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(54) A method and a system of fragmentising objects

(57) The invention relates to a method for fragmentising objects, which method comprises that the objects are advanced towards a number of rotating blades having at least one common axis of rotation, which blades are distributed in accordance with a pattern lengthwise of the axis of rotation, wherein - in line with the blades - at least one hold-on means is provided, which hold-on means is configured for cooperating with the blades for cutting objects or completely or partially crushing objects or reducing the size of objects. Novel aspects of the method according to the invention comprises that the objects are advanced essentially at an angle which is oblique in relation to the path curves of the blades or at right angles thereto, whereby an object is, during its advancement, caused to contact at least one first blade and then gradually, depending on the size of the object, an increasing number of blades. Tests have shown that the noise level is reduced in this manner, in particular in case of elongate objects of wood without significantly influencing the capacity.

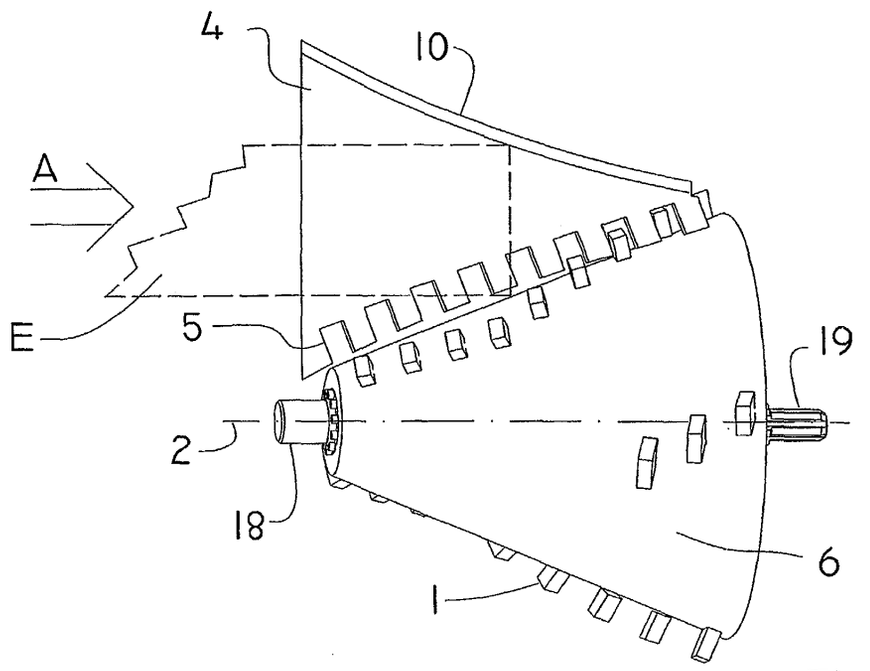

Fig. 2

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Description

[0001] The invention relates to a method of fragmentising objects, said method comprising that the objects are advanced towards a number of rotating blades having at least on common axis of rotation, said blades being distributed according to a pattern along the axis of rotation, wherein - in line with the blades - at least one hold-on means is provided, said hold-on means being configured for cooperating with the blades for cutting into objects or full or partial crushing of objects or reducing the size of objects. Moreover the invention relates to a system of fragmentising objects.

[0002] For fragmentising, crushing, etc, industrial waste, including packaging, plastics, cardboard, paper, light metal and wood, it is known to use devices having two parallel and horizontal cylindrical rollers, wherein blades are mounted on the rollers. Objects are introduced at right angles in relation to the axes of rotation of the rollers and between the rollers for instance by being dropped in free fall.

[0003] US 2003/0062435 describes an example of a method of fragmentising objects, wherein the method comprises that the objects are introduced in free-falling state to a rotating drum in a direction preferably perpendicular to the axis of rotation of the drum.

[0004] Novel aspects of the method according to the invention comprises that the objects are, during fragmentation, advanced essentially at an angle which is oblique in relation to the path curves of the blades, or at right angles thereto, whereby an object is caused to contact at least a first blade during its advancement and then gradually, depending on the size of the object, with more blades along the axis of rotation. Tests have shown that the noise level is reduced in this manner, in particular in case of elongate objects of wood, without significantly affecting the capacity. This is assumed to be due ia to the fact that the oblique or perpendicular angle causes the wood to be torn more or less obliquely or longitudinally of the lengthwise expanse of the veins, whereby a larger part of the fibres are torn apart rather than cut. The force required to tear the fibres apart is smaller than the force required to cut the fibres. Since less force is required, the noise level is reduced. It is a further effect that the noise shielding is more easily improved. The oblique angle involves that the blades can successively be arranged further down and further away from the side from where the objects are advanced, and that must necessarily comprise a non-shielded opening. By enabling the blades to be farther away, the noise through the opening will be reduced and a larger part of the blades can be shielded from a noise point of view.

[0005] In a preferred embodiment, the hold-on means can be configured with cutting edges for cooperating with the blades, wherein the distance of the cutting edges to the blades is adjustable. In case of a small distance between cutting edges and blades, for instance branches will be cut, while they will be torn and frayed in case of larger distances. In connection with eg fragmentation of transport pallets of wood containing metallic nails, a distance can be selected to be suitably large for avoiding that the nails are cut, thereby reducing the wear on the blades and, likewise, the nails can more easily be sorted out in a subsequent operation.

[0006] According to a further preferred embodiment the advancement of the objects can be regulated relative to the speed of rotation of the blades. Hereby it is ensured that the capacity is used optimally. It is a further aspect that a reduction in the speed of rotation, which may be indicative of an object which is difficult to fragmentise being processed, causes the advancement to be throttled back to avoid clogging.

[0007] According to yet an embodiment, the method may comprise use on objects of wood, wherein the objects are oriented such during their advancement that the blades hit the objects essentially in a direction which is perpendicular to the longitudinally extending axis of the veins. Such orientation of the objects achieves further reduction of noise compared to random orientation of the objects. This can be used to advantage eg in case of fragmentation of EU-pallets, where the predominant orientation of the veins in the boards essentially constituting the pallet is known.

[0008] According to the invention, novel aspects of a system of fragmentising objects may comprise that the objects are advanced towards a number of rotating blades having at least one common axis of rotation, said blades being distributed in accordance with a pattern along the axis of rotation, wherein - in line with the blades - at least one hold-on means is provided, which hold-on means is configured for cooperating with the blades for cutting into objects or completely or partially crushing objects or reducing the size of objects, and wherein the objects are able to advance essentially at an angle which is inclined in relation to the path curves of the blades or at right angles thereto, whereby an object is caused to be in contact with at least a first blade during its advancement and then gradually, depending on the size of the object, with an increasing number of blades. Hereby the same effect is accomplished as was described above in the context of the method of the invention.

