

(19)



(11)

EP 1 872 921 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.01.2008 Bulletin 2008/01

(51) Int Cl.:
B27L 11/02^(2006.01) B02C 19/22^(2006.01)
B26D 1/28^(2006.01)

(21) Application number: **07397022.0**

(22) Date of filing: **28.06.2007**

(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 LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventors:
• **Laivo, Pasi**
23950, Pyhäranta (FI)
• **Ruusuranta, Veijo**
23800, Laitila (FI)

(30) Priority: **30.06.2006 FI 20060639**

(74) Representative: **Hovi, Simo Pekka Tapani et al**
Seppo Laine Oy,
Itämerenkatu 3 B
00180 Helsinki (FI)

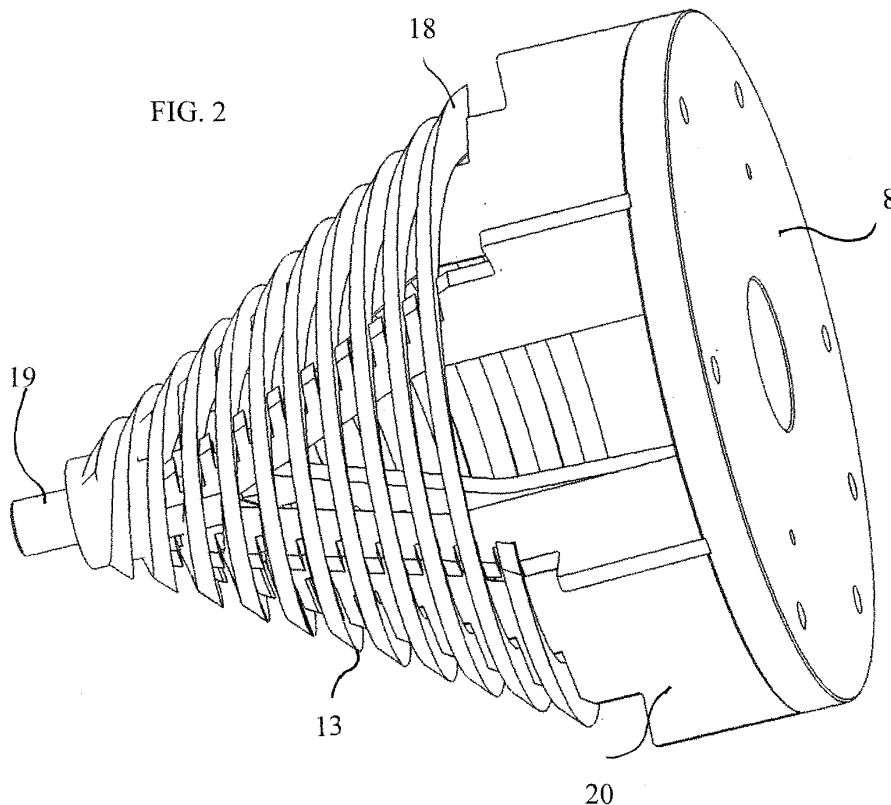
(71) Applicant: **Laitilan Metallit Laine Oy**
23800 Laitila (FI)

(54) **Chip spiral, method for producing chips and chipping machine**

(57) A chip spiral, the construction of which is such that it can be reliably and efficiently used for chipping all kinds of wood, wood products, semi-finished products, blanks, waste wood and material comparable to wood. The chip spiral comprises helical blades (18) and a frame

structure (18). The blades (18) are attached to the frame structure (20) and the structure is formed so that its central part is open, whereby the chips are discharged from the chip spiral via its hub. The power requirement of the construction is smaller than in prior art while the chip production rate per time unit is larger.

FIG. 2



EP 1 872 921 A1

Description

[0001] The present invention relates to a chip spiral according to the preamble of claim 1.

[0002] The invention also relates to a chipping method utilizing the spiral as well as to a chipping machine.

[0003] The word chipper usually means a device having a metal frame by means of which wood or other material as described above is chipped into pieces to be used in, among others, combustion, production of cellulose and paper pulp, gasifying, composting or landscape covering. Such a chipper can be either meant for fixed installation or it can be a device that can be transported by means of a tractor or other corresponding device. The device can be powered by an electric motor, a diesel engine, a hydraulic motor, a tractor or any separate engine unit. With the present spiral-type chip chippers the wood is chipped by means of a spiral screw having a solid shaft in the center thereof, into which the spiral-formed petals are fastened by means of welding. The spiral screw is located in a casing, the inner surface of which comprises engagement surfaces extending near the outer circumference of the screw. An inlet opening opens to the outer surface of the screw, from which opening the material to be chipped is pushed against the circumference of the spiral screw, whereby the blade edge of the spiral cuts chip pieces from the surface of the material to be chipped. In the casing of the chipper the material to be chipped is cut into chips of a certain size against one, two or more engagement surfaces. The engagement surfaces can comprise solid or adjustable engagement blades or other corresponding structures.

