(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 227 890 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
21.12.2005 Bulletin 2005/51

(21) Application number: **00974411.1**

(22) Date of filing: **18.10.2000**

(51) Int Cl.[7]: **B02C 4/28**

(86) International application number:
PCT/EP2000/010252

(87) International publication number:
WO 2001/032312 (10.05.2001 Gazette 2001/19)

(54) **ROLLER MILL FOR GRINDING GRANULAR MATERIALS, PARTICULARLY CEREALS**

WALZENMÜHLE ZUM MAHLEN VON KÖRNIGEM GUT, INSBESONDERE VON GETREIDE

MOULIN A CYLINDRES DESTINE AU BROYAGE DE MATIERES EN GRAINS, NOTAMMENT DE CEREALES

(84) Designated Contracting States:
CH DE IT LI
Designated Extension States:
RO

(30) Priority: **02.11.1999 IT PD990243**

(43) Date of publication of application:
07.08.2002 Bulletin 2002/32

(73) Proprietor: **Agrex S.p.A.**
35010 Curtarolo (IT)

(72) Inventor: **BARBIERI, Silvano**
I-35010 Curtarolo (IT)

(74) Representative: **Fabris, Stefano et al**
Cantaluppi & Partners S.r.l.
Via Matteotti 26
I-35137 Padova (IT)

(56) References cited:
DE-C- 402 917
DE-C- 927 963
GB-A- 369 477
GB-A- 751 464

- **PATENT ABSTRACTS OF JAPAN vol. 1999, no. 02, 26 February 1999 (1999-02-26) & JP 10 309482 A (SATAKE ENG CO LTD), 24 November 1998 (1998-11-24)**

EP 1 227 890 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present invention relates to a roller mill for grinding granular materials, particularly cereals such as corn, wheat and the like, according to the preamble to main Claim 1.

[0002] A mill of this type, such as is known from GB-A-369 477, typically comprises one or more pairs of contrarotating rollers defining, between their cylindrical surfaces, a gap into which the material to be ground is fed, and a feed device disposed above the rollers for feeding the flow of material to be ground into the gap.

Background art

[0003] Within the specific technical field of the present invention, one of the main requirements during the use of roller mills for grinding cereals is to ensure maximum uniformity of the supply of the material to be ground between the rollers in order to optimize the output yield of ground material. This requirement translates into the aim of achieving a supply of material which is as steady as possible, is free of fluctuations, and is distributed as uniformly as possible over the entire longitudinal extent of the rollers.

[0004] There are known mills for grinding granular materials which provide for the use of vibrating feed devices in which the material is supplied to the mill by falling from a feeder in which a vibratory motion is produced. An example of such a vibrating feeder is known from German patent application No. 3741-984. This provides specifically for the flow of material supplied to the crushing members of the mill to be modulated by the vibratory motion imparted to the feeder so that it is supplied in successive waves generated in sequence and in phase with the frequency of rotation of the mill. However, this solution is not optimal for use in mills for grinding cereals in which a uniform and steady supply of the flow of material to be ground is required.

Disclosure of the invention

[0005] The object of the present invention is to provide a roller mill for grinding cereals which is designed structurally and functionally so as to overcome the disadvantages complained of with reference to the prior art mentioned and to satisfy the requirements indicated, achieving an improved uniformity of distribution and supply of the material being ground.

[0006] This object is achieved, according to the present invention, by means of a roller mill having the characteristics set out in the appended claims.

Brief description of the drawings

[0007] The characteristics and the advantages of the invention will become clearer from the detailed description of a preferred embodiment thereof, described purely by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a partially-sectioned, perspective view of a mill with contrarotating rollers, according to the invention,

Figure 2 is a partially-sectioned, perspective view of a detail of the mill of Figure 1,

Figures 3 and 4 are partially-sectioned, perspective views of a detail of Figure 2,

Figure 5 is a side elevational view of the detail of Figures 3 and 4,

Figure 6 is a front elevational view of a detail of Figure 5.

Best mode of carrying out the invention

[0008] With reference initially to Figure 1, a mill with contrarotating rollers 2 for grinding granular materials, particularly cereals such as corn, wheat and the like, is generally indicated 1. The rollers 2 are supported rotatably on a fixed framework 3 of the mill.

[0009] A working gap 4 is defined between the cylindrical surfaces of the rollers and the flow of material to be ground is fed into the gap 4 by means of a feed device generally indicated 5. The device comprises a hopper 6, defined by a partially inclined base 6a and side walls 6b, for holding the material to be ground. The material is loaded into the hopper through a loading hole 7 and is supplied to the rollers 2 from an opening 8 having a gate 9 which can pivot to a limited extent and the function of which will become clearer from the following description.

[0010] Deflector plates 10a, 10b, 10c are provided between the feed device 5 and the rollers 2 for directing the flow of material being ground into the working gap 4 of the rollers.

[0011] The hopper 6 is supported so as to be pivotable on the framework 3 of the mill by support means comprising respective first and second pairs of arms 11, 12.