[0009] According to a preferred embodiment the system may comprise at least one shaft or roller, to which shaft or roller the blades are attached. Hereby all blades can be rotated together by the shaft or the roller being turned, thereby requiring only one drive means.

[0010] According to a further preferred embodiment the system may comprise two shafts or rollers, said shafts or rollers having in a first plane essentially parallel axes of rotation, wherein blades are distributed along each axis of rotation in such a manner that an outer end of the cutter blades of each of these blades is situated on a diameter, which diameter is increased in the direction of advancement. Hereby it is accomplished that even wide objects can be fragmentised, albeit they are

advanced obliquely in relation to the axes of rotation of the blades. It is moreover accomplished that the blades that meet the objects first have more force for the fragmentation, which may be advantageous eg in case of objects having a hard shell that is initially to be broken.

[0011] According to a further preferred embodiment the system may comprise two conical rollers, wherein the external diameter of the rollers are increased in the advancement direction of the objects, and wherein the blades are arranged to protrude in relation to the rollers. This embodiment is simple to manufacture. Moreover the conical surface of the rollers will serve as guide face for the objects and hence contribute to ensuring the advancement of the objects further on in the advancement direction.

[0012] According to an alternative embodiment the system may comprise two shafts or rollers, said shafts or rollers having axes of rotation being in a first plane situated obliquely in relation to each other, wherein blades are distributed along each axis of rotation in such a manner that an outer end of the cutter blade of each of these blades is situated on essentially the same diameter. This embodiment is even simpler to manufacture and may provide more space for coupling of drive means to the shafts or the rollers at that end thereof where the ends are farthest away from each other.

[0013] According to a preferred embodiment of the system, the blades and the axes of rotation can be arranged in such a manner that outer ends of cutter blades of blades from each shaft or roller have overlapping path curves. Hereby it is ensured that the objects will be fragmented entirely due to the overlap.

[0014] According to yet a preferred embodiment the active side of the hold-on means can be arranged in a position within the overlapping path curves. Hereby it is further ensured that the objects are fragmented completely.

[0015] According to a further preferred embodiment the active side of the hold-on means can be situated at an angle, which angle is inclined relative to a plane, in which plane the axes of rotation are in parallel and in such a manner that the distance between each axis of rotation and the active side of the hold-on means is increasing in the direction of advancement. Hereby that part of the path curve of the blades is increased which may influence the objects, thereby enabling the blades to function more efficiently which may increase the capacity.

[0016] According to yet a preferred embodiment, outer ends of the cutter blades of the blades can be angled forwardly in the direction of rotation. Hereby the blades will pull the objects towards the axis of rotation rather than pushing the objects away, thereby increasing the efficiency of the blades.

[0017] According to a further preferred embodiment the blades at the smaller diameter of the rollers are arranged lengthwise essentially in line. Hereby the tendency of the blades to tear the objects apart and moreover do so in larger fragments is increased. The speed of the blades is smaller on the position due to the smaller diameter, but in return there is more force available precisely due to the smaller diameter.

[0018] In accordance with yet a further preferred embodiment, the blades at the larger diameter of the rollers are arranged lengthwise in a helical shape. Hereby the blades are not to operate simultaneously, but come gradually, whereby the maximum torque for rotating the blades is reduced.

[0019] According to yet a preferred embodiment the system may comprise at least one conveyor belt for feeding objects and at least one advancement roller for advancing objects towards the blades. Hereby a continuous feeding of objects all the way to or in proximity of the blades is ensured.

[0020] In the following the invention will be described in further detail by means of figures that illustrate exemplary embodiments of the invention:

Figure 1 is a perspective view of a system according to the invention;

Figure 2 shows a system seen from above;

Figure 3 shows a system seen from the side;

Figure 4 shows an alternative system seen from above;

Figure 5 shows a system seen from the front;

Figure 6 shows a system seen in an inclined view from the front and from the side;

Figure 7 shows views, seen from the front, from the side and from above, of a conical roller;

Figure 8 is a perspective view of a conical roller;

Figure 9 is a perspective view of an alternative system;

Figure 10 shows a system seen from above;

Figure 11 shows a section of a system along with transport equipment, seen from the side;

Figure 12 shows a system along with transport equipment, seen from the front;

Figure 13 shows a section of a perspective view of a system along with transport equipment.

[0021] Figures 1-3 show a conical roller 6 on which a number of blades 1 are secured. A hold-on means 4 is configured for cooperating with the blades for cutting into objects E (shown by dotted line in Figure 2) or com-

plete or partial crushing of objects or reducing the size of objects, the roller 6 and hence the blades rotating in the direction R. To this end, the hold-on means 4 may comprise a number of recesses with cutting edges 5. For ensuring the advancement of objects E onwards to the blades 1, a plate 10 is arranged that will guide the objects in the right direction. Figure 2 shows advancement of an object E in the direction A towards the blades 1. The blades 1 rotate along with the roller 6 about the axis of rotation 2 which is in parallel with the direction A, whereby the direction A remains essentially perpendicular on the path curves of the blades 1. During advancement the objects E will come into contact with an increasing number of blades 1. Figure 2 shows that the roller 6 comprises a journaling end 18 and a shaft end 19 which is adapted for coupling to not shown means for rotating the roller 6. Instead of a roller 6, a shaft can be used, on which blades are mounted directly or eg on laser-cut round plates welded to the shaft. Figure 3 shows that the axis of rotation 2 is arranged at an angle C upwards in relation to the hold-on means 4. Hereby the blades 1 will, in particular at the end where the diameter of the roller 6 is the largest, act across a larger angle per rotation compared to the situation where the hold-on means 4 is in parallel with the axis 2 and in the same level. This is due to the taper ratio. In case of a cylindrical roller, the axis of rotation can be in parallel with the hold-on means 4, but it may be lifted a distance above the level of the hold-on means to increase the angle per rotation during which the blades 1 can act on an object E.