[0004] The material to be chipped is introduced into the chip spiral by means of an external force in the direction of the longitudinal axis of the spiral screw, nearly in the direction of the spiral screw or in an angle up to 45 degrees to the longitudinal screw. The operator of the machine or more employees can act as the introduction power depending on how much effort is required for introducing the material to be chipped. Especially with solidly arranged chippers it can be advantageous to use automatic introduction or transport devices that efficiently feed material to the cutting blade. Rotating by means of its power source, the spiral blade also pulls the piece to be chipped towards the flywheel casing of the chipper, simultaneously working chips off the piece. The rotation movement of the chip spiral causes the chips to be transported to where chip removal means, such as discharge blades, can move the chips forward in the process. In known chippers of this type the rotary movement of the chip spiral moves the chips forward only along the circumference of the chip spiral.

[0005] The high power requirement during the chipping action is a feature of known spiral-type chippers. Because a number of cutting actions are occurring simultaneously during introduction of material, the required amount of cutting energy is high, leading to a high power requirement. On the other hand, a large chip production

per time unit is achieved, so that the power requirement as such has its reasons. Further, a feature of the blades of these chippers' blades is clogging of the spaces between the cutting blades of the spiral blade depending on the wood species, its humidity, amount of knots and other properties of the material to be chipped. Especially in the chipping of wood of large diameter and classed as hardwood (such as oak and beech) a the high power requirement mentioned above is a considerable disadvantage. The high power requirement is, on the other hand, caused by the fact that there can be as much as ten cutting blade surfaces of the blade spiral simultaneously performing the cutting operation. On the other hand, the power requirement is also effected by the closed design of the blade spiral allowing the chipped material, chips, to be discharged from the blade spiral only via the outer circumference of the blade spiral. The cutting movement pushes material towards the shaft of the blade between the blade surfaces and simultaneously, also partly in the direction of the pitch of the cutting blades of the thread-like spiral. As the apparatus operates, more and more material is accumulated in this space. As the chips are compressed into the space between the blades, the friction force against the steel surfaces increases and more power is needed for transporting the chips from the space between the blades. In case the density and friction power of the compressed chips against the blade surfaces increases too much due to, for example, knots, the space between the blades is clogged. In this case the blade must be removed from the chipper and the spaces between the blades must be cleaned. Removing the compressed chips is difficult and to achieve it, the chips might even have to be steamed. During the cleaning of the blade the chipper is not available for productive use and it is even possible that the blade can not be cleaned in the open, but the blade must instead be transported to somewhere with access to the necessary tools. The production outages of the apparatus cause reduction of effective work time and thus reduction in production, which reduces the value of the investment in apparatus. The packing of chips between the blades of the blade spiral causes friction and heating, thus increasing the load on the apparatus.

[0006] Chips can also be produced by means of other kinds of blade chippers or crushers. A common disadvantage with these is that the size of the chips can greatly vary and a large amount of small chip fragments can easily be produced.

[0007] Usually, the feed rate determines the size of the chips and in case the feed bogs down and even nearly stops due to, for example, clogging, even dust can be produced. Due to the too small a chip size and especially because of the dust, chips are not well suitable for, among others, gasifying plants, because the chips containing too small a fraction and chip dust cause danger of explosion.

[0008] The aim of the present invention is to produce a chip spiral having a smaller power requirement than

that of prior art chip spirals producing chips with a corresponding grain size.

[0009] A further aim of the invention is to produce a chip spiral that is less prone to clogging than prior art chip spirals having a solid shaft.

[0010] The invention is based on the fact that the central part of the chip spiral is formed at least partly open, whereby the chips can be discharged via the central part of the spiral.

[0011] More specifically, the chip spiral according to the invention is characterized by what is disclosed in the characterizing part of claim 1.

[0012] The chipping method according to the invention, on the other hand, is characterized by what is disclosed in the characterizing part of claim 7.

[0013] The chipping apparatus according to the invention, on the other hand, is characterized by what is disclosed in the characterizing part of claim XX.

