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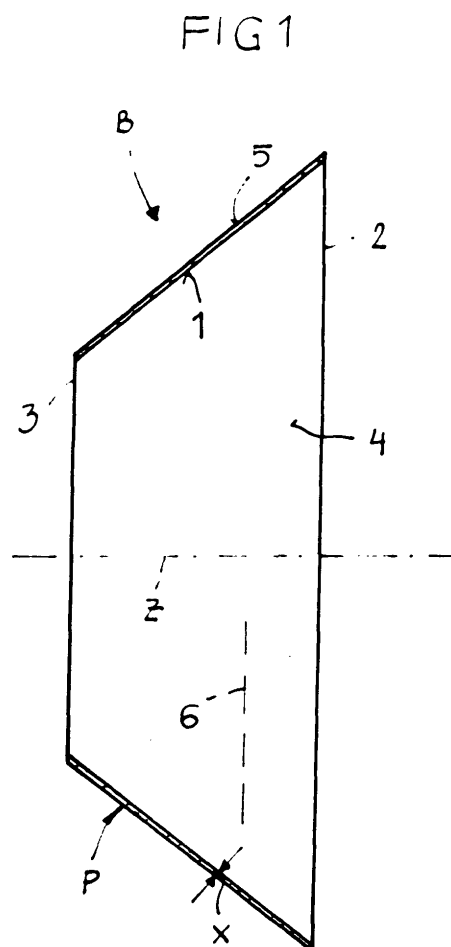
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Amended claims in accordance with Rule 137(2) EPC.

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(54) **Braking body and yarn feeder**

(57) A braking body B of a yarn brake Y generally being a frustocone jacket 1 made of at least radially elastic homogenous thermoplastic polymeric foil material B, the inner surface 1 of which is defining a circumferentially continuous yarn braking zone 6 consists of a high-performance thermoplastic polymer such as polyketone. A yarn feeder comprising a stationary storage body 13 and a yarn brake Y including a braking body B being resiliently pressed axially against a storage body 13 as a frusto-conical braking body consisting of a high-performance thermoplastic polymer such as polyketone.



Description

[0001] The invention relates to a braking body according to the preamble part of claim 1 and to a yarn feeder according to the preamble of claim 13.

[0002] WO 2006/032376 A discloses a frustoconical braking body having a wall thickness between about 0.2 mm and 1.0 mm. The braking body consists of a thermoplastic foil material of engineering plastic and is made by thermo-vacuum shaping. The plastic material used is either polyethylene, polyvinylchloride, or polyterephthalate (PE, PVC, PET).

[0003] EP 1 164 103 A discloses a braking body substrate and a weft yarn feeder being equipped with a yarn brake including the frustoconical braking body substrate. The braking body substrate is made from calendered engineering thermoplastic materials, thermoplastic resins or thermosetting plastic material and consists of an outer frustoconical carrier body and an axially shorter frustoconical braking body inserted into the interior of the frustoconical carrier body. One example of the engineering plastic material is epoxy resin. In the yarn feeder the braking body is axially resiliently pressed via the carrier body against the front end of the stationary storage body such that the braking zone at the inner surface of the frustoconical braking body contacts the rounded withdrawal rim. The large diameter end of the braking body protrudes outwardly in relation to the storage surface of the storage body. The small diameter end of the braking body substrate is situated in front of the front end of the storage body and is suspended in a radial star-like arrangement of tension springs the outer ends of which are anchored in a holder ring. The holder ring is snapped into a carrier ring which is axially adjustable in a housing bracket of the yarn feeder in order to set the contact pressure between the braking body and the storage body withdrawal rim.

[0004] DE 10 2004 051 372 A discloses a braking body for a yarn brake. The braking body is a true regular frustocone jacket made from a mesh fabric containing weft yarns and warp yarns of polyester. The braking body is made by deep drawing under elevated temperatures.

[0005] EP 1 243 542 A discloses a frustoconical braking body of a yarn brake of a yarn feeder. The braking body has a discontinuous braking zone defined by a circumferential row of inclined slits in the frustoconical jacket. The braking body is made from engineering thermoplastic polymeric material or from engineering thermosetting polymeric material or from engineering polymer reinforced with carbon fibre.

[0006] The generally frustoconical braking body of a yarn brake is a wear part which has to be exchanged frequently because the braking zone contacting the withdrawal rim of the storage body wears out rapidly. The yarn is withdrawn overhead of the storage body between the withdrawal rim and the braking zone. During withdrawal the yarn is orbiting like the hand of a clock, causing permanent relative movements between the radially

elastic braking body and the in most cases metallic withdrawal rim. As the yarn locally lifts the braking zone from the withdrawal rim the braking body permanently is deformed and is breathing in relation to the withdrawal rim.