[0022] Figures 4-6 show an embodiment of a system with two rollers 6,7 and a hold-on means 4. The rollers 6, 7 have parallel axes of rotation 2 and 3. Put in plain terms, the plate 10 in Figure 1 has been replaced by a roller. That modification will increase the performance since more blades 1 are able to act on one or more objects. Figure 4 shows that the axes of rotation 2 and 3 are in parallel with the advancement direction A of not shown objects. Hereby objects will be advanced essentially perpendicular in relation to the path curves to be swept by the blades 1, which will be exemplified in Figure 5 by indications 11 and 12 that indicate a part of the path curve of a blade 1 on each roller 6, 7. It will also appear that the path curves overlap within a zone 13. The hold-on means 4 can advantageously be arranged at the lower edge of the zone 13, whereby it is ensured that any object will be hit by a blade 1, irrespective of how small the object is. Figure 5 indicates that preferably the rollers 6 and 7 rotate towards each other and down towards the hold-on means 4. Objects will hereby be cut apart/cut/crushed etc. between blades 1 and hold-on means 4. The hold-on means 4 and/or the rollers 6, 7 are preferably adjustable, whereby the distance between cutting edges 5 and blades 1 can be regulated, eg for selection of desired effect on the objects. As will appear eg from Figure 4, the blades 1 can be distributed along each axis of rotation 2 and 3 in such a manner that an outer end of the cutter blade of each of these blades is situated on a diameter, which diameter is increased in the direction of advancement A. It will further appear that the external diameter of the two conical rollers is increased in the direction of advancement A of the objects; and that the blades are arranged to protrude relative to the rollers. It will further appear from Figure 5 that outer ends of the cutter blades of the blades 1 are angled forwards in the direction of rotation R.

[0023] Figures 7 and 8 show an embodiment of a conical valve 6 with blades 1, including blades arranged in line 15 at the smaller diameter of the roller and blades arranged helically 14 at the larger diameter of the roller.

[0024] Figures 9 and 10 show cylindrical rollers 16 and 17 arranged at an angle B between their respective axes of rotation 2 and 3. Moreover, a hold-on means 4 is shown that has cutting edges 5 configured for cooperating with blades 1 secured to the rollers. An exemplified object E is conveyed in a direction A towards the blades 1. The direction A is not in parallel with the axes 2 and 3, whereby the object E is conveyed under an oblique angle towards the path curves swept by the blades 1 during rotation. If the object E is a board with its veins situated in the direction A, it will appear that the blades 1 will hit the object transversally and obliquely and thereby tear the wood apart predominantly by pulling fibres from fibres and to some extent also by cutting off. It will appear from Figure 10 that the rollers 16 and 27 have axes of rotation 2 and 3 that are, in a first plane, situated obliquely in relation to each other with the angle B, wherein blades 1 are distributed along each axis of rotation 2 and 3 in such a manner that an outer end of the cutter blades of each of these blades is situated on essentially the same diameter.

[0025] Figures 11-13 show a conical roller 6 with blades 1 that are able to receive objects from a conveyor 20 and deliver the objects in finely-divided state to yet a conveyer 22, which in turn delivers the finely-divided objects on to a further conveyor 23. To improve the advancement of objects to the blades 1, it is an option to use an advancement roller 21. Figures 12 and 13 also show a second roller 7, and Figure 13 shows a hold-on means 4 that cooperates with the blades 1. The supply of force and energy to the various devices are neither shown nor explained as it can be accomplished without further ado by a person skilled in the art. The system according to the invention can be incorporated in process lines etc without further ado, including also fragmentising rejected objects of plastics that are, following being finely divided, returned to an extruder.

[0026] With two conical rollers having parallel axes of rotation, where blades are used that have a cutting length of about 40 mm, where the rollers have a length of 550 mm, the largest diameter 0600, the smallest diameter Ø150 and with a 74-kW engine power available, tests have shown that a number of revolutions of merely 6-800 revolutions per minute yields good capacity with low noise level compared to other known fragmentation

devices when fragmentising rejected EU-pallets of wood.

[0027] The system and method according to the invention can be used eg for fragmentation and reduction of the volume of:

- Light metal: aluminium, zinc, cupper, foil and industrial waste;
- Paper: Office and industrial waste;
- Wood: Pallets, demolition timber, branches and twigs and industrial waste;
- Plastics: cans, containers, plates and industrial waste;
- Cardboard: packaging and industrial waste.

[0028] The system and the method may also lend itself for use for other similar materials and products and can be integrated in/implemented directly in eg a process line.

[0029] It will be understood that the invention as disclosed in the present description and figures can be modified or changed, while continuing to be comprised by the protective scope of the appended claims.

Claims

1. A method of fragmentising objects, said method comprising that the objects are advanced towards a number of rotating blades having at least one common axis of rotation, said blades being distributed in accordance with a pattern lengthwise of the axis of rotation, wherein - in line with the blades - at least one hold-on means is arranged, which hold-on means is configured for cooperating with the blades for cutting into objects or completely or partially crushing of objects or reducing the size of objects, **characterised in that** the objects are, during fragmentation, advanced essentially at an angle which is oblique in relation to the path curves of the blades or at right angles thereto, whereby an object is, during its advancement, caused to contact at least a first blade and then gradually, depending on the size of the object, more blades along the axis of rotation.

2. A method according to claim 1, wherein the hold-on means is configured with cutting edges for cooperating with the blades, wherein the distance of the cutting edges to the blades is adjustable.

3. A method according to claim 1 or 2, wherein the advancement of the objects is regulated in relation to the speed of rotation of the blades.

4. A method according to one or more of claims 1-3, wherein the method comprises use on objects of wood, wherein the objects are oriented such during the advancement that the blades hit the objects essentially in a direction which is at right angles to the lengthwise axis of the veins.

5. A system of fragmentising objects, which objects can be advanced towards a number of rotating blades with at least on common axis of rotation, said blades being distributed according to a pattern lengthwise of the axis of rotation, wherein - in line with the blades - at least one hold-on means is provided, which hold-on means is configured for cooperating with the blades for cutting into objects or completely or partially crushing objects or reducing the size of objects; and wherein the objects can essentially be advanced at an angle which is oblique relative to the path curves of the blades or at right angles thereto, whereby an object will, during its advancement, be caused to contact at least one first blade and then gradually, depending on the size of the object, with an increasing number of blades.

6. A system according to claim 5, wherein the system comprises at least one shaft or roller, to which shaft or roller the blades are secured.

7. A system according to claim 5 or 6, wherein the system comprises two shafts or rollers, said shafts or rollers having, in a first plane, essentially parallel axes of rotation where blades are distributed along each axis of rotation in such a manner that an outer end of the cutter blades of each of these blades is situated on a diameter, which diameter is increased in the direction of advancement.

8. A system according to claim 7, wherein the system comprises two conical rollers, wherein the external diameter of the rollers is increased in the direction of advancement of the objects, and wherein the blades are arranged to protrude relative to the rollers.

