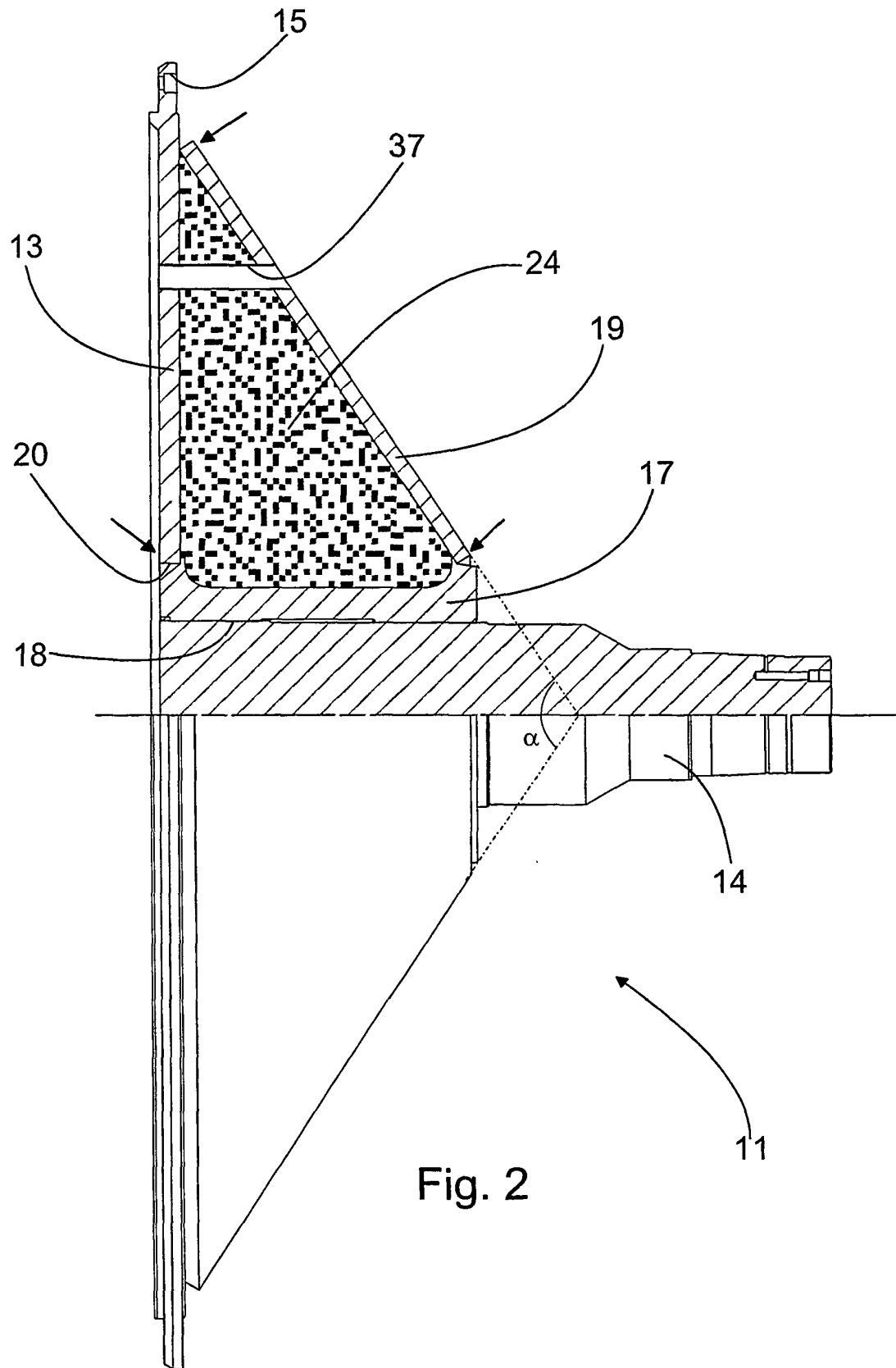
Revendications

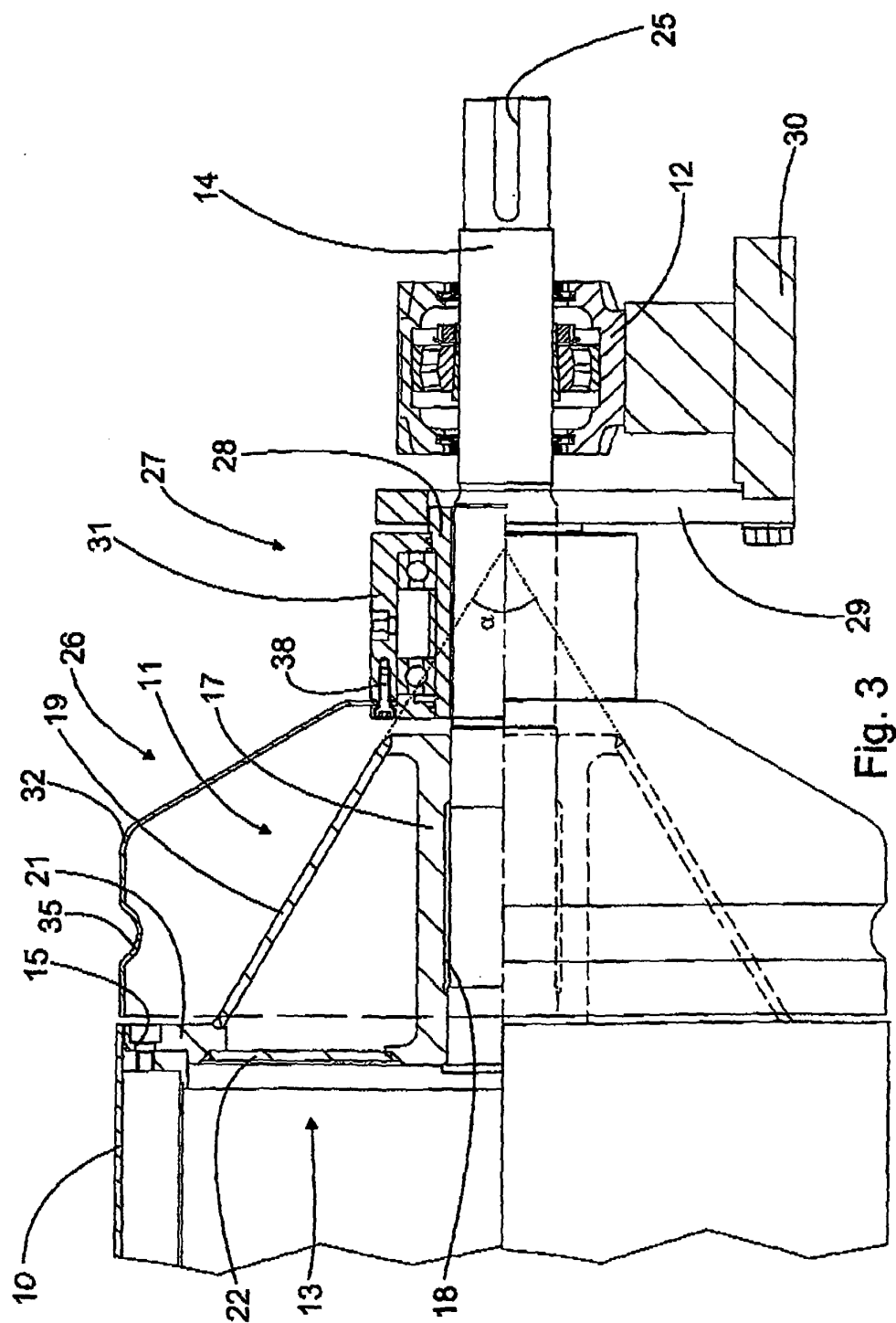
1. Cylindre pour une machine formant des bandes, lequel cylindre comprend une coque (10) avec des pièces d'extrémité (11) à ses deux extrémités pour supporter le cylindre de façon rotative dans des dispositifs à paliers de la machine formant des bandes, lesquelles pièces d'extrémité (11) sont agencées pour être attachées de façon détachable à chaque extrémité de la coque (10), chacune des pièces d'extrémité (11) comportant une plaque d'extrémité (13) pourvue d'un arbre saillant (14) pour le support dans un dispositif de palier (12), **caractérisé en ce que** la pièce d'extrémité (11) comprend une pièce intérieure séparée (17), pourvue d'un alésage interne (18) correspondant à l'arbre saillant (14) pour la fixation, la plaque d'extrémité (13) étant supportée par la pièce intérieure (17) par au moins une plaque (19), **en ce qu'un** trou d'installation (20) est ménagé dans la plaque d'extrémité (13) pour la pièce intérieure

(17), et la plaque (19) est agencée pour s'étendre vers l'extrémité opposée de la pièce intérieure (17) et vers la plaque d'extrémité (13), et **en ce que** la plaque (19) est disposée de façon conique, l'angle du cône a étant compris entre 45 et 140° et de préférence entre 55 et 130°.