5 Abrasion caused by friction of the orbiting withdrawn yarn, abrasion caused by friction of the withdrawal rim and heat generated by the friction causes wear in the braking zone. The wear in the braking zone does not develop uniformly but creates successive spots which
10 are worn out more than the interspaces between the spots. A typical appearance of the worn-out braking zone of the braking body has the image of a pearl necklace. The braking body at this point has to be replaced. The wear results in undesirably short service life of the braking
15 body and a relatively high frequency of braking body exchanges with a lot of shut-down time of the yarn feeder because an exchange of the braking body requires switching off the yarn feeder and the weaving machine or the knitting machine. The engineering plastic materials
20 of known braking bodies, moreover, performed such that in operation of the yarn brake the yarn tension resulting from the braking effect of the yarn brake shows significant irregularities even during each single orbiting revolution of the withdrawn yarn along the braking zone of the braking
25 body. The irregularities result from the co-action between the yarn and the surface of the plastic material of the braking body, and, furthermore, from increasing wear. Irregularities of the yarn tension may be the reason for yarn breakages and negative interference on the insertion process in the weaving machine or the knitting
30 machine. Both drawbacks, the irregular yarn tension and the rapid progress of wear in the braking zone are detrimental to the performance of the braking body or the yarn feeder, respectively.

35 **[0007]** It is an object of the invention to create a braking body or a yarn feeder allowing to achieve a uniform yarn tension during each revolution of the withdrawn yarn along the braking zone and an extended service life of the braking body in order to lower the frequency of shut-downs of the yarn feeder to exchange the braking body.
40

[0008] This object is achieved by the features of claim 1 and the features of claim 13.

[0009] Mainly due to excellent resilience against mechanical loads and heat, and a very smooth and tough surface in the braking zone working with the yarn and the withdrawal rim the high-performance thermoplastic polymer material like e.g. polyketone of the braking body results in an extended service life and a superior yarn tension development, compared to engineering plastic
45 of known braking bodies.

[0010] The yarn tension as produced during each revolution of the orbiting yarn along the braking zone of the braking body remains very uniform over nearly the full service life of the braking body.

55 **[0011]** In the yarn feeder equipped with the frustoconical braking body made from a sheet or foil of a high-performance thermoplastic polymer like e.g. polyketone the material choice results in a markedly lowered fre-

quency of shutdowns for braking body exchanges and in very few yarn breakages and almost no detrimental interferences with the yarn insertion process.

[0012] In a preferred embodiment the braking body consists of a semi-crystalline or amorphous high-performance thermoplastic polymer like e.g. polyketone.

[0013] The polyketone for the braking body expediently is selected from the following polyketones group: polyetheretherketone, polyaryletherketone, polyetherketoneketone, or a similar polyketone. Polyketones in one family within various high-performance thermoplastic polymers which all allow to achieve the above mentioned advantages of the braking body.

[0014] Polyketone is a high-performance plastic material obtained from aromatic dehalides and bisphenolate salts by nucleophilic substitution.

[0015] Among the high-performance thermoplastic polymers like e.g. the family of polyketones used for braking bodies of yarn brakes polyetheretherketone is one which exhibits two glass transition temperatures around 140°C and 270°C, has a melting point of about 350°C, and is highly resistant to thermal degradation. Polyketones, furthermore, are resistant to both organic and aqueous environments and show a high strength to weight ratio. High-performance thermoplastic polymers are available either semi-crystalline or amorphous.

[0016] Until now polyketones have been used in bearings, pistons, pumps, compressor valves and cable insulations. Polyketones are compatible with ultrahigh vacuum applications. Polyetheretherketone also is an advanced bio-compatible material used in medical implants, and is also used in structures of aerospace craft.

[0017] Owing to the excellent strength to weight ratio and the high resistancy against thermal degradation, the wall thickness of the polyketone frustocone jacket only needs to amount to between 0.1 mm and 0.5 mm. The small wall thickness results in a very lightweight braking body showing an excellent performance even in the case of high yarn speeds, or delicate yarn qualities, or small diameter storage bodies.

[0018] The high-performance thermoplastic polymers used for manufacturing the braking body expediently should have a Young's modulus between about 3.0 and 4.0 GPa, preferably about 3.6 GPa, and a tensile strength between about 75 and 110 MPa, preferably about 90 MPa.