9. A system according to claim 5 or 6, wherein the system comprises two shafts or rollers, which shafts or rollers have axes of rotation being, in a first plane, situated obliquely in relation to each other, wherein blades are distributed along each axis of rotation in such a manner that an outer end of the cutter blades of these blades is situated on essentially the same diameter.

10. A system according to one or more of claims 6-9, wherein the blades and the axes of rotation are arranged in such a manner that the outer ends of the cutter blades of the blades from each shaft or roller have overlapping path curves.

11. A system according to claim 10, wherein the active side of the hold-on means is arranged in a position

within the overlapping path curves.

12. A system according to one or more of claims 6-11, wherein the active side of the hold-on means is situated at an angle, which angle is oblique in relation to a plane, in which plane the axes of rotation are in parallel and in such a manner that the distance between each axis of rotation and the active side of the hold-on means is increasing in the direction of advancement.

13. A system according to one or more of claims 5-12, wherein outer ends of the cutter blades of the blades are angled forwards in the direction of rotation.

14. A system according to claim 8, wherein the blades at the smaller diameter of the rollers and lengthwise are arranged essentially on line.

15. A system according to claim 8 or 14, wherein the blades at the larger diameter of the rollers and lengthwise are arranged helically.

16. A system according to one or more of claims 5-15, wherein the system comprises at least one conveyor belt for feeding objects and at least one advancement roller for advancing objects towards the blades.