2. Cylindre selon la revendication 1, **caractérisé en ce que** la plaque d'extrémité (13), l'arbre saillant (14) et la pièce intérieure (17) sont des corps de révolution usinés séparément.
3. Cylindre selon la revendication 1 ou 2, **caractérisé en ce que** la plaque (19) est agencée de telle façon que la plaque d'extrémité (13) et la pièce intérieure (17) sont coaxialement relatives l'une par rapport à l'autre dans la pièce d'extrémité (11).
4. Cylindre selon l'une quelconque des revendications 1 - 3, **caractérisé en ce que** la pièce d'extrémité (11) comprend une seconde plaque (22) qui est agencée comme partie de la plaque d'extrémité (13).
5. Cylindre selon l'une quelconque des revendications 1 - 4, **caractérisé en ce qu'un** matériau d'amortissement et/ou d'isolation (24) est disposé dans l'espace délimité par la plaque d'extrémité (13), la pièce intérieure (17) et la plaque (19).
6. Cylindre selon l'une quelconque des revendications 1 - 5, **caractérisé en ce que** le cylindre comprend une poulie à câble (26) qui est agencée pour s'étendre axialement sur la longueur libre de l'arbre saillant (14) vers la plaque d'extrémité (13).
7. Cylindre selon la revendication 6, **caractérisé en ce que** la poulie à câble (26) comprend un palier (27) qui est disposé autour de l'arbre saillant (14), le palier (27) comportant une bague intérieure (28) qui est ajustée autour et qui est séparée de l'arbre saillant (14), le palier (27) ayant une bague extérieure (31) à laquelle la poulie à câble (26) est attachée.
8. Cylindre selon la revendication 6 ou 7, **caractérisé en ce que** la poulie à câble (26) est faite d'une feuille de métal et comporte une partie de plaque (32), la partie de plaque (32) comportant une gorge (35) pour le câble.
9. Cylindre selon la revendication 8, **caractérisé en ce que** la partie de plaque (32) comprend une partie en forme de cylindre (33) pour le câble, laquelle partie (33) étant réalisée avec la même feuille de métal que la partie de plaque (32), ou est une partie additionnelle séparée (34) attachée à la partie de plaque (32).