[0019] The excellent performance of the braking body is achieved already with a homogenous frustocone. However, for certain applications it even may be expedient to use a high-performance thermoplastic polymer like polyketone which contains reinforcing fibre material, even carbon fibres.

[0020] In an expedient embodiment the uniformity of the yarn tension resulting from the cooperation between the braking zone of the braking body and the yarn may be further improved by providing a circumferentially continuous, outwardly extending integrally formed flange at the large diameter end of the frustoconical jacket. The

flange somewhat stiffens or reinforces the large diameter end region of the braking body, attenuates an undulation tendency there and thus brings about an even more uniform development of the yarn tension during each revolution of the withdrawn yarn along the braking zone. Moreover, when mounting or exchanging the braking body in most cases the braking body is gripped by hand or with the help of a tool at the large diameter end. Also when removing rests of broken yarn or lint deposits by pressurised air or by using a tool or the fingers, the large diameter end might easily become damaged, as a sharp large diameter end of a true frustocone jacket is prone to scratching or cracking during such manipulations. The flange forms a protection for the vulnerable large diameter end region of the braking body and thus contributes to a long service life..

[0021] In an expedient embodiment the flange extends substantially radially with respect to the frustocone axis. The flange fulfils a further protective function in that it hinders during awkward operation conditions the yarn from moving outwardly around the and behind the large diameter end where it might wrap around protruding components of the yarn feeder.

[0022] In another expedient embodiment the flange is inversely conical in relation to the conicity of the frustocone jacket. So to speak, the outer edge of the frustocone jacket is bent backwards.

[0023] In a preferred embodiment the inversely conical polyketone flange has a rounded curvature, in an axial section of the braking body, and a smooth transition into the large diameter end of the frustocone jacket. During operation of the braking body the polyketone flange dampens a vibration tendency in the large diameter end region of the braking body.

[0024] Preferably, the flange may define an angle of about 90° with the outer surface of the frustocone jacket, the generatrice of which, expediently, is a straight line between the small diameter end and the large diameter end.

[0025] In an expedient embodiment, the braking body is made by thermoshaping a high-performance thermoplastic polymer foil or sheet, preferably a flat blank e.g. of a polyketone foil or sheet. A preferred process for shaping the braking body is thermo-vacuum shaping or deep drawing, preferably under elevated temperatures.

[0026] In another embodiment, the braking body made from the high-performance thermoplastic polymer like e.g. a polyketone is inserted with an outer frustoconical carrier body. The braking body defines the braking zone and constitutes - so to speak - a brake lining in the carrier body. The braking body may be attached to the inner wall of the carrier body.

[0027] Embodiments of the invention will be described with reference to the drawings. In the drawings is:

Fig. 1 an axial section of a first embodiment of a braking body,

Fig. 2 an axial section of a second and third embodiment of a braking body,

Fig. 3 an axial section of a yarn feeder being equipped with a yarn brake including a braking body, e.g. according to Fig. 1, and

Fig. 4 an axial section of a braking body substrate.

[0028] A braking body B as shown in Fig. 1 is a yarn braking body intended for use in a yarn brake Y of a yarn feeder F (Fig. 3). The braking body B is a wear part or spare part which has to be exchanged when the service life has expired, e.g. due to wear.

[0029] The braking body B in Fig. 1 is a true frustocone jacket 1 having a small diameter end 3 and a large diameter end 2, a frustocone axis Z and a straight generatrice. The frustocone jacket 1 has an inner continuous and smooth surface 4 and an outer surface 5. The inner surface 4 defines a circumferentially continuous braking zone 6 (indicated by a dotted line). The braking body consists of a high-performance thermoplastic polymer such as a polyketone selected from the following polyketone group: polyetheretherketone, polyaryletherketone, polyetherketoneketone (PEEK, PAEK, PEKK). The wall thickness x amounts to between 0.1 mm and 0.5 mm.

[0030] The braking body B is made by thermoshaping, preferably thermo-vacuum shaping or deep drawing a sheet or a foil, most preferably a flat foil or sheet blank. The use of a blank results in the fact that the finally shaped braking body does not need further treatment like cutting the edges in the small diameter end 3 or the large diameter end 2. The inner surface 4 of the frustocone jacket 1 may either have a polished surface quality or may be treated by polishing. The high-performance thermoplastic polymer such as a polyketone may be semi-crystalline or amorphous, and may even contain reinforcing fibre material. The braking body B is elastic at least in radial direction and is relatively stiff in axial direction along the axis Z.