[0012] The support arms 11 are articulated, at their opposite axial ends, to the fixed framework 3 and to the hopper 6, in the region of the opening 8 for supplying the material. Each support-arm articulation point preferably has a flexible coupling, for example, made of rubber. Each support arm 11 is also arranged axially along an axis substantially parallel to the direction, indicated by the arrow A in Figure 4, in which the material to be ground falls from the hopper, thus permitting a pivoting movement predominantly along an axis transverse the direction of falling A.

[0013] The support arms 12 have opposite axial ends articulated to the fixed framework 3 and to the hopper 6, respectively, on the side remote from the opening 8. These support arms 12 also preferably have flexible couplings at their articulation points and each extends

axially along an axis, indicated B in Figure 5, which intersects the direction of falling A and is therefore such as to allow the hopper to pivot transverse the axis B.

[0014] The pivotable support of the hopper 6 by means of the arms 11 and 12 enables it to perform a combined pivoting movement given by the resultant of the individual pivoting movements permitted by the arms 11 and 12, respectively.

[0015] Each support arm 12 is also acted on resiliently by a respective spring 13 acting between the framework 3 and an intermediate portion of the corresponding arm 12. The spring 13 is arranged in a manner such that its resilient action has a predominant component directed perpendicularly to the axis B of the axial extent of the arms 12, as well as tangentially relative to the path of pivoting of the arms.

[0016] The mill according to the invention further comprises drive means, generally indicated 14, associated with the hopper for bringing about a vibratory motion thereof, as will be explained in the following description.

[0017] The drive means 14 comprise a transmission having one or more belts 15 and disposed between first and second parallel and spaced-apart shafts, indicated 16 and 17 respectively. The shaft 16 is supported for rotation on the hopper 6 by means of a pair of bearings 18 so as to have an axis of rotation X parallel to the axes of articulation of the arms 11, 12. An eccentric mass 19 is mounted on the shaft 16 between the bearings 18 and is formed by two disks 19a, 19b which are keyed to the shaft 16 and fixed together releasably so that their relative angular positions can be adjusted. This adjustment serves to vary the eccentricity of the mass 19 relative to the axis of rotation X.

[0018] A pulley 20 is keyed to the shaft 16 outside the bearings 18 and is engaged by the belts 15 for transmitting the rotary motion to the shaft 16. The belts 15 extend in endless loops around a second pulley 21 keyed to the second shaft 17 which has an axis of rotation Y and constitutes the drive shaft of the belt transmission. The drive shaft 17 is preferably the shaft provided for transmitting the drive to the rollers 2 of the mill.

[0019] As shown in Figure 5, the axes of rotation X, Y of the shafts 16, 17 are disposed in a plane, indicated by the axis C, which is approximately parallel to the longitudinal axis B of each support arm 12, or has a slight inclination to the axis B. Moreover, the positioning of the belt transmission relative to the hopper is selected in a manner such that the axis X of rotation of the eccentric mass 19 is offset, relative to the axis of articulation of the arm 12 to the hopper 6, on the side remote from the spring 13 (see Figure 5). The shaft 17 is rotated in the direction of rotation indicated by the arrow E of Figure 4 so that respective pulling portions 15a of the belts 15 are defined, relative to the plane containing the axes X and Y, on the side remote from the arms 12.

[0020] In operation, by virtue of the pulses generated by the rotation of the eccentric mass, the hopper 6 is subjected to a combined vibratory motion limited by the pivoting permitted by the support arms 11, 12. Within the limits of the pivoting motion permitted by the arms 12, two predominant components are defined in the vibratory motion of the hopper and are directed substantially perpendicularly to the plane C, in the direction of the arrow D and in the opposite direction D' of Figure 5, according to the angular position of the eccentric mass during its rotation. It should be noted that, during the pivoting movement in the direction D, the springs 13 act on the hopper in compression, contributing to the pivoting in this direction, whereas the belts 15 and, in particular, the portions 15a, act as travel-limiting elements. When the motion is reversed from the direction D to the direction D', however, the portions 15a of the belt help to return the hopper resiliently, by means of the tension present in them, contributing to the rapid reversal of the pivoting movement of the hopper.

[0021] In operation, by virtue of this vibratory motion, the material in the hopper 6 is conveyed to the opening 8 and is supplied through the opening in order to fall towards the rollers 2. The pivoting gate 9 serves to even out the flow of material towards the opening 8 and has front apertures 9a for the outlet and discharge of accumulated material should the hopper 6 reach an "over filled" condition.

[0022] Experimental tests carried out by the Applicant have shown that the combined effects of the belt transmission in bringing about the vibratory motion of the hopper produced by the rotation of an eccentric mass achieve many advantages in comparison with known arrangements.

[0023] In particular, a substantially continuous, fluctuation-free supply of the material is achieved. The material to be ground is supplied to the rollers in the form of a continuous "film" distributed uniformly over the entire axial extent of the cylindrical surfaces of the rollers. This advantageously reduces production costs considerably and achieves high output rates with larger output yields of ground material than in known arrangements. It was also found that there were fewer fluctuations in the distribution and supply to the rollers in the presence of materials with different characteristics of weight and moisture content.