[0014] Considerable advantages are achieved by means of the invention.

[0015] A considerable advantage of the invention is that during operation, the spiral is not clogged as easily as known spirals. The chips are discharged more naturally in their cutting direction and any material remaining between the blade spirals is pressed to the center of the spiral, pushed by the new material cut by the spiral, and does thus not remain in the space to clog the space between the blades. As the blade does not become clogged, the production per time unit is better. Another corresponding advantage is the reduction of energy consumption in comparison with a spiral blade of a corresponding size producing chips of similar size or with an apparatus provided with such a blade. In preliminary tests using electric motor drive, the power requirement has been up to 40 % less.

[0016] When compared with other chipper types, the apparatus provided with a spiral blade according to the invention has a very considerable, advantage especially in the production of chips supplied to gasifying plants. As the blade always cuts chips of constant size from the material to be chipped, the operation of plant using such chips is stable. The chips are not ground into small shavings, aggregates or even dust during cutting or while in the chipper. In gasifying plants the too small fractions, such as shavings, aggregates or dust, cause danger of explosion, as it is too easily gasified, whereby conditions prone to explosions can be formed in the gasifying chamber. When using the chipper according to the invention, no fractions causing this danger of explosion are formed, whereby the operation of the gasifying plant using such chips is safer and more efficient. This will expand the possibilities of using chips.

[0017] The apparatus according to the invention can be used for chipping all cuttable materials having a body for grabbing the material. Such materials include all wood-based materials, such as branches, trunks, sawn goods and solid saw waste as well as sufficiently clean wood-based waste materials, such as construction or

demolition site waste, all kinds of wood, wood products, semi-finished products, blanks, waste wood and materials comparable to wood. The chipping can be made in a chip chipper, crusher or other machine or in an accessory of corresponding devices. Among other materials that can be chipped, plastics can be mentioned if the pieces are solid enough.

[0018] In the following, the invention is disclosed in more detail by means of reference to the appended drawings.

[0019] Figure 1 is an illustration of a chipping machine into which the chip spiral according to the invention can be fitted.

[0020] Figure 2 is an illustration of one possible chip spiral according to the invention as a 3D-drawing.

[0021] Figure 3 is an illustration of the chip spiral of figure 2 seen from the side.

[0022] Figure 4 is an illustration of the chip spiral of figure 2 seen from the front.

[0023] The spiral chipping apparatus is supported by frame 1 and its central functional component is formed by a longitudinal shaft formed by the shaft 6 of the chip spiral and the power transmission shaft 5. These shafts are connected to each other by a flywheel 7 located at the end of the power transmission shaft 5 and a flange 8 located at the end of the shaft 6 of the chips spiral 9. The shaft 5, 6 is supported by bearings at the ends as well as by three bearings 2, 3, and 4 in the middle. The power transmission of the drive engine to the power transmission shaft 5 can be accomplished by any suitable means. Typically, an electric motor, an internal combustion engine or a movable power source, such as a tractor or a separate internal combustion engine is arranged to operate as the drive means. The power transmission from the engine to the power transmission shaft 5 can be accomplished by means of gear transmission, U-joint shaft or hydraulic power transmission. The choice of suitable power source and drive is based on the planned use of the apparatus. For example, in power plants a fixed electric engine drive can be most advantageous while in apparatuses meant for use in the open both transportation of the apparatus and the production of drive power can be accomplished with a farm or forestry tractor.

[0024] The chip spiral 9 is loaded in the casing 10 and the casing is provided with a feed opening 11 for the material to be chipped. Feed plate 12 extends from the lower edge of the feed opening 11, along which plate the material to be chipped is fed towards the blade edges 13 of the chip spiral. In this example a feed hopper 14 has been attached in front of the feed opening 11 for facilitating the feeding of material to be chipped. The hopper can alternatively be replaced by a feed conveyor or other feed means.

[0025] The chipper apparatus described above functions as follows:

[0026] When the motor of the apparatus is started, kinetic energy is stored in the flywheel for smoothing the operation of the apparatus during load changes. The chip

spiral 9 rotates at the same speed as the flywheel. When the piece to be chipped, such as a tree trunk, is pushed along the feed plate 12 towards the chip spiral, its upper part is caught by the blade edges 13 of the chip spiral 9, the edges cutting into the tree and pulling the tree forward towards the blade portion with the large diameter of the chip spiral 9. As the helix of the spiral pulls the tree forward, it cuts during its rotation chip pieces of certain size from the wood, the pieces either falling from the of the spiral inside the casing 10 or are mainly transported towards the center of the spiral and are transported forward along the helix between the blades of the spiral.