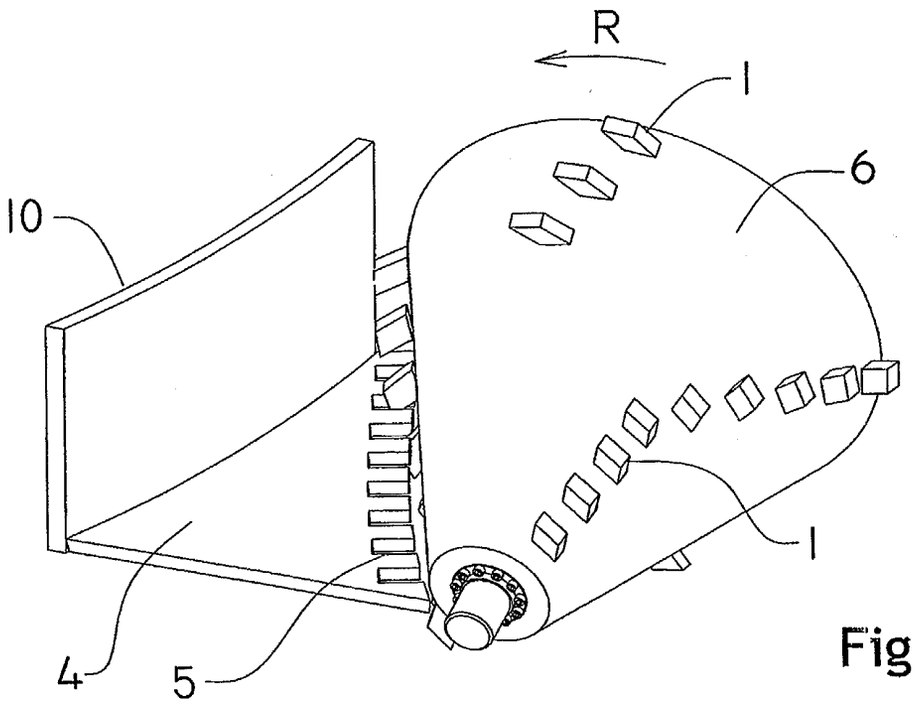

Fig. 1

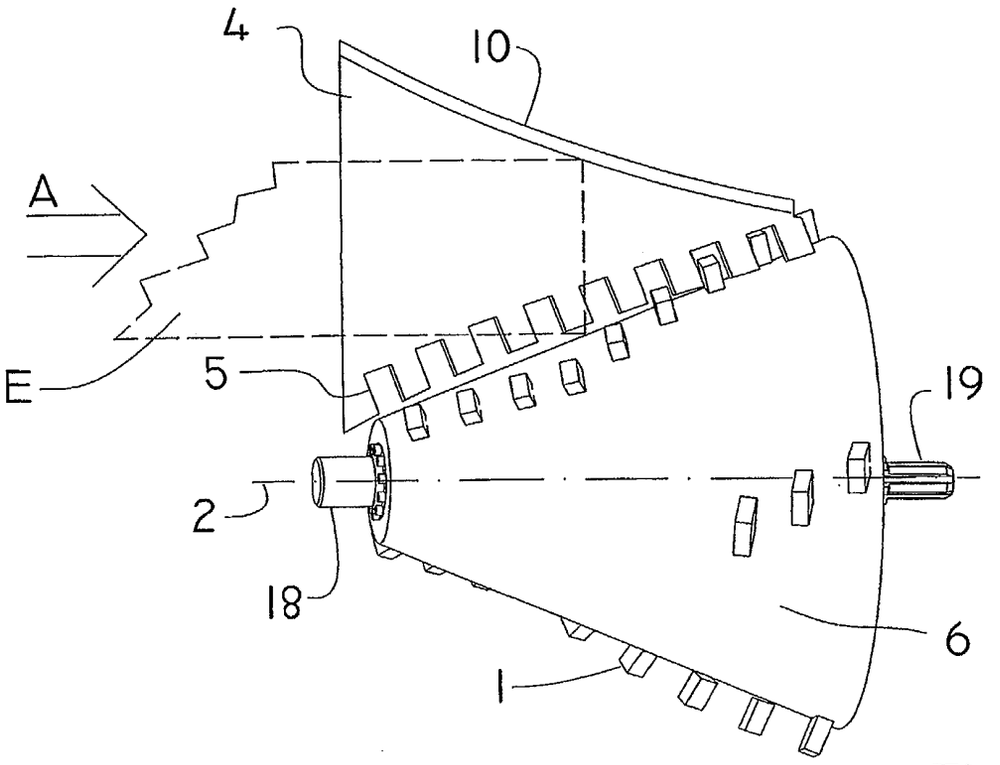

Fig. 2

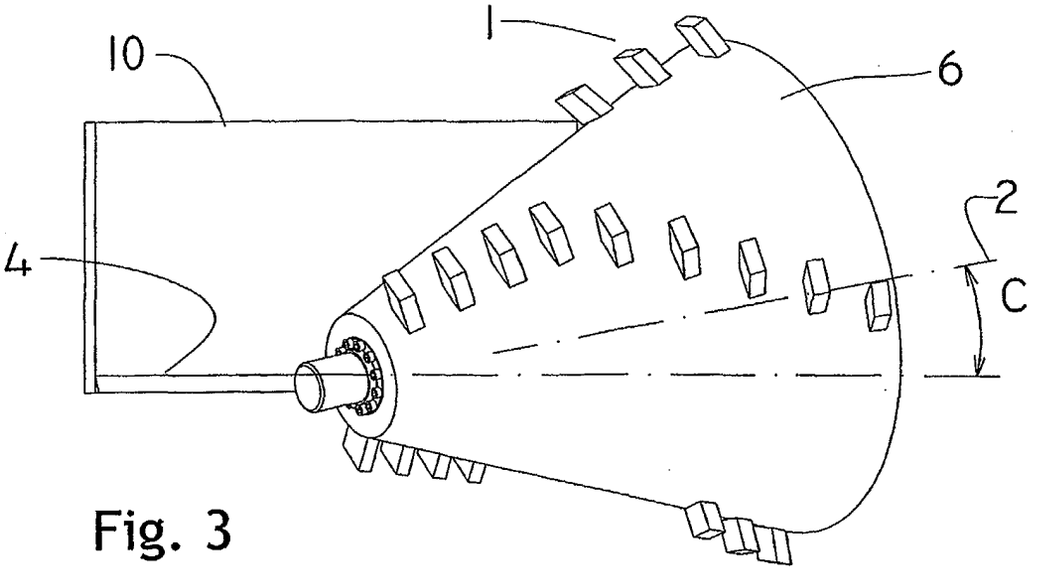

Fig. 3