Claims

1. A roller mill for grinding granular materials, particularly cereals, comprising:

   - at least one pair of contrarotating rollers (2) between which a gap (4) is defined for the passage of the material to be ground,
   - feed means (5) arranged for supplying a flow of material to be ground between the rollers (2), and
   - drive means (14) associated with the feed means (5) for bringing about a vibratory motion

of the feed means so that the flow of material to be ground is fed by falling into the gap (4) between the rollers (2),

characterized in that the drive means comprise:

- a shaft (16) which is supported rotatably on the feed means (5) and on which there is at least one mass (19), eccentric relative to the axis of rotation of the shaft (16) and fixed for rotation with the shaft (16), and
- belt transmission means (15) for rotating the shaft (16) about its axis of rotation and bringing about the vibratory motion of the feed means (5) by the rotation of the eccentric mass (19).

2. A mill according to Claim 1, in which the feed means comprise a hopper (6) for holding the material to be ground, and support means (11, 12) are provided for supporting the hopper (6) pivotably on a fixed framework (3) of the mill.

3. A mill according to Claim 2, in which the support means comprise at least one support arm (12) having opposite axial ends articulated to the framework (3) and to the hopper (6), respectively, the transmission means comprising at least one first pulley (20) mounted on the shaft (16) and at least one second pulley (21) mounted on a second shaft (17), the transmission belt (15) extending in a closed loop around the two pulleys (20, 21) and the plane containing the axes of rotation of the shafts (16, 17) being substantially parallel to the longitudinal axis of the support arm (12).

4. A mill according to Claim 3, in which there is at least one pair of support arms (12) for supporting the hopper (6) so that it can pivot relative to the fixed framework (3) of the mill, the arms (12) being spaced apart and parallel to one another and having opposite axial ends articulated to the hopper and to the fixed framework, respectively, resilient means (13) acting between the framework (3) and each respective support arm (12).

5. A mill according to Claim 4, in which the resilient means comprise, for each support arm (12), at least one spring (13), the resilient action of which has a component which is directed along an axis substantially perpendicular to the plane containing the axes of rotation of the shafts (16, 17), and is disposed between their axes of rotation.

6. A mill according to any one of Claims 3 to 5, in which the first shaft (16) is arranged for receiving the rotary drive from the second shaft (17) by means of the belt transmission (15).

7. A mill according to any one of Claims 3 to 6, in which the second shaft (17) is arranged for rotating the rollers (2).

Patentansprüche

1. Walzenmühle zum Mahlen granulärer Materialien, insbesondere Cerealien, die Folgendes umfasst:

- mindestens ein Paar gegenläufiger Walzen (2), zwischen denen ein Spalt (4) für die Passage des zu mahlenden Materials definiert ist,
- Zuführmittel (5), die so angeordnet sind, dass sie einen Fluss des zu mahlenden Materials zwischen die Walzen (2) leiten,
- Antriebsmittel (14), die so mit den Zuführmitteln (5) verbunden sind, dass sie eine Vibrationsbewegung der Zuführmittel erzeugen, so dass der Fluss des zu mahlenden Materials durch Fallen in den Spalt (4) zwischen die Walzen (2) geleitet wird,

dadurch gekennzeichnet, dass die Antriebsmittel Folgendes umfassen:

- einen Schaft (16), der drehbar auf den Zuführmitteln (5) gelagert ist und an dem sich mindestens eine relativ zur Drehachse des Schaftes (16) exzentrische und zwecks Drehung an dem Schaft (16) befestigte Masse (19) befindet, und
- Riemenübertragungsmittel (15) zur Drehung des Schaftes (16) um seine Drehachse und Erzeugung der Vibrationsbewegung der Zuführmittel (5) durch Drehung der exzentrischen Masse (19).

2. Mühle nach Anspruch 1, bei der die Zuführmittel ein Magazin (6) zur Aufnahme des zu mahlenden Materials umfassen und das Magazin (6) schwenkbar an einem festen Rahmen (3) der Mühle auf Stützmitteln (11, 12) gelagert ist.

3. Mühle nach Anspruch 2, bei der die Stützmittel mindestes einen Stützarm (12) umfassen, dessen gegenüber liegende axiale Enden mit dem Rahmen (3) bzw. dem Magazin (6) gelenkig verbunden sind, wobei die Übertragungsmittel mindestens eine an dem Schaft (16) befestigte erste Riemenscheibe und mindestens eine an einem zweiten Schaft (17) befestigte zweite Riemenscheibe (21) umfassen, sich der Übertragungsriemen (15) in einer geschlossenen Schleife um die beiden Riemenscheiben (20, 21) herum erstreckt und die die Drehachsen der Schäfte (16, 17) enthaltende Ebene im Wesentlichen parallel zur Längsachse des Stützarmes (12) verläuft.

4. Mühle nach Anspruch 3 mit mindestens einem Paar Stützarme (12) zur Lagerung des Magazins (6), so dass dieses relativ zu dem festen Rahmen (3) der Mühle schwenkbar ist, wobei die Arme (12) voneinander beabstandet sind und parallel zueinander verlaufen und ihre gegenüber liegenden axialen Enden mit dem Magazin bzw. dem festen Rahmen gelenkig verbunden sind, und elastischen Mitteln (13), die zwischen dem Rahmen (3) und dem jeweiligen Stützarm (12) wirksam sind.