[0027] The distance between the cutting blade surfaces 13 of the chip spiral defines the size of the produced chips. The spiral cuts the rest of the material as well against the feed plate. The chips are directed from the chip spiral 9 and the inside of the casing 10 to the blower casing 16, in which the discharge blades 17 located at the end of the chip spiral 9 and attached to the flywheel 7 discharge the chips via, for example, a blow chute. Some of the chips can be transported to the space between the spiral and the casing 10 where one or more engagement surfaces can be arranged near the outer circumference of the spiral. The chips are further cut against these surfaces and are simultaneously directed towards the blower casing.

[0028] The construction and operation described above describe both the operation of a prior art chipper as well as the operation of the chipper according to the invention. The apparatus according to the invention differs from the prior art apparatus in that the following novel chip spiral is used therein.

[0029] In figures 1, 2, 3 and 4 the number 8 refers to the flange of the chip spiral by means of which the chip spiral is fastened to the flywheel 7 of the chipper. The cutting blade spirals are marked by number 18. The number of the blade spirals per blade can be one or more, usually constructions with one, two or three spirals are used. In the chip spiral shown in the figures there are three blade spirals, as can best be seen in figure 4. At the tip of the chip spiral there is a bearing journal 19 necessary for the bearings for supporting the other end thereof to the bearing. In principle the chip spiral could be fastened only via the flange 8, but as the chip spiral 9 is exposed to relatively large loads during operation, it is necessary to support the tip. The bearings allow for a more durable and stiffer construction.

[0030] In the chip spiral according to the invention there is no central shaft known from previous constructions, but the blade spirals 18 are fastened by welding to the toothed frame plates 20 instead. The frame plates 20 are fastened to the hub 21 forming the bearing journal 19 located at the tip of the spiral and they extend radially from the circumference of the hub outwards in an angle. The angle of the frame plates 20 determines the angle of the cone and their number and position can be defined by means of the discharge/blow requirements of the different sizes of chip pieces produced by the variations in

the number of blade spirals 18 and the pitch of the thread of the spiral. The number of the toothed frame plates 20 can be three or more. The frame plates 20 give this construction the necessary torsion stiffness in the axial as well as in the radial direction. The ends of the toothed frame plates 20 are welded to the flange 8 of the blade and they act like the blades of a fan. The position of the frame plates 20 in relation to the center line of the blade can be directly radial or it can deviate from the radial direction.

[0031] At least one blade spiral 18 or more blade spirals is/are welded to the frame plates 20, the spirals being produced from steel plates by pressing into form and welding them together at the ends. A cutting blade edge 13 is milled onto the outer edge of the spiral. In a construction according to the invention the blade spirals 18 are produced by pressing them into form and by attaching the sectors pressed into form by their ends, for example by welding. It is essential on one hand that the height of the blade spirals is sufficiently large for achieving a reliable and durable fastening. Further, the height of the blade spirals must be sufficiently small so that the discharge of the chips via the hub of the chip spiral takes place as freely as possible and the chips are not allowed to be compressed into the spaces between the blades, thus causing power-consuming friction. The frame plates 20 are not necessarily toothed in form, they can be, for example, staggered, but it is essential that the blade spirals 18 can be fastened to the frame plates 20 as well as possible.

[0032] The height of the frame plates 20 should be as small as possible, so that the chips can be discharged from the middle of the chip spiral as freely as possible. The minimum height of the frame plates 20 is determined by the distance 18 necessary for the sufficiently stiff fastening of the blade spirals 18 and the necessary strength for guaranteeing the necessary overall sufficient stiffness of the construction. The blade spirals 18 and the frame plates form a lattice construction that is constructionally quite stiff so that a relatively light structure can be used for achieving a sufficient strength. In practice it is essential that a free space be formed between the inner edges 22 of the frame plates 20, into which the shavings cut by the blade spirals 18 can flow. Right at the end of the chip spiral there is no free space, but the spirals are attached instead to the hub 21. It is obvious that the area covered by the hub should be as short as possible so that the cut chips are allowed to flow as freely as possible to the open hub of the chip spiral. At the tip of the spiral the blade edge must, however, only cut the material with the largest diameter so that in this point the danger of clogging is not large.