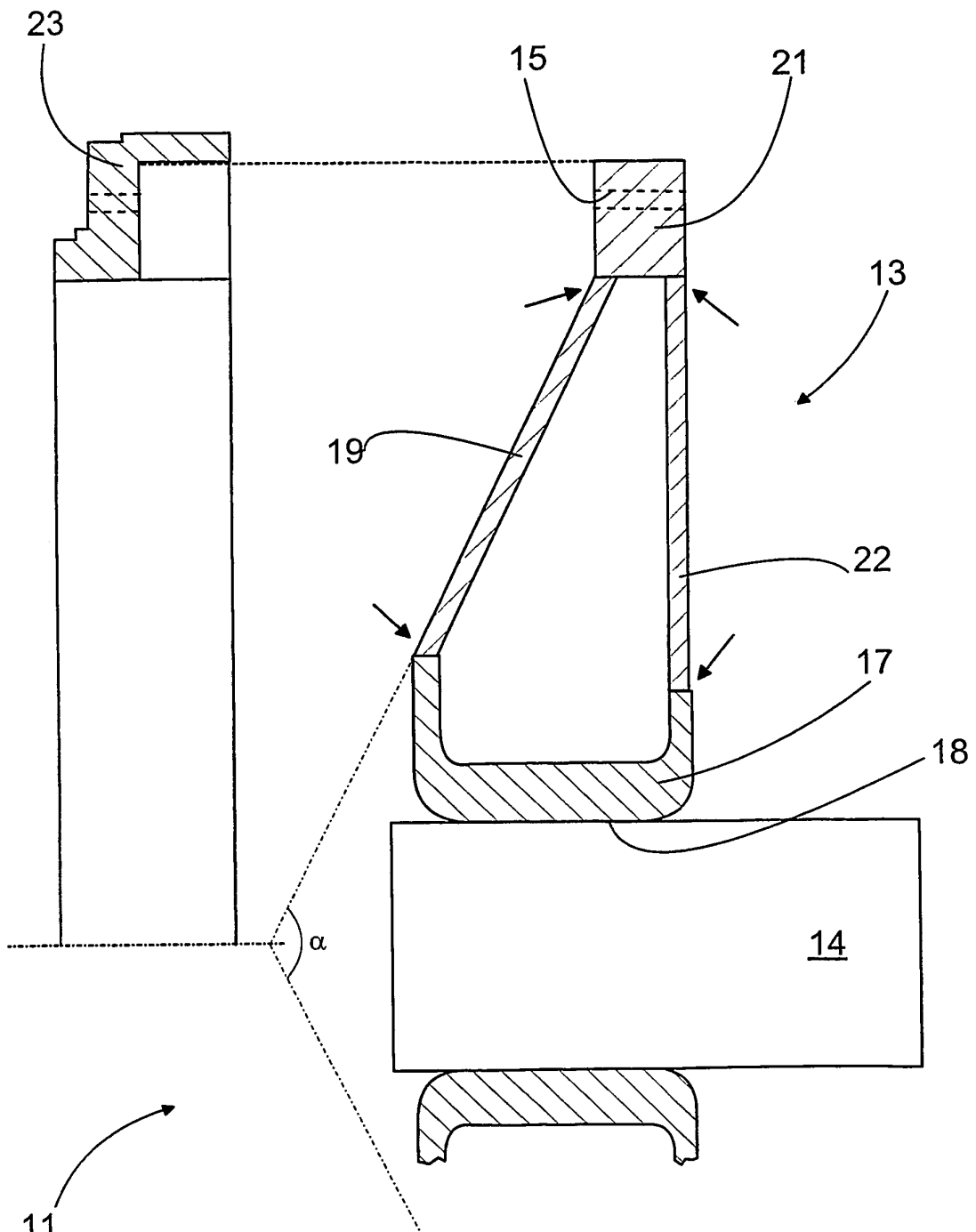
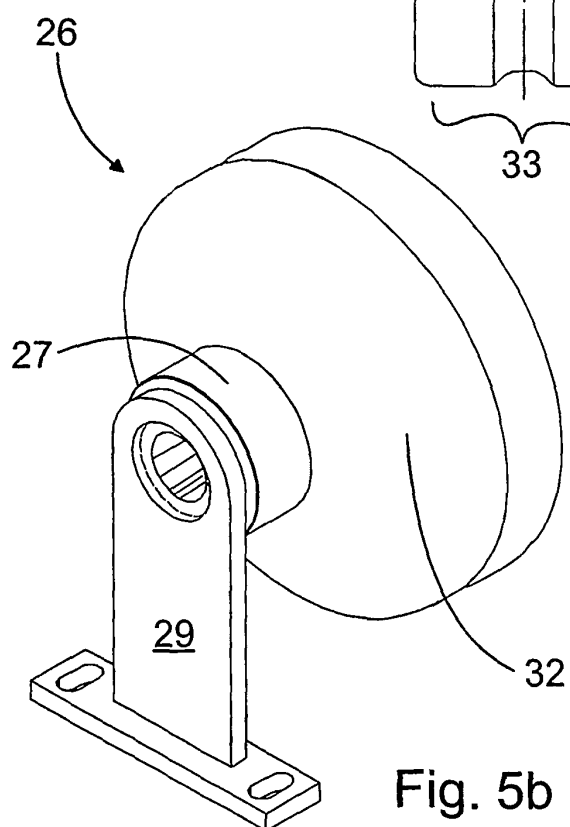