5. Mühle nach Anspruch 4, bei der die elastischen Mittel der Stützarme (12) jeweils mindestens eine Feder (13) umfassen, deren Federkraft eine Komponente aufweist, die entlang einer im Wesentlichen senkrecht zu der die Drehachsen der Schäfte (16, 17) enthaltenden Ebene verlaufenden Achse ausgerichtet ist, und die sich zwischen den Drehachsen befindet.

6. Mühle nach einem der Ansprüche 3 bis 5, bei der der erste Schaft (16) so angeordnet ist, dass er die Drehkraft des zweiten Schaftes (17) mittels Riemenübertragung (15) aufnimmt.

7. Mühle nach einem der Ansprüche 3 bis 6, bei der der zweite Schaft (17) so angeordnet ist, dass er die Walzen (2) dreht.

Revendications

1. Moulin à cylindres destiné à broyer des matières en grains, en particulier des céréales, comprenant :

   - au moins une paire de cylindres contrarotatifs (2) entre lesquels un espace (4) est défini pour le passage de la matière à broyer,
   - un moyen d'alimentation (5) agencé pour alimenter un flux de matière à broyer entre les cylindres (2), et
   - un moyen d'entraînement (14) associé au moyen d'alimentation (5) destiné à entraîner un mouvement vibratoire du moyen d'alimentation de sorte que le flux de matière à broyer soit alimenté en tombant dans l'espace (4) entre les cylindres (2),

   caractérisé en ce que le moyen d'entraînement comprend :

   - un arbre (16) qui est supporté de manière à pouvoir tourner sur le moyen d'alimentation (5) et sur lequel il y a au moins une masse (19) excentrée par rapport à l'axe de rotation de l'arbre (16) et fixée pour tourner avec l'arbre (16), et
   - un moyen de transmission à courroie (15) destiné à faire tourner l'arbre (16) autour de son axe de rotation et à entraîner le mouvement vibratoire du moyen d'alimentation (5) par la rotation de la masse excentrique (19).

2. Moulin selon la revendication 1, dans lequel le moyen d'alimentation comprend une trémie (6) destinée à accueillir la matière à broyer, et des moyens de support (11, 12) sont fournis pour supporter la trémie (6) de manière pivotante sur un châssis fixe (3) du moulin.

3. Moulin selon la revendication 2, dans lequel les moyens de support comprennent au moins un bras de support (12) ayant des extrémités axiales opposées articulées avec le châssis (3) et avec la trémie (6), respectivement, le moyen de transmission comprenant au moins une première poulie (20) montée sur l'arbre (16) et au moins une seconde poulie (21) montée sur un second arbre (17), la courroie de transmission (15) s'étendant en une boucle fermée autour des deux poulies (20, 21) et le plan contenant les axes de rotation des arbres (16, 17) étant sensiblement parallèles à l'axe longitudinal du bras de support (12).

4. Moulin selon la revendication 3, dans lequel il y a au moins une paire d'arbres de support (12) destinés à supporter la trémie (6) de sorte qu'elle puisse pivoter par rapport au châssis fixe (3) du moulin, les bras (12) étant espacés l'un de l'autre et parallèles l'un à l'autre et ayant des extrémités axiales opposées articulées avec la trémie et avec le châssis fixe, respectivement, des moyens élastiques (13) agissant entre le châssis (3) et chaque bras de support respectif (12).

5. Moulin selon la revendication 4, dans lequel les moyens élastiques comprennent, pour chaque bras de support (12) au moins un ressort (13), dont l'action élastique a une composante qui est dirigée le long d'un axe sensiblement perpendiculaire au plan contenant les axes de rotation des arbres (16, 17), et est disposée entre leurs axes de rotation.

6. Moulin selon l'une quelconque des revendications 3 à 5, dans lequel le premier arbre (16) est agencé pour recevoir l'entraînement rotatif provenant du second arbre (17) au moyen de la transmission à courroie (15).

7. Moulin selon l'une quelconque des revendications 3 à 6, dans lequel le second arbre (16) est agencé pour faire tourner les cylindres (2).