[0033] The idea of the spiral is that there is free space behind the attachment edge 23 opposite to cutting edge 13 of each blade spiral. Thus the blade spirals must have a certain height. On the other hand one can say that the blade spirals 18 form the outer shell with their cutting edges 13 and an inner shell with their attachment edges

23 and that at at least a part of the length of the blade spiral the attachment edges 23 are at a distance from each other. In order to form an open space behind the spirals the blade spirals can be attached to the frame structure (frame plates 20) of the chip spiral along the length of each full pitch of the blade spiral only along a part of the length of the blade spiral. The frame plates 20 can extend up to the central shaft of the chip spiral without deviating from the inventive idea and they can there be connected together by means of, for example, welding. Thus, sector-like flow spaces are formed behind the blade spirals through which the chips can flow. In this structure the flow of the chips is, however, less free than in a structure with a totally free space.

[0034] The chip size of the chips produced by means of the chipping machine can be determined by the amount of blade spirals and the pitch of the thread. The larger the number of blades in the spiral and the smaller the pitch thereof is, the smaller the produced chips are. For example, with three blade spirals and a pitch of 104 mm the blade will produce chips with a chip size of 15-25 mm. A blade having one blade spiral having a pitch of 160 mm will correspondingly produce chips in the size of 60-100 mm. In practice, however, the size distribution of the chip size is smaller due to the operation manner of the blade of the chipper and the fact that the material to be chipped is drawn to be worked upon with a constant speed by means of the thread of the spiral itself. However, hourly productions of up to 120 m³ can be achieved with a spiral blade. The production rate can of course be increased by increasing the power and dimensions of the apparatus. The above-mentioned production rate can, however, be achieved with a power of about 120-220 kW, so that chipper can be powered by a powerful farm tractor.

[0035] It is obvious that the open blade spiral according to the invention can be located in other chipper or crusher constructions as well. The blade of the chip spiral can be replaced by some other method of fastening, for example by providing the ends of the frame plates with fastening lugs. The relative dimensions of the toothed frame plates of the spiral blade and the frame shaft of the bearing journal can naturally be changed so as to be suitable. The material of the blade spirals and other parts of the spiral screw is most preferably steel due to its good strength and low cost, they can be made of any metal or a combination of different metals or they can be made of any other suitable material. The toothed frame plates can be replaced by a form other than a toothed form. The blade spirals, frame plates and other components of the structure can be attached in addition to welding by any means capable of producing as reliable and durable a structure as welding. The components of the chip spiral can also be coated with any material, such as wear-resistant nitrides or oxides capable of producing the desired wear resistance or other desirable properties. The chip spiral can be conical in form, as shown in the accompanying drawings or it can be cylindrical. In a cylindrical

structure the frame plates are straight and the shell surfaces of the helical blades are straight as well. In a cylindrical structure there thus is a screw-like straight thread and a spiral thread at the helical blade of the spiral blade.

Claims

1. A chip spiral comprising a frame structure (20), a blade attached thereto and forming at least one ascending thread (18), the blade having an attachment edge (23) and a blade edge (13), and means (8) for attaching the chip spiral to a power plant rotating it, **characterized in that** the attachment edge (23) of the blade forms an inner shell on at least a part of the length of the chip spiral, wherein the opposing edges of the spiral are located a distance from each other and on one full pitch of the thread the blade is fastened to the body construction by only a part of its length.
2. A chip spiral according to claim 1, **characterized in that** the frame structure is at least three radially arranged frame plates (20) to which the blade (18) is attached by at least its attachment edge (23).
3. A chip spiral according to claim 1 or 2, **characterized in that** the frame plates (20) have internal edges (22) between which there is free space.
4. A chip spiral according to any of the previous claims, **characterized in that** the number of blades is one, two or three.
5. A chip spiral according to any of the previous claims, **characterized in that** the frame plates (20) comprise toothing into which the blades (18) are attached.
6. A chip spiral according to any of the previous claims, **characterized in that** the frame plates (20) and blades (18) form a lattice construction.
7. A chip spiral according to any of the previous claims, **characterized in that** the outer shell is conical and the blades are spirals.
8. A chip spiral according to any of the previous claims, **characterized in that** the outer shell is cylindrical and the blades are straight screw threads.
9. A chipping method in which a chip spiral having at least one helical blade is rotated, the material to be chipped is introduced to the blade, whereby it cuts chip pieces from the material, and the chip pieces are blown from the blade, **characterized in that** at least a portion of the chip pieces is discharged from the blade via the open hub of the blade.