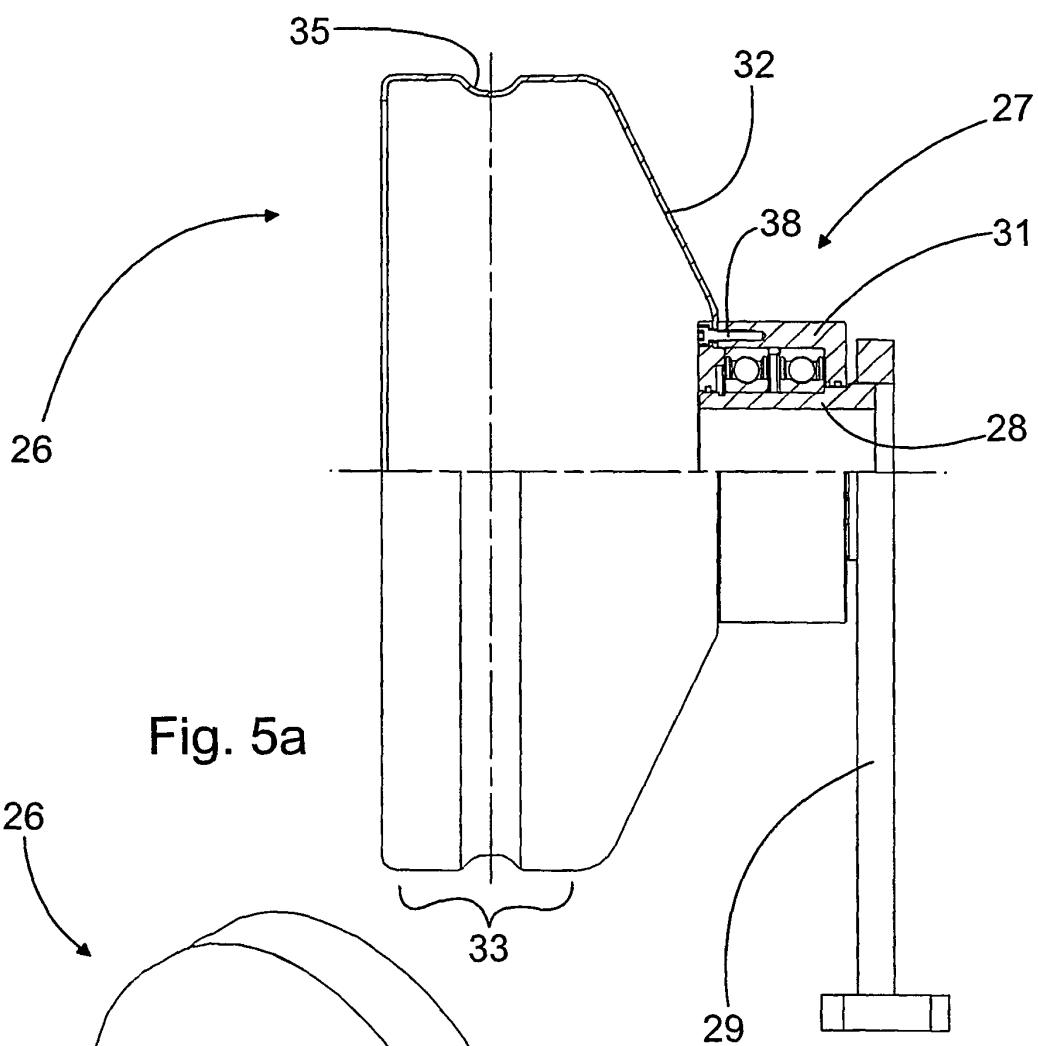
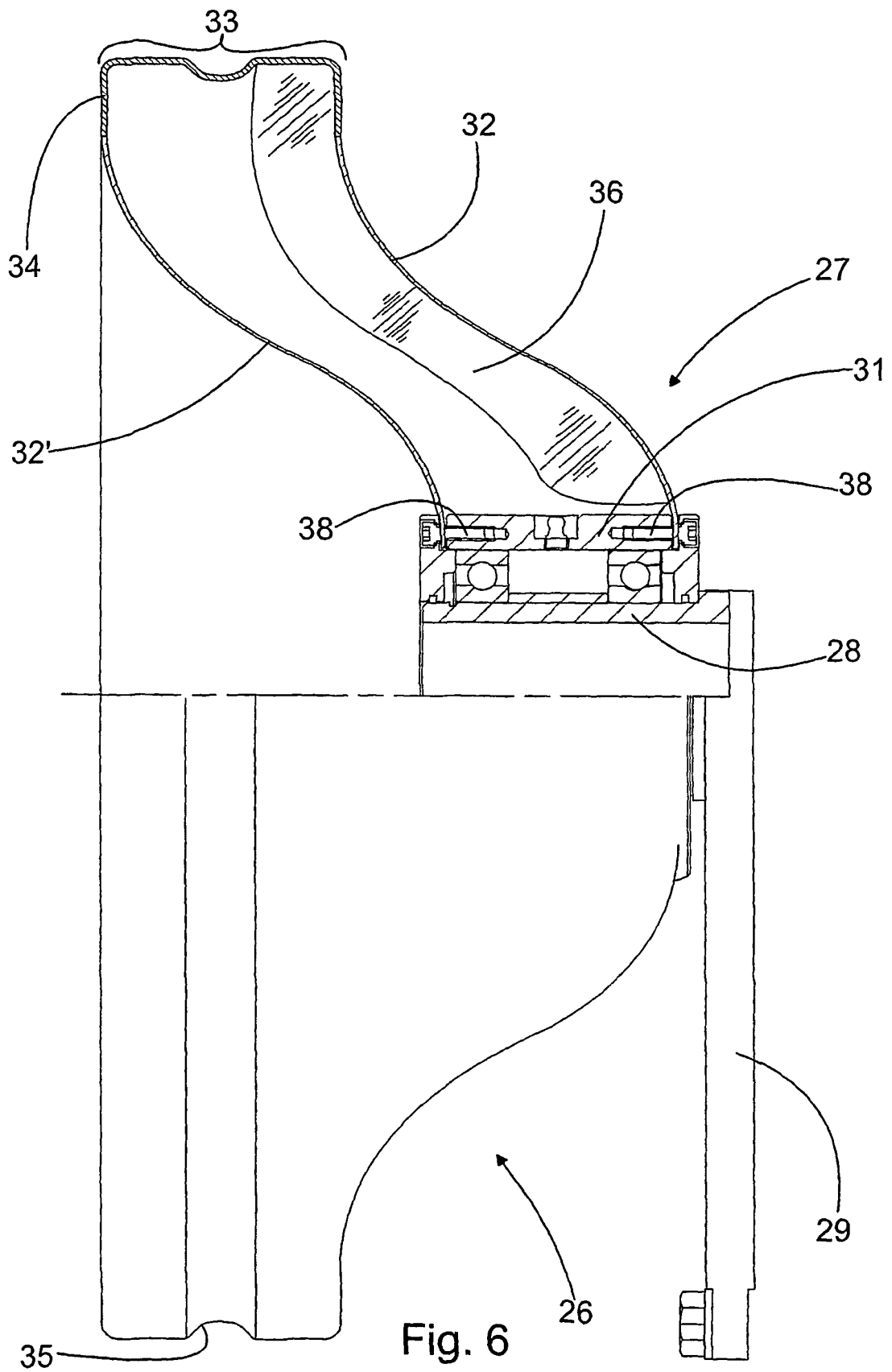


Fig. 4





REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4820947 A [0003]
- US 5837101 A [0004]
- DE 19542191 A1 [0005]