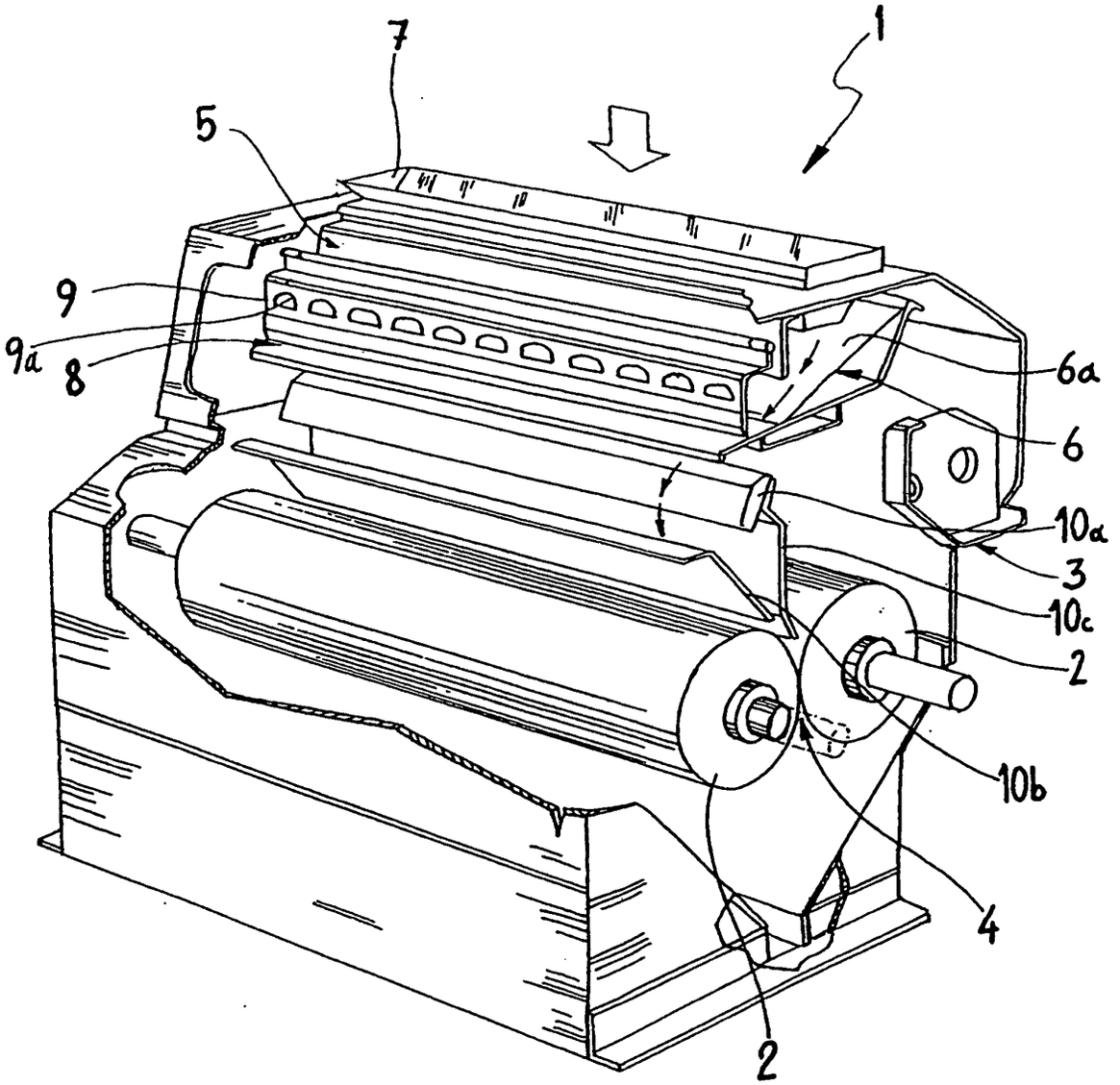

Fig.1

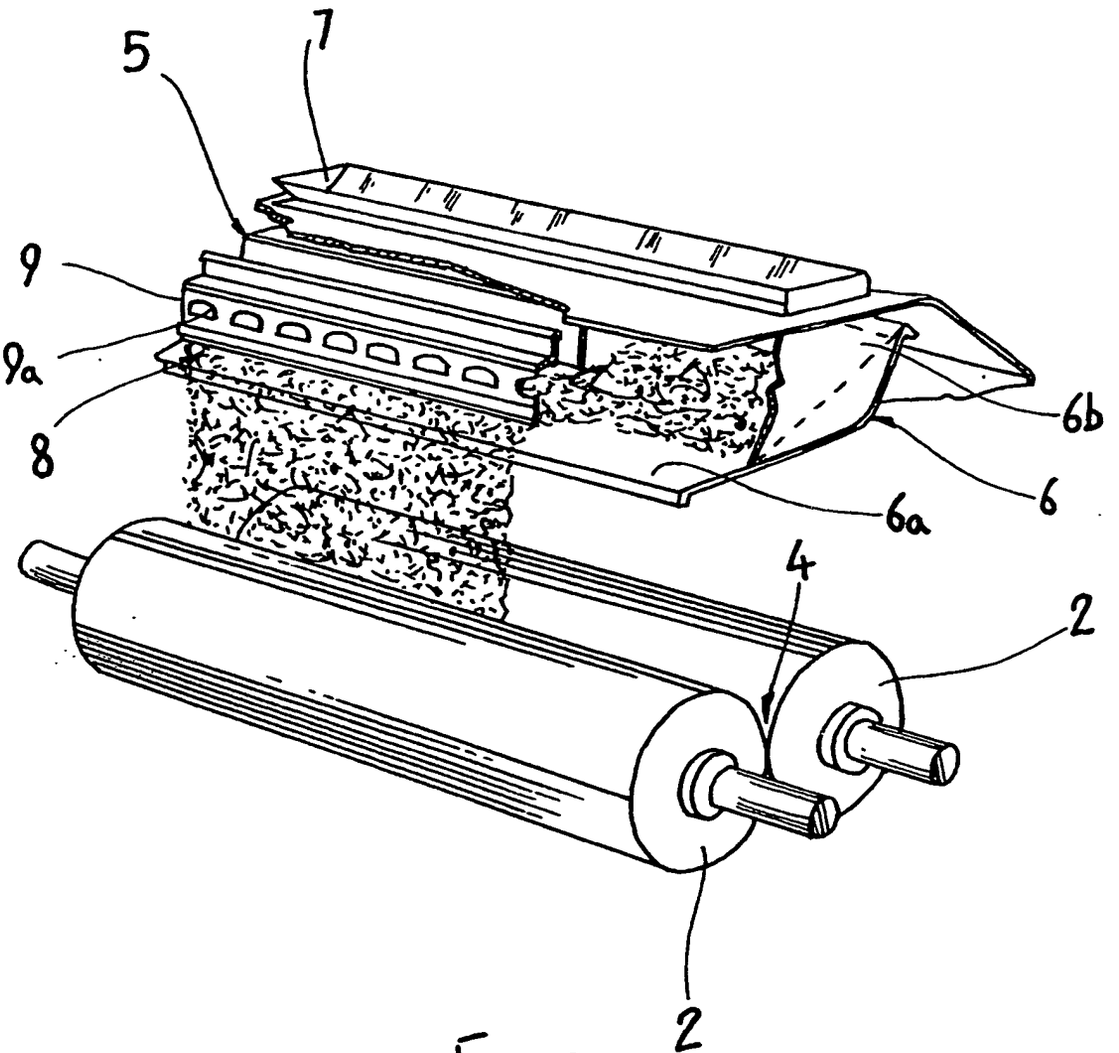

Fig.2