10. A chipping apparatus comprising means (5) for attaching the apparatus to a power source, a chipping blade (9) rotatable by the power source, means (11, 12, 14) for feeding the material to be chipped to the blade (9) and means (17) for removing the material from the chipping machine, **characterized in that** the blade is a chip spiral comprising a frame structure (20), a blade (18) attached thereto and forming at least one ascending thread, the blade having an attachment edge (23) and a blade edge (13), and means (8) for attaching the chip spiral to the power source rotating it and in which the attachment edge (23) of the blade (18) forms an inner shell at at least a part of the length of the chip spiral, wherein the opposing edges of the thread are located at a distance from each other, and at one full pitch of the thread the blade is attached to the body structure by only a part of its length.
11. An apparatus according to claim 11, **characterized in that** it comprises means for attaching the apparatus to a tractor used as the power source.
12. An apparatus according to claim 11, **characterized in that** it comprises means for attaching the apparatus to an electric motor or a diesel engine used as the power source.

5

10

15

20

25

30

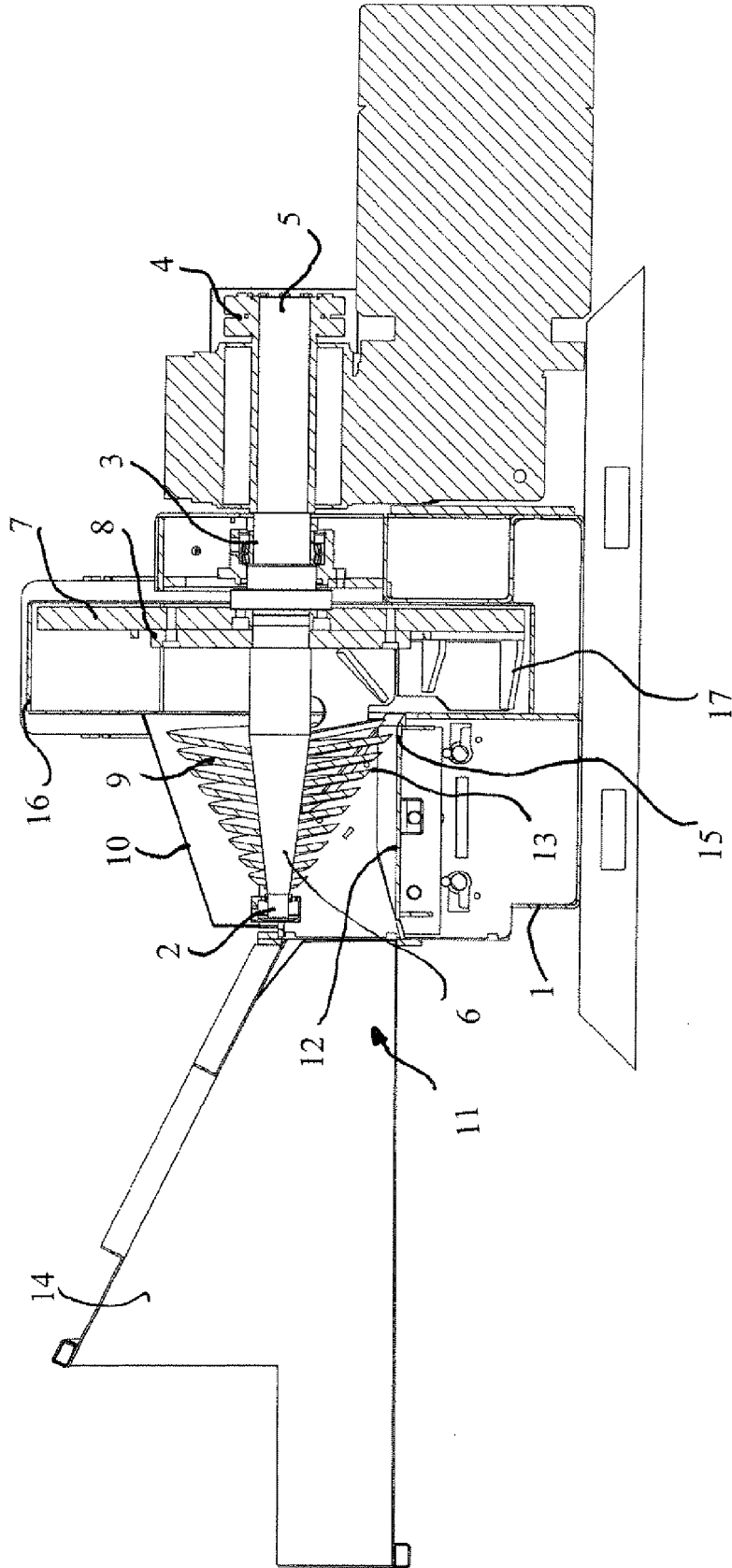
35

40

45

50

55



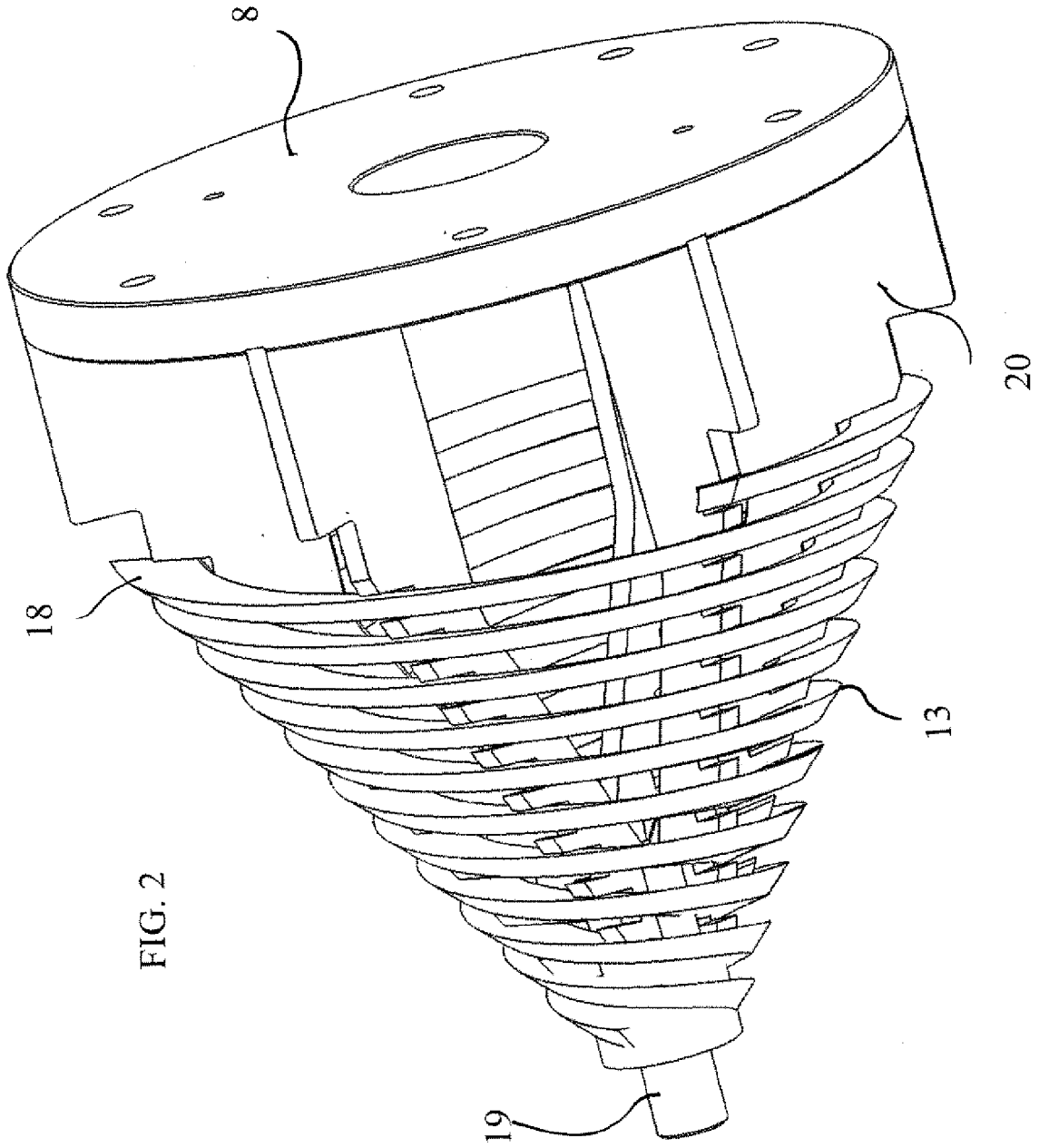


FIG. 2

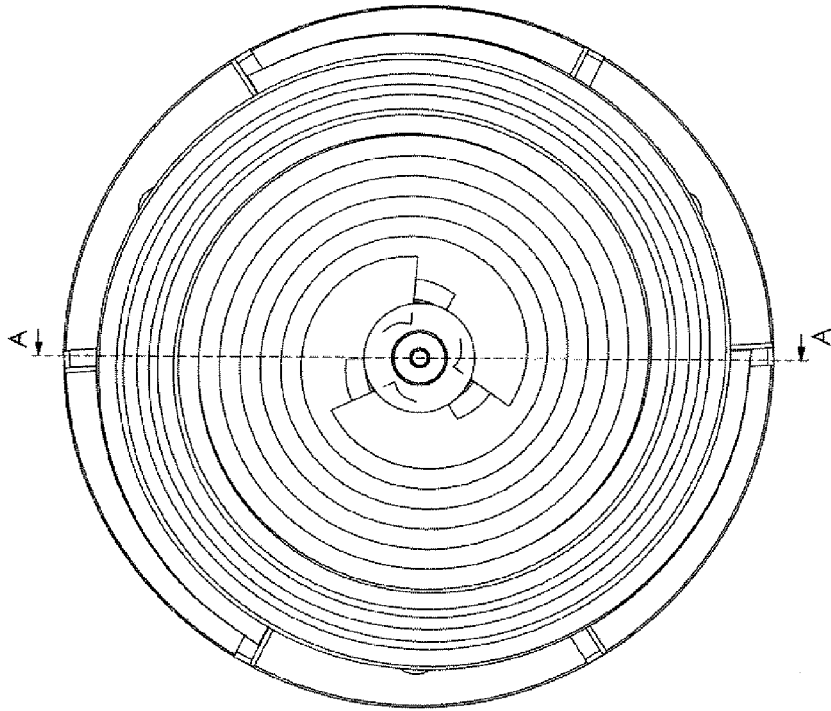


FIG. 4

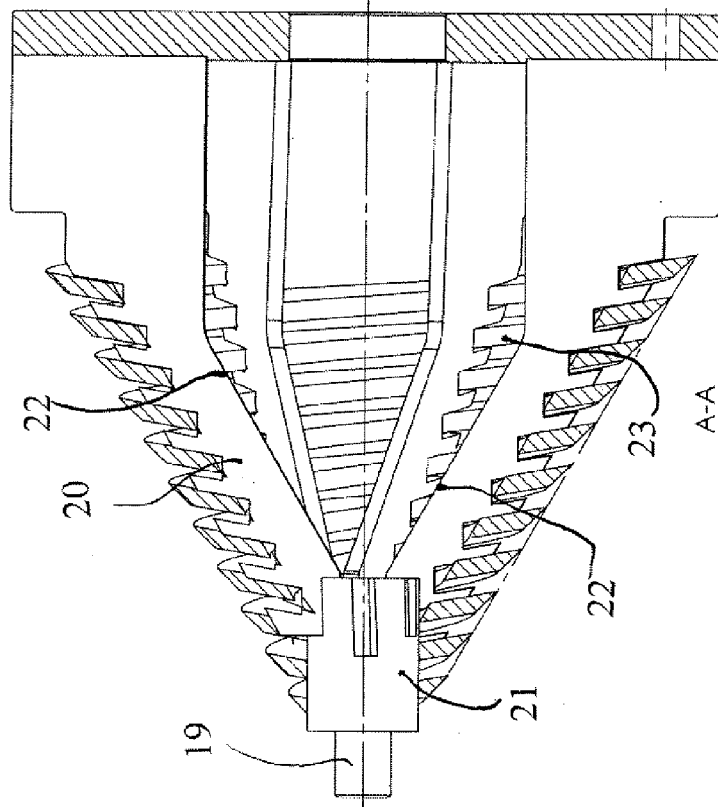


FIG. 3



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 865 319 A (HOFFMAN RUDOLF) 11 February 1975 (1975-02-11) * abstract; figures * -----	1,4,7-12	INV. B27L11/02 B02C19/22 B26D1/28
A	WO 2004/082909 A (KIRCHMAYR JOHANN [AT]) 30 September 2004 (2004-09-30) * abstract; figures * -----	1-12	
A	US 4 053 004 A (BARWISE ROBERT D ET AL) 11 October 1977 (1977-10-11) * figures * -----	1-12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B27L B02C B26D A01G
Place of search		Date of completion of the search	Examiner
Munich		2 October 2007	Meritano, Luciano
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

2
EPO FORM 1503 03.02 (P04C01)

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

EP 07 39 7022

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-10-2007

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3865319	A	11-02-1975	NONE	

WO 2004082909	A	30-09-2004	NONE	

US 4053004	A	11-10-1977	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82