[0031] In the embodiment in Fig. 2 a flange 7 (or 7' in dotted lines) may be integrally formed at the large diameter end 2 of the frustocone jacket 1. The flange 7' either extends radially with respect to the axis Z of the frustocone jacket 1, or the flange 7 is inversely conical in relation to the conicity of the frustocone jacket 1 (shown in full lines). When being inversely conical the flange 7 may be rounded with a radius r as shown, and may have a smooth transition 8 into the large diameter end 2 of the frustocone jacket 1.

[0032] The yarn feeder F (either a weft yarn feeder for a weaving machine or a knitting yarn feeder for a knitting machine) in Fig. 3 includes a yarn brake Y being equipped with the braking body B shown in Fig. 1 or in Fig. 2 (not shown).

[0033] The yarn feeder F has a housing 9 containing a not shown motor for driving a central shaft 10. The rear part of the shaft 10 is hollow and communicates with an

obliquely outwardly extending winding tube 11. A storage body 13 is rotatably supported on the shaft 10 and is hindered against co-rotation with the shaft 10 by e.g. co-acting permanent magnets arranged in the storage body 13 and the housing 9. The storage body 13 defines a substantially cylindrical storage surface 14 for a not shown yarn supply consisting of consecutively wound on yarn windings of a yarn exiting the winding tube 11. The yarn supply is formed by rotating the winding tube 11 in relation to the stationary storage body 13. From the yarn supply on the storage surface 14 the yarn is withdrawn overhead of the storage body 13 and over a rounded or conical withdrawal rim 18 and through a stationary outlet eyelet 15 stationarily supported in a bracket 12 of the housing 9. The yarn eyelet 15, in this case, is supported in a basket-shaped structure 17 snapped into a holder 16 mounted in the bracket 12. The holder 16 may be adjusted along bracket 12.

[0034] The basket-shaped structure 17, furthermore, holds a ring-shaped body 19 in turn holding the small diameter end 3 of the braking body B such that the braking body B is axially resiliently pressed against the withdrawal rim 18 with the braking zone 6 contacting the entire circumference of the withdrawal rim 18. The large diameter end 2 of the braking body B protrudes outwardly beyond the withdrawal rim 18. The small diameter end 3 may be inserted loosely, or snapped-in into the body 19, or even may be fixed there.

[0035] During operation of the yarn feeder F the yarn while being withdrawn from the yarn supply on the storage surface 14 is pulled through between the braking zone 6 of the braking body B and the withdrawal rim 18 before it runs through the outlet eyelet 15 and further axially to the insertion means (not shown) of the weaving machine or the knitting machine.

[0036] The braking body B is at least locally radially deformed by the yarn while the withdrawn yarn is orbiting around the withdrawal rim 18. The yarn is braked. The braking effect between the braking zone 6 and the withdrawal rim 18 and the friction of the yarn on the braking surface 6 generate a certain yarn tension in the running yarn, e.g. depending on the braking body contact pressure backed-up by the holder 16. Due to the excellent surface quality and the high resistance against abrasion by mechanical loads and heat of the high-performance thermoplastic polymer material such as polyketone plastic material as used for manufacturing the braking body B, the yarn tension, depending among others on the coefficient of friction in the braking zone and the coefficient of friction in the withdrawal rim 18, remains broadly constant during each revolution of the yarn along the braking zone 6 and for the entire service life.

[0037] In order to replace the braking body the holder 16 is moved in the bracket 12 in Fig. 3 to the right side until the braking body B forms a gap with the withdrawal rim 18. Then either the structure 17 is taken out from the holder 16 or the body 19 is taken out from the structure 17, or the braking body B directly is taken out from the

body 19. Then the braking body B is replaced by another braking body B, before the holder 16 is moved back into the original position. In order to vary the braking effect the holder 16 may be moved gradually in Fig. 3 to the left side or the right side in order to increase or decrease the axial contact pressure of the braking body B on the withdrawal rim 18.

[0038] The braking body substrate of Fig. 4 consists of an outer frustoconical thin-walled carrier body 20 of frustoconical shape and the braking body B. The braking body B e.g. made of polyketone is inserted into the carrier body 20 and may be attached to the inner wall of the carrier body 20 between big-diameter and small-diameter ends 21, 22. The braking body B has the same conicity as the carrier body 20, and may be axially shorter than or as long as the carrier body 20. The carrier body 20 may consist of a high-performance thermoplastic polymer such as polyketone as well, or of another polymeric plastic material, or of sheet metal, or of a plastic impregnated fabric. The braking body B constitutes a brake lining of the braking body substrate. As indicated, the carrier body 20 may be integrally formed with an end flange 7', similar to the braking body B in Fig. 2.