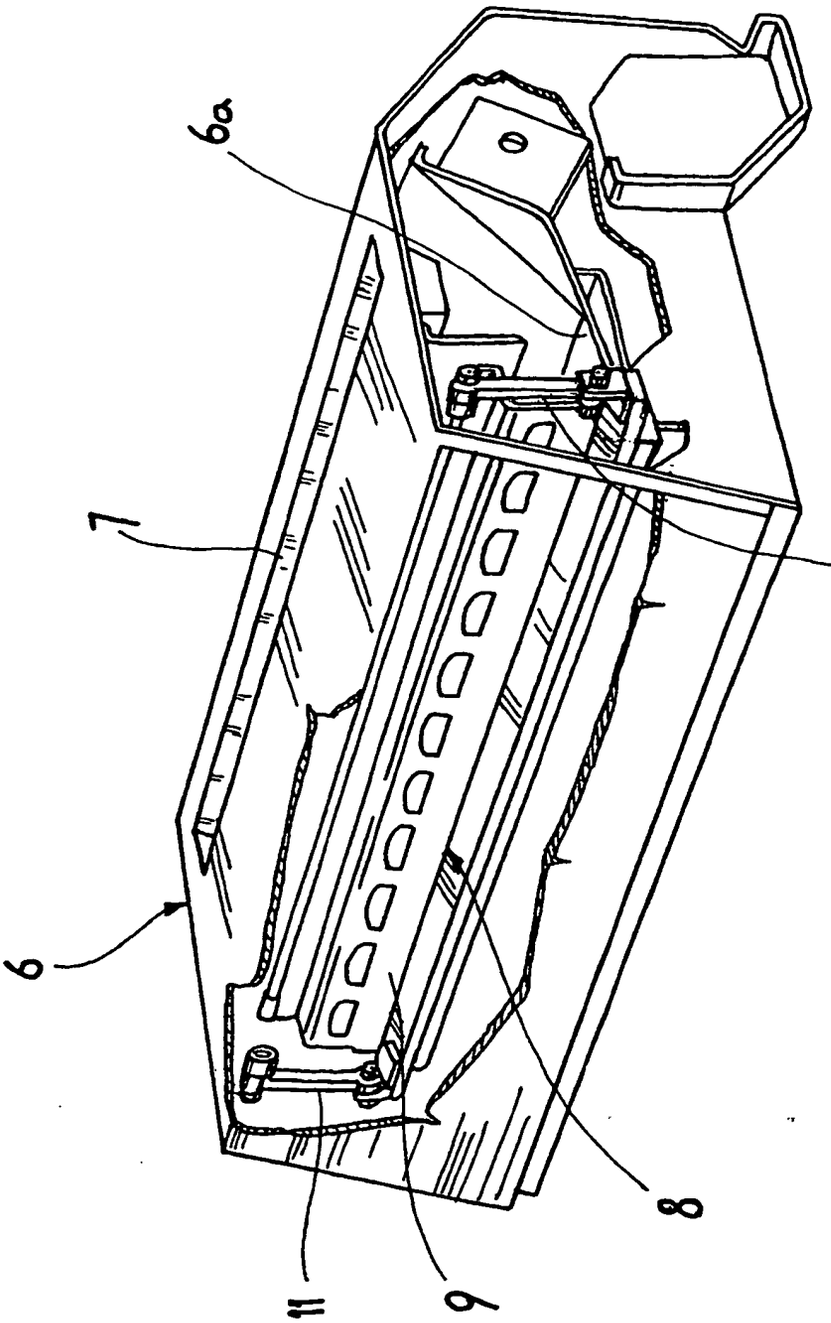

Fig. 3

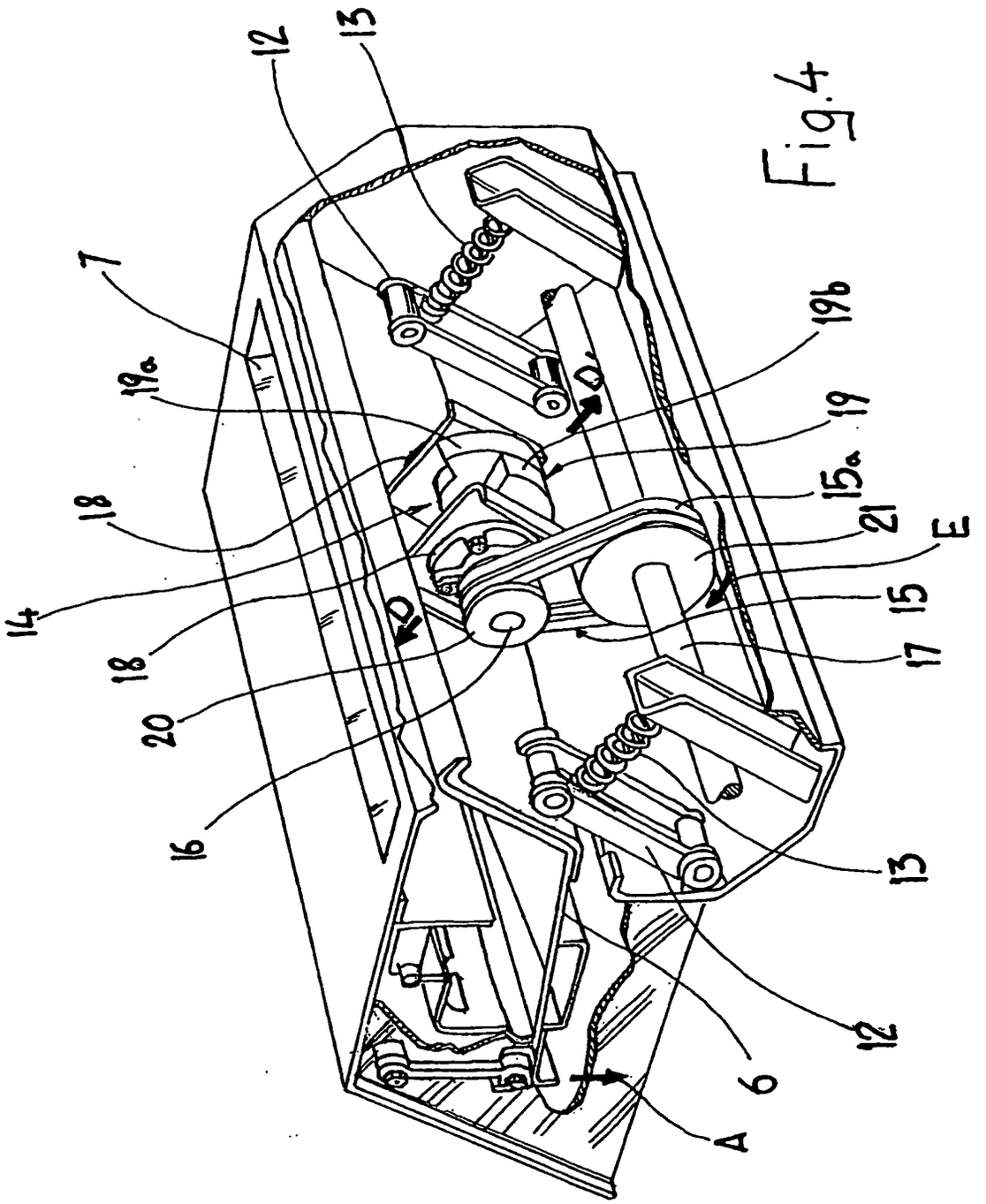