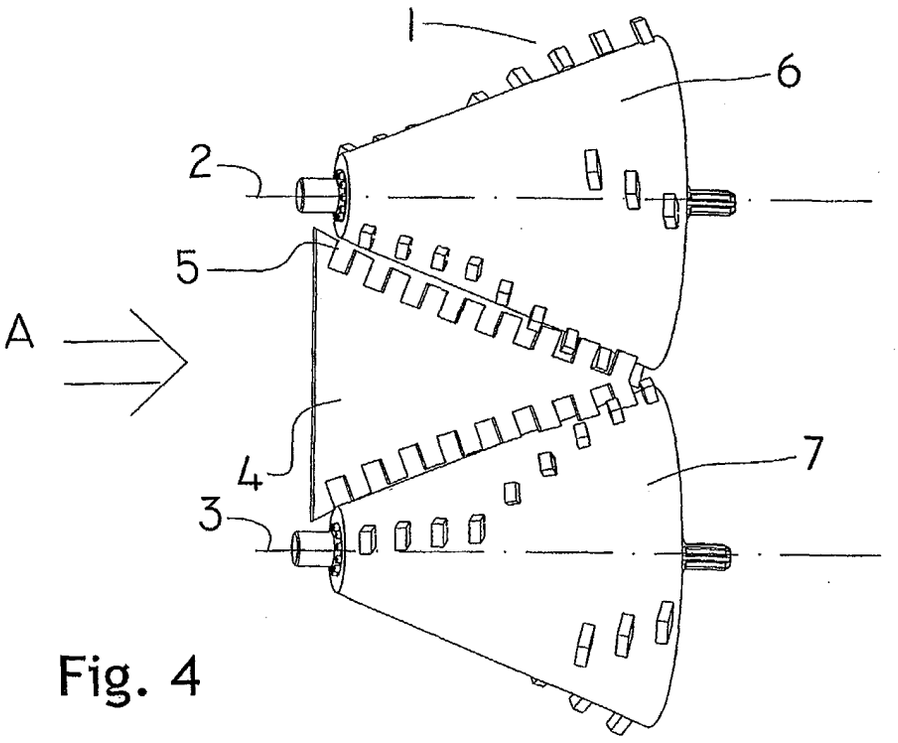

Fig. 4

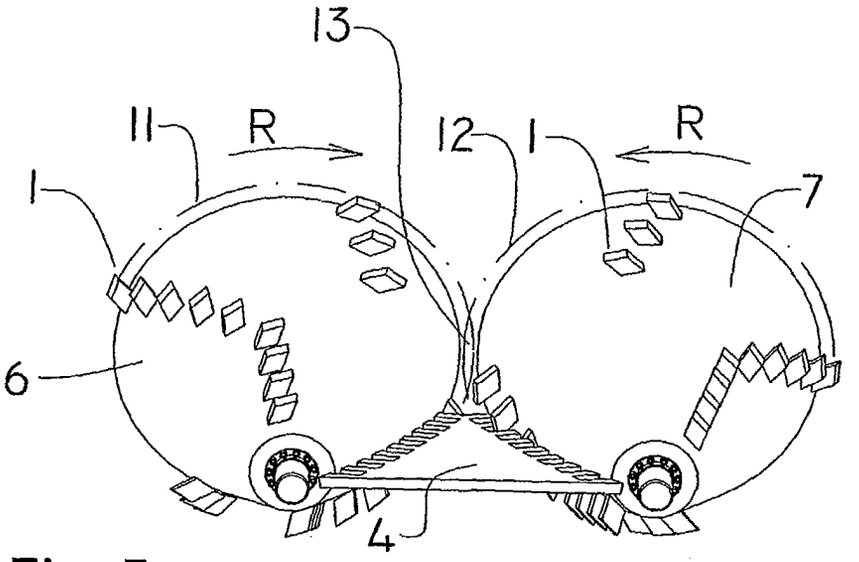

Fig. 5

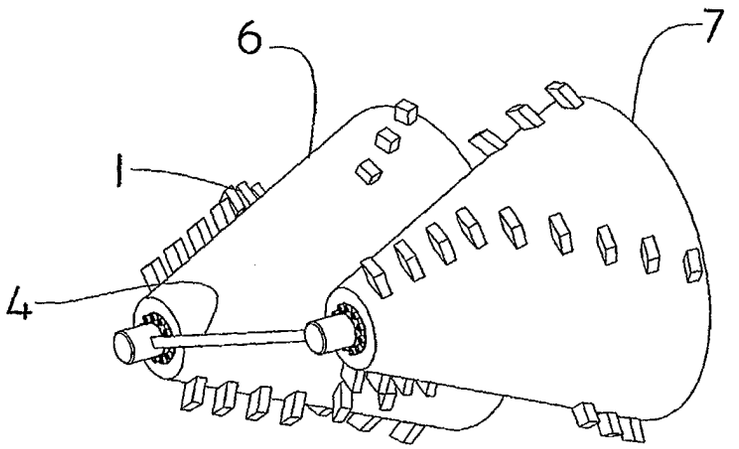

Fig. 6

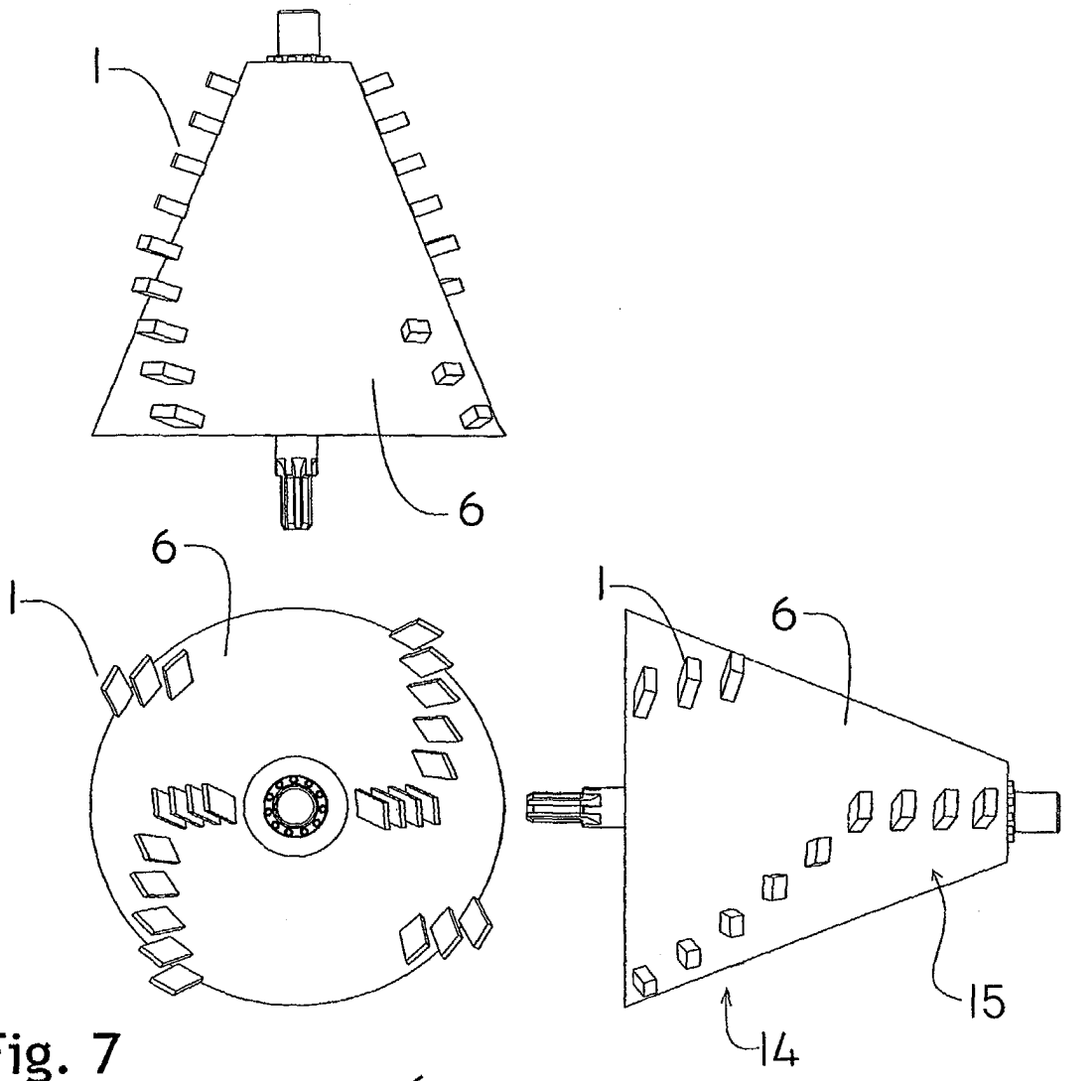