Claims

1. Braking body (B) of a yarn brake (Y) of a yarn feeder (F), the braking body (B) generally being a frustocone jacket (1) made of at least radially elastic homogenous thermoplastic polymeric foil material (P), the inner surface (1) of the braking body (B) defining a circumferentially continuous yarn braking zone (6) **characterised in that** the braking body (B) consists of a high-performance thermoplastic polymer such as polyketone.
2. Braking body according to claim 1, **characterised in that** the braking body (B) consists of a semi-crystalline or amorphous high-performance thermoplastic polymer such as polyketone.
3. Braking body according to claim 1, **characterised in that** the polyketone is selected at least from the following group of polyketones: polyetheretherketone, polyaryletherketone, polyetherketoneketone (PEEK, PAEK, PEKK).
4. Braking body according to claim 1, **characterised in that** the wall thickness (X) of the polyketone frustocone jacket (1) is substantially constant and amounts to about between 0.1 mm and 0.5 mm.
5. Braking body according to claim 1, **characterised in that** the high-performance thermoplastic polymer such as polyketone in the braking body (B) has a Young's modulus between about 3.0 GPa and 4.0 GPa, preferably about 3.6 GPa, and tensile strength
6. Braking body according to at least one of the preceding claims, **characterised in that** the polyketone frustocone jacket (1) contains reinforcing fibre material.
7. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) has a circumferentially continuous, outwardly extending integrally formed flange (7, 7') at the large diameter end (2) of the frustocone jacket (1).
8. Braking body according to claim 7, **characterised in that** the flange (7') at the large diameter end (2) extends substantially radially with respect to the frustocone axis (Z).
9. Braking body according to claim 7, **characterised in that** the flange (7) is inversely conical in relation to the conicity of the frustocone jacket (1), preferably with a rounded curvature (r) and a smooth transition (8) in the large diameter end (2).
10. Braking body according to claim 9, **characterised in that** the polyketone flange defines a angle (α) of about 90° with the outer surface (5) of the frustocone jacket (1).
11. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) is made by thermoshaping, preferably thermovacuum shaping or deep drawing, of a foil-blank or of a sheet.
12. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) is inserted into, and preferably attached to, an outer carrier body (20) being a frustocone jacket, preferably consisting of polyketone or of another polymeric material or of sheet metal or of an impregnated fabric.
13. Yarn feeder (F), in particular weft yarn feeder or knitting yarn feeder, comprising a stationary storage body (13) defining a substantially cylindrical storage surface (14) for a yarn supply, the storage body (13) having a circumferentially continuous front end withdrawal rim (18) for overhead withdrawal of a yarn from the yarn supply and over the withdrawal rim (18), a yarn brake (Y) including a braking body (B) generally being a frustocone jacket (1) made of at least radial elastic homogenous thermoplastic polymeric foil material (P), the inner surface (1) of the braking body (B) defining a circumferentially continuous yarn braking zone (6), the braking body (B)

being resiliently pressed axially against the storage body (13) such that the braking body braking zone (6) contacts the withdrawal rim (18) from the front side, **characterised in that** the braking body (B) consists of a high-performance thermoplastic polymer material such as a polyketone of the following group: polyetheretherketone, polyaryletherketone, polyetherketoneketone (PEEK, PAEK, PEKK).

Amended claims in accordance with Rule 137(2) EPC.

1. Braking body (B) of a yarn brake (Y) of a yarn feeder (F), the braking body (B) generally being a frustocone jacket (1) made of at least radially elastic thermoplastic polymeric foil material (P), the inner surface (1) of the braking body (B) defining a circumferentially continuous yarn braking zone (6) **characterised in that** the braking body (B) comprises a high-performance thermoplastic polyketone from the following group of polyketones: polyetheretherketone, polyaryletherketone, polyetherketoneketone (PEEK, PAEK, PEKK), and that the polyketone in the braking body (B) has a Young's modulus between about 3.0 GPa and 4.0 GPa and tensile strength between about 75 and 110 MPa.

2. Braking body according to claim 1, **characterised in that** the braking body (B) comprises a semi-crystalline or amorphous high-performance thermoplastic polyketone.

3. Braking body according to claim 1, **characterised in that** the polyketone in the braking body (B) has a Young's modulus of about 3.6 GPa, and tensile strength of about 90 MPa.

4. Braking body according to claim 1, **characterised in that** the wall thickness (X) of the polyketone frustocone jacket (1) is substantially constant and amounts to about between 0.1 mm and 0.5 mm.