Fig.4

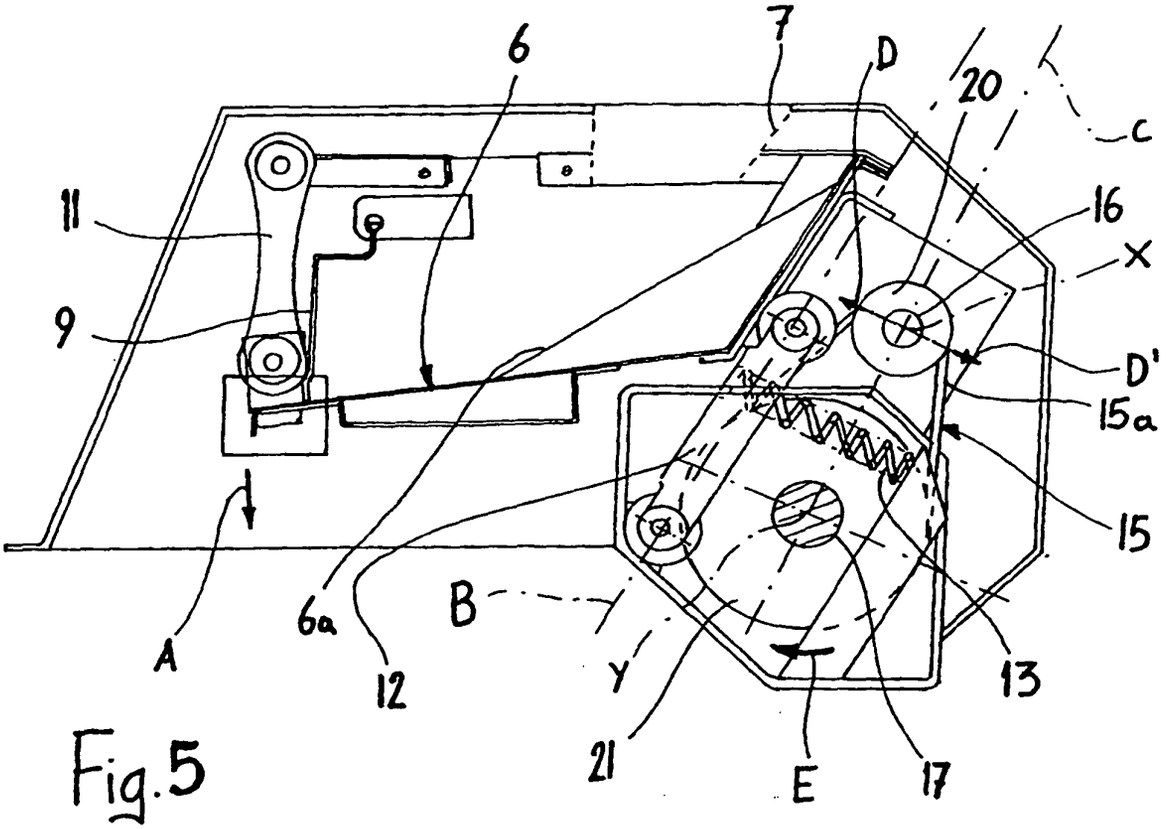
6
7
D
20
C
11
16
X
9
D'
15a
15
A
6a
B
12
Y
13
21