Fig. 7

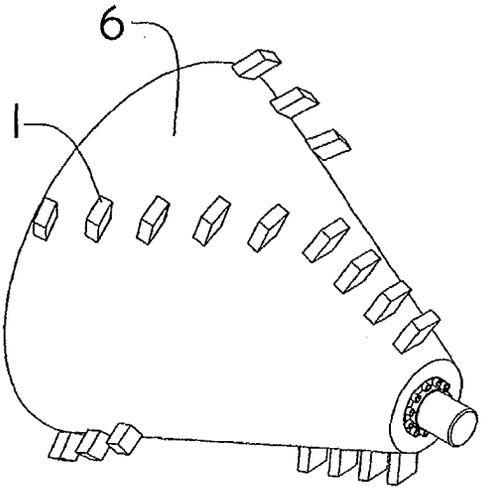

Fig. 8

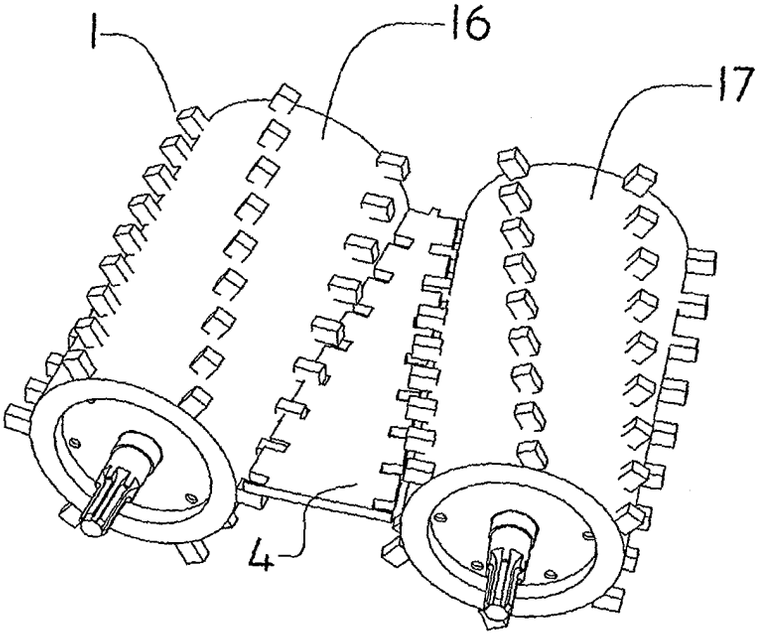

Fig. 9

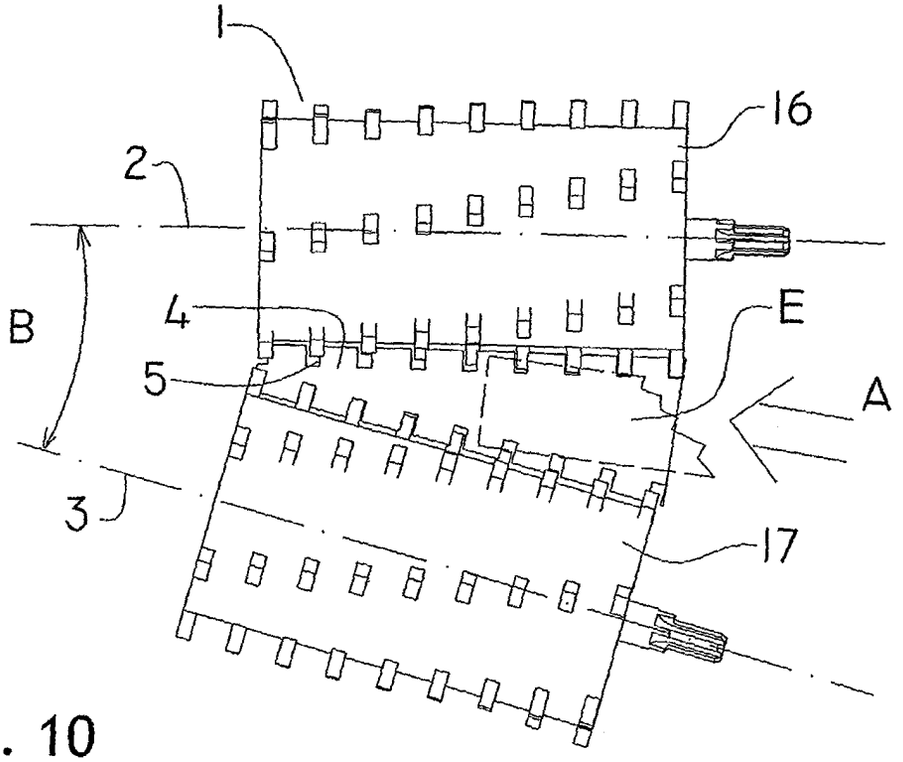