5. Braking body according to at least one of the preceding claims, **characterised in that** the frustocone jacket (1) comprises polyketone and reinforcing fibre material.

6. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) has a circumferentially continuous, outwardly extending integrally formed flange (7, 7') at the large diameter end (2) of the frustocone jacket (1).

7. Braking body according to claim 6, **characterised in that** the flange (7') at the large diameter end (2) extends substantially radially with respect to the frus-

tocone axis (Z).

8. Braking body according to claim 6, **characterised in that** the flange (7) is inversely conical in relation to the conicity of the frustocone jacket (1), preferably with a rounded curvature (r) and a smooth transition (8) in the large diameter end (2), such that the polyketone flange defines a angle (α) of about 90° with the outer surface (5) of the frustocone jacket (1).

9. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) is made by thermoshaping, preferably thermo-vacuum shaping or deep drawing, of a foil-blank or of a sheet of polyketone

10. Braking body according to at least one of the preceding claims, **characterised in that** the braking body (B) is inserted into, and preferably attached to, an outer carrier body (20) being a frustocone jacket, preferably consisting of polyketone or of another polymeric material or of sheet metal or of an impregnated fabric.

11. Yarn feeder (F), in particular weft yarn feeder or knitting yarn feeder, comprising a stationary storage body (13) defining a substantially cylindrical storage surface (14) for a yarn supply, the storage body (13) having a circumferentially continuous front end withdrawal rim (18) for overhead withdrawal of a yarn from the yarn supply and over the withdrawal rim (18), a yarn brake (Y) including a braking body (B) generally being a frustocone jacket (1) made of at least radial elastic homogenous thermoplastic polymeric foil material (P), the inner surface (1) of the braking body (B) defining a circumferentially continuous yarn braking zone (6), the braking body (B) being resiliently pressed axially against the storage body (13) such that the braking body braking zone (6) contacts the withdrawal rim (18) from the front side, **characterised in that** the braking body (B) consists of a high-performance thermoplastic polyketone of the following group: polyetheretherketone, polyaryletherketone, polyetherketoneketone (PEEK, PAEK, PEKK).