E
17

Fig.5

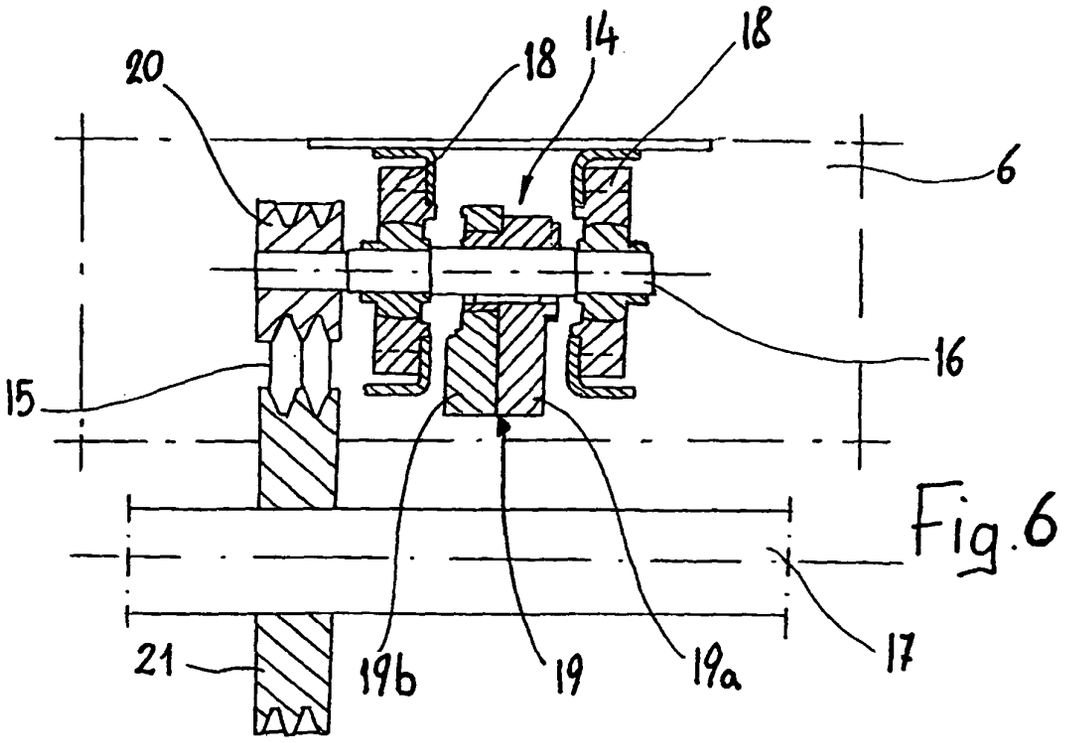
20
18
14
18
6
16
15
17
21
19b
19
19a

Fig.6