Fig. 10

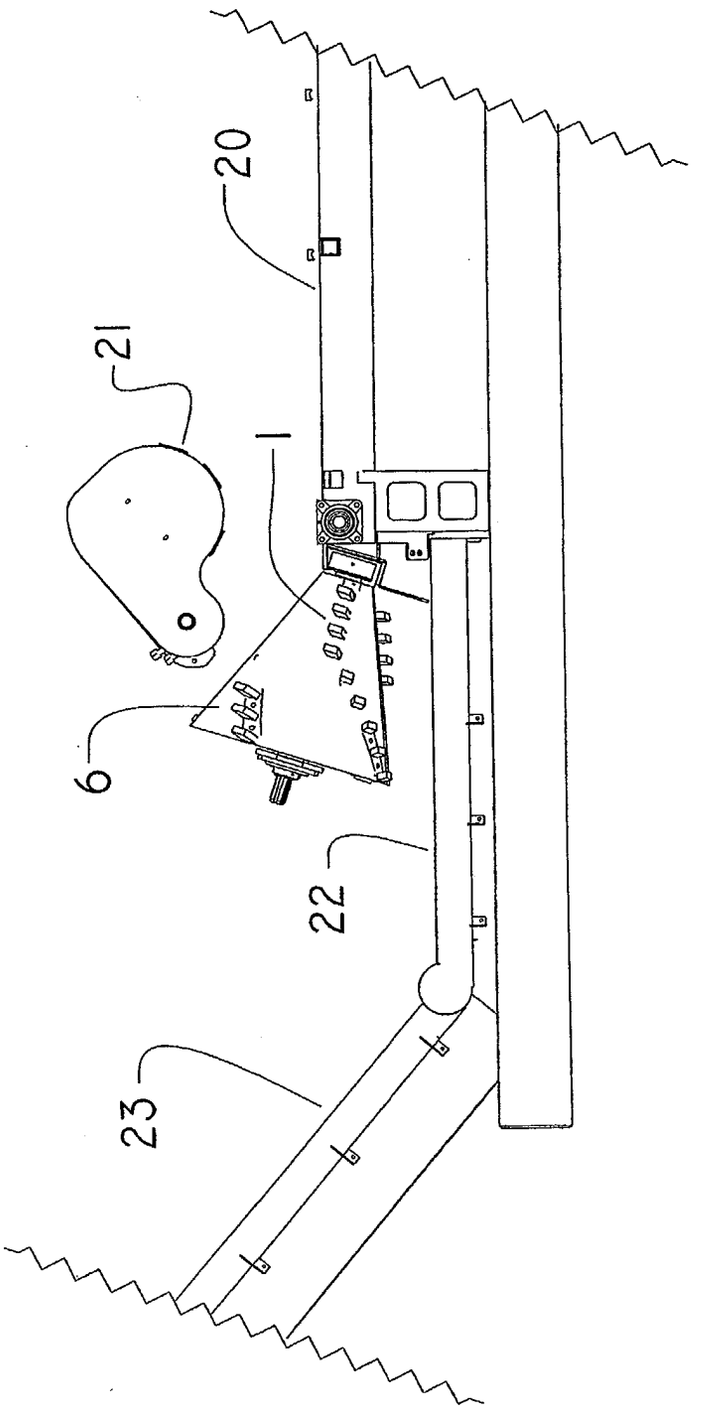

Fig. 11

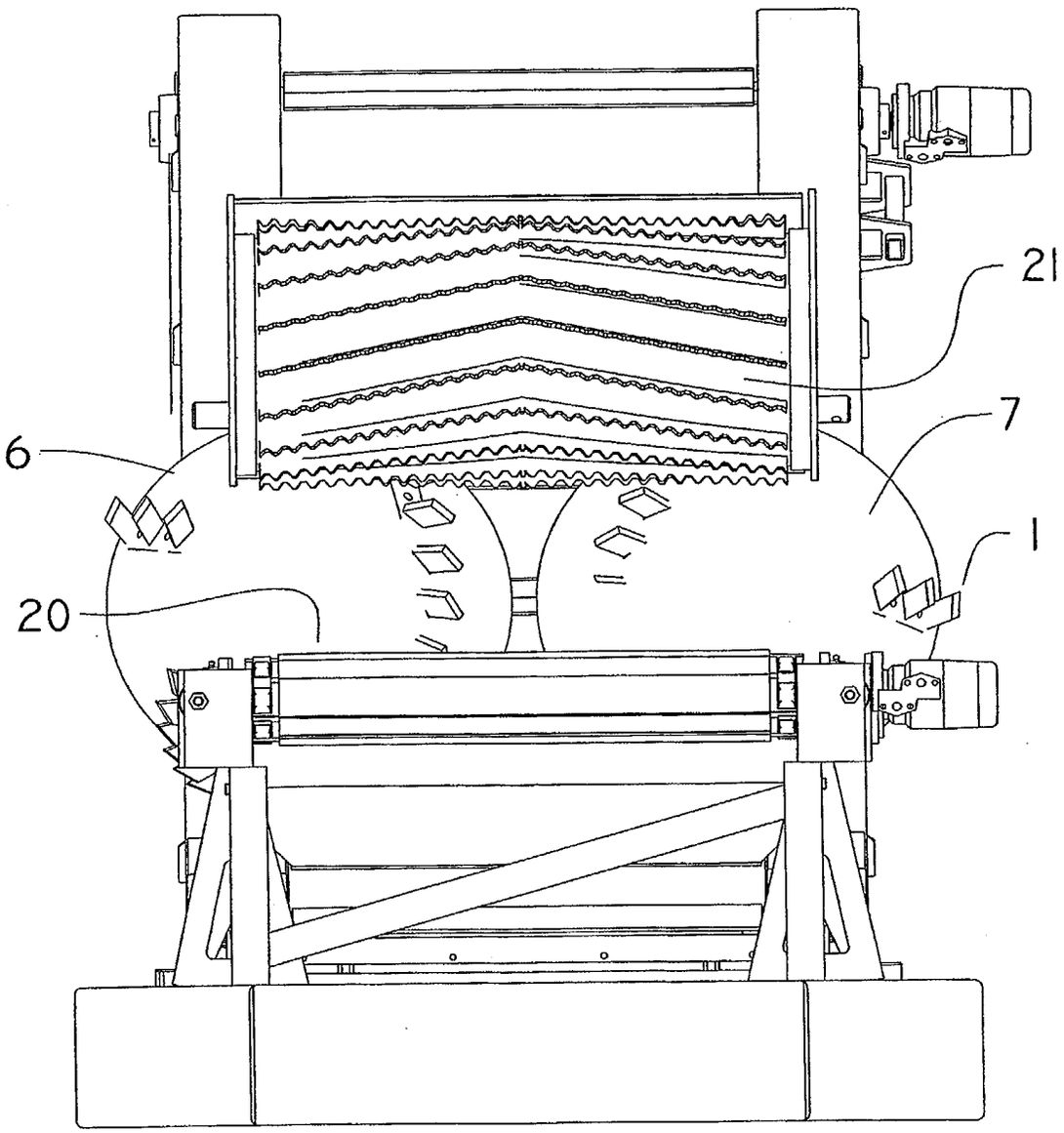

Fig. 12

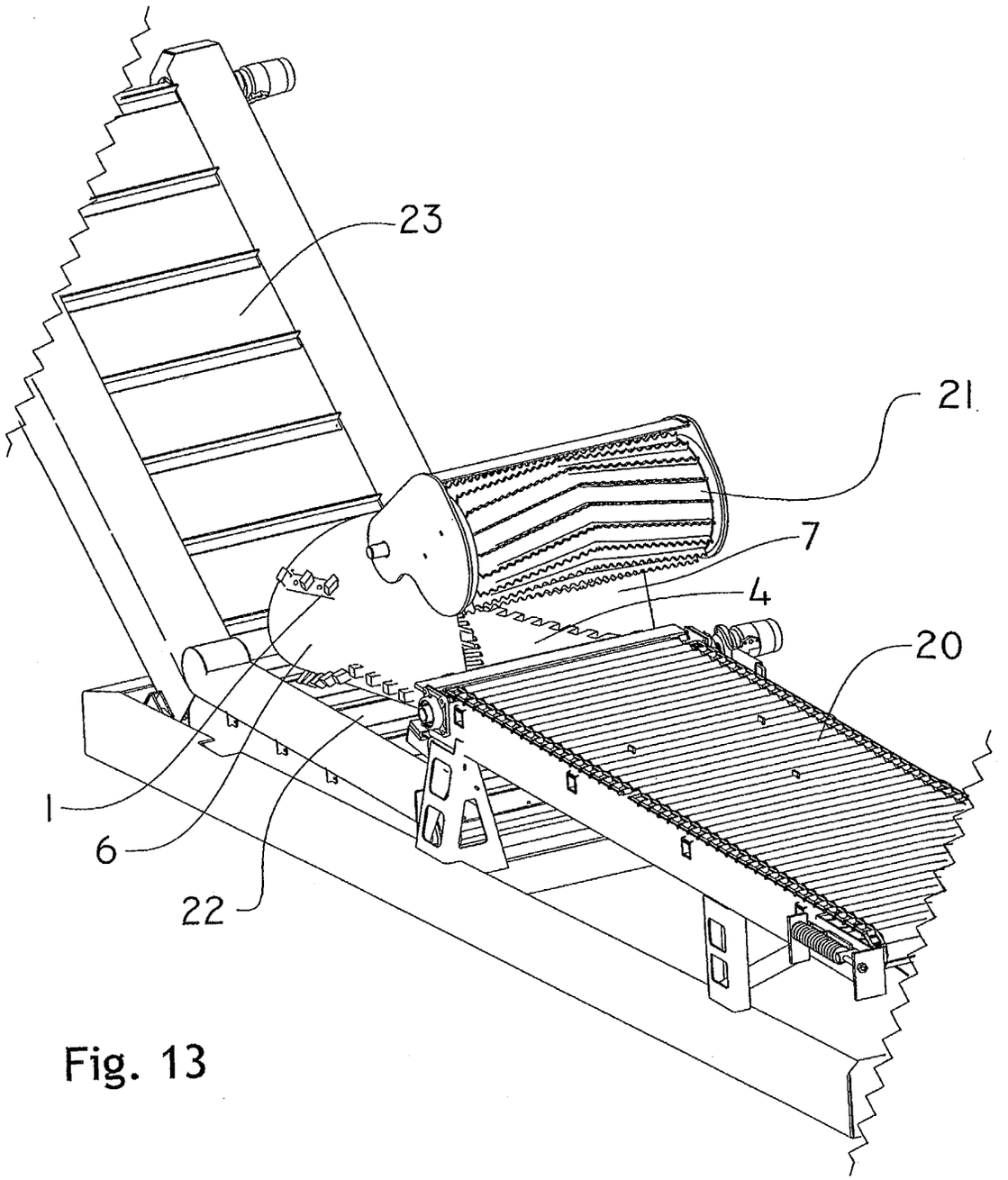

Fig. 13