FIG 1

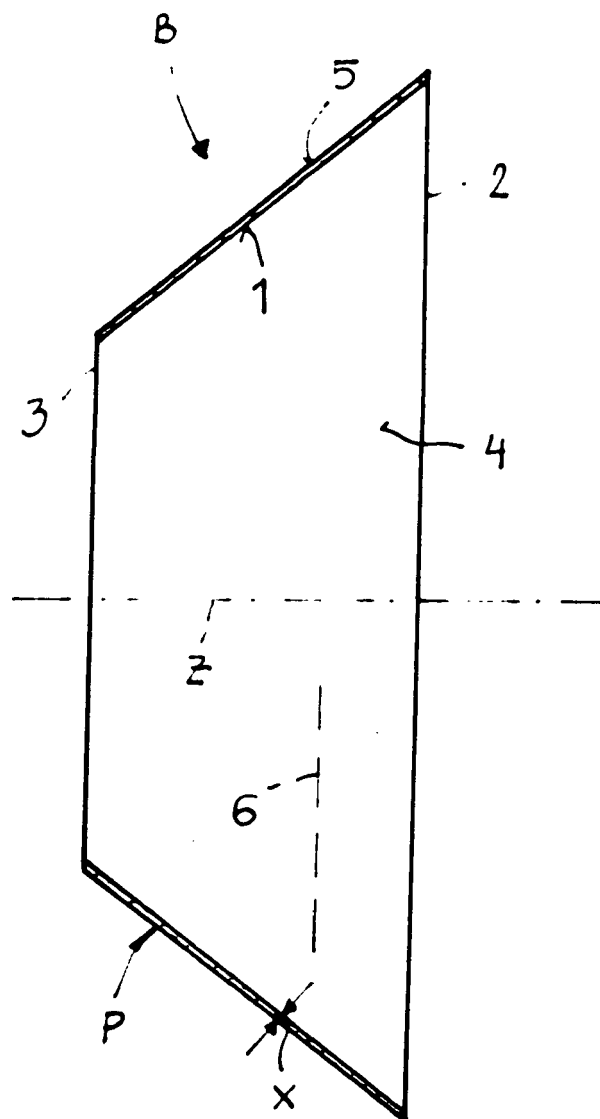


FIG 2

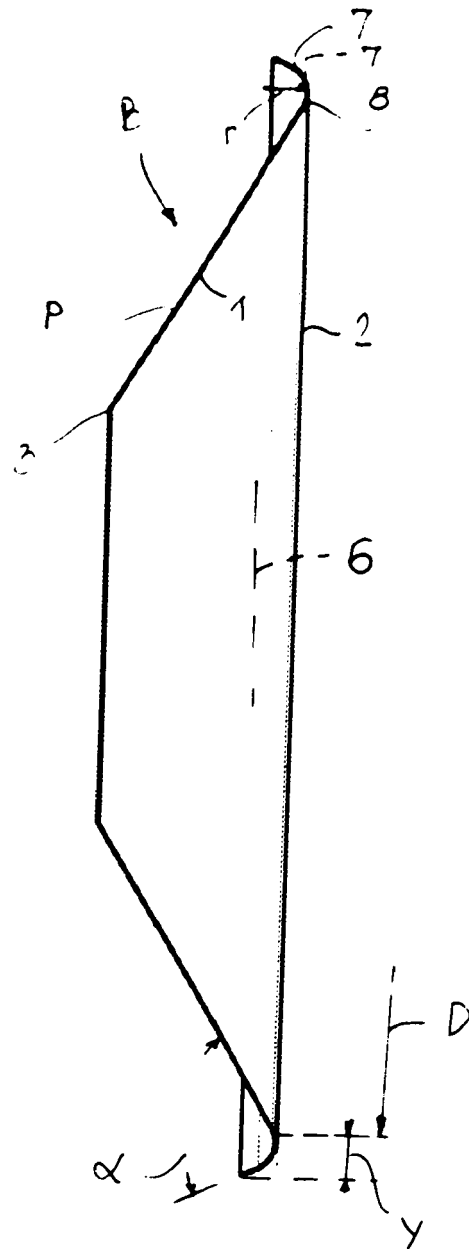


FIG 3

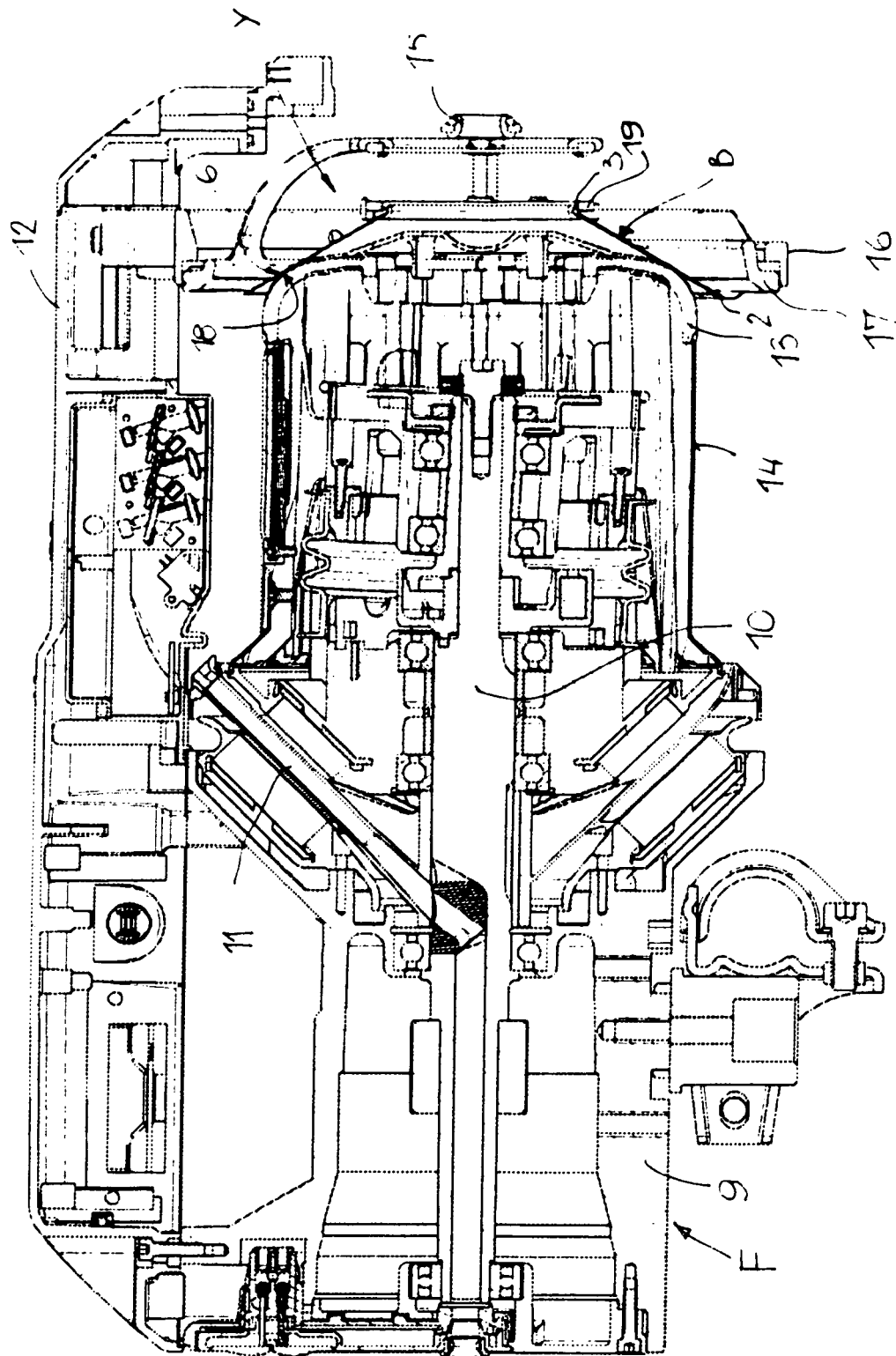
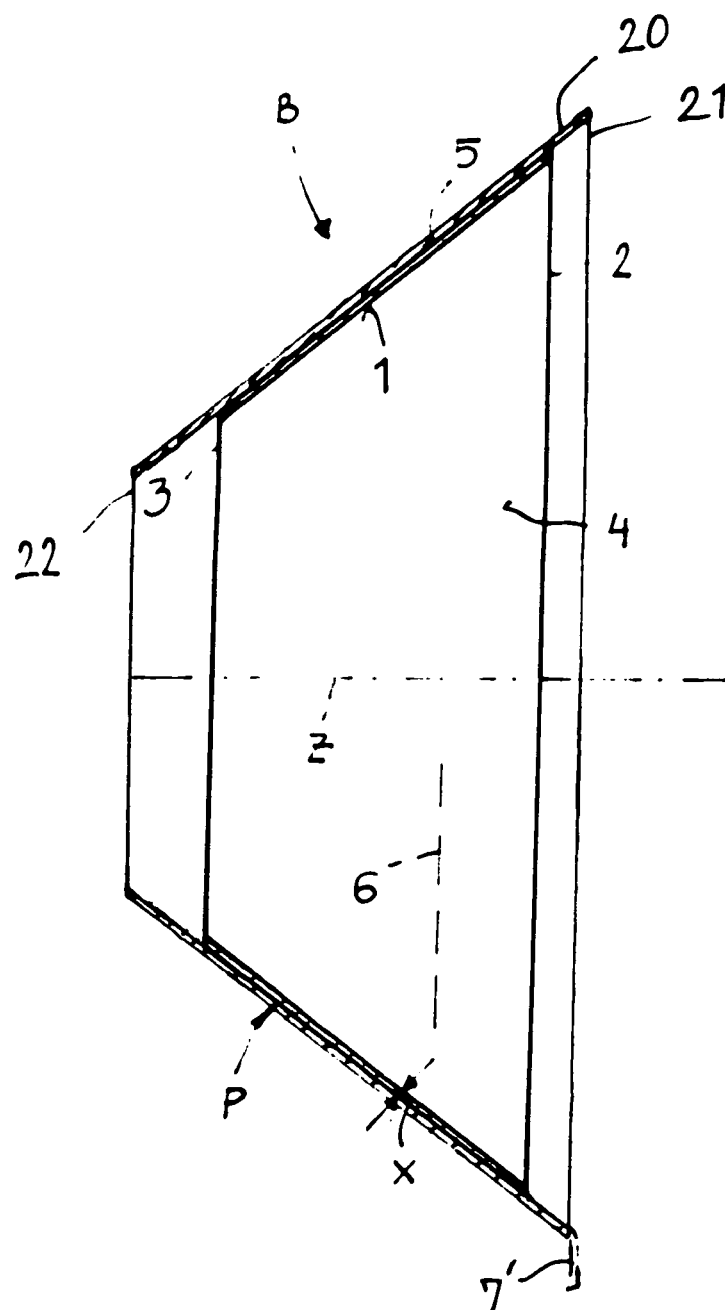


FIG 4





EUROPEAN SEARCH REPORT

Application Number
EP 09 00 1467

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
Munich		17 September 2009	Louter, Petrus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 00 1467

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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17-09-2009

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