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(54) A bag-breaking machine for single-use bags

(57) The bag-breaking machine for single-use bags comprises a conveyor screw (5) made of a spiral-wound metal sheet arranged coaxially and internally of a channel (3) into which one or more than one bags (2) can be introduced. The screw (5) can be rotated on command about an axis thereof in order to transfer the bags (2) towards a discharge end (4) of the channel (3). The screw (5) affords a free space in a central zone thereof. A screening device (9) is predisposed to receive the bags (2) after they are broken open and the material as they exit from the discharge end (4) of the channel (3). The machine is particularly useful for separating granular and powdery material from a bag which the material was previously contained in.

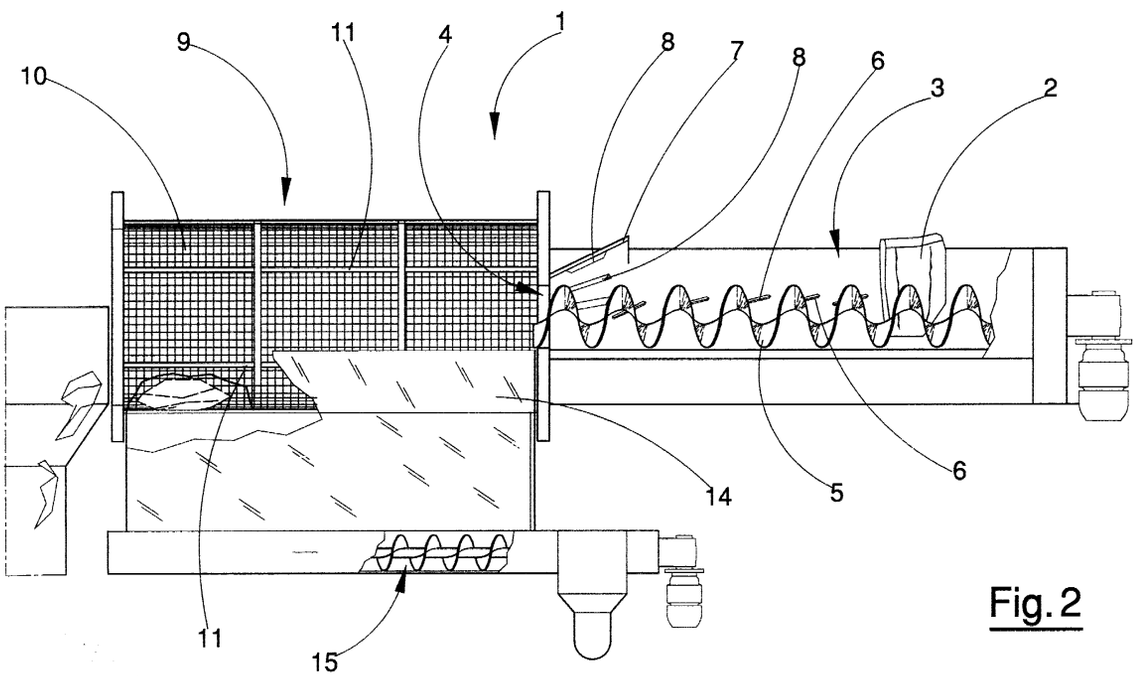

Fig. 2

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Description

[0001] The invention is specifically, though not exclusively, useful in fields where considerable quantities of loose granular or powder materials or products are used, which are packed in sacks or bags which are intended for a single use only, to be opened and then disposed of. This is the case, for example, with products or materials used in the construction industry (cement, lime etc.), or in animal husbandry (forage, various feeds and so on), where the materials are supplied in strong sacks or paper, jute or plastic packs (or even other materials). The machine of the invention both effects the opening of these sacks or bags and separates the bags from the loose materials or products contained in them.

[0002] The invention relates in particular to a bag-breaking machine comprising a fixed elongate channel superiorly provided with at least one opening where one or more bags containing loose (preferably granular or powdery) material can be inserted, and another opening at an end of the channel, for discharge. The machine is equipped with a conveyor screw comprising a spiral-wound metal sheet predisposed coaxially and internally of the channel, being rotatable on command about its own axis and being able to break open the bags and transfer them, together with the materials contained therein, towards the discharge of the channel in an advancement direction which is parallel to the longitudinal axis of the channel. The machine further comprises a screening device predisposed to receive the bags and the loose material exiting from the discharge at the end of the channel and completely separate them.

[0003] A machine of this type is already known from, for example, US patent no. US 4,278,384, which teaches a spiral-wound sheet metal conveyor screw wound about and fixed to a rotating shaft. Elongate elements project from the internal wall of the channel in a parallel direction to the longitudinal axis of the channel; these elements have the task of preventing the opened bags from winding about the conveyor screw and of helping the bags to advance along the channel. The bags are introduced into the screw conveyor, where the rotating screw cuts them open in several places, penetrating into them by means of the external cutting edge of the sheet steel of which the screw is composed, and drags them along the channel towards the screening device, where the total separation of the material is performed.

[0004] The prior art also teaches US patent no. US 4,182,592, which described a bag-breaking machine comprising a screw conveyor provided with a transport channel having smooth internal walls and internally of which there is a helical rotatable conveyor screw, wound about a central shaft. A loading hopper loads the bags into the screw conveyor. The conveyor screw exhibits on its edge a series of projecting cutters which cut and/or tear the bags. US 4,182,592 also teaches the use of other cutting and/or tearing means, constituted by a cutting edge located on the edge of the conveyor screw and by cutters which project from the screw central shaft. The screw conveyor transfers the bags and the material contained in them to a rotating perforated drum, in which the bags are separated from the material. The drum is provided with a vibrator which aids the screening operation.

[0005] Prior art machines of the above-described type present some limitations and drawbacks.

[0006] Firstly, they have a relatively high energy consumption, especially for the screw which breaks and infeeds the bags (while they are still full of material) to the screening device.

[0007] Secondly, these known machines do not guarantee complete separation of the loose materials from the bags containing them, with a consequent loss of a part of material, which is eliminated together with the bags.

[0008] Other drawbacks in these known machines are that they are noisy and complex in terms of construction.

[0009] The aim of the present invention is to obviate the above-mentioned limitations and drawbacks in the prior art by providing a bag-breaking machine capable of achieving an effective separation of the bags from the material contained in them, with a relatively limited energy consumption.

[0010] An advantage of the present invention is that it effects a complete separation of the loose material from the bags, which are destined to be eliminated at the outlet of the machine.

[0011] A further advantage of the invention is to provide a bag-breaking machine which is relatively quiet during operation.

[0012] A still further advantage of the machine is that it comprises a device able to provide a complete and effective screening operation on the opened bags and the loose materials by means of the use of constructionally simple vibrating means.

[0013] These aims and advantages and others besides are all attained by the invention as it is characterised in the appended claims.

[0014] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of a preferred but non-exclusive embodiment of the invention, illustrated purely by way of a nonlimiting example in the accompanying figures of the drawings, in which:

figure 1 shows a schematic plan view from above of the present invention, with some parts sectioned;
figure 2 is a schematic side view in vertical elevation of the machine of figure 1;
figure 3 is a side view from the right of figure 2, with some parts removed better to evidence others;
figure 4 shows a schematic plan view from above of a second embodiment of the machine.

[0015] With reference to the above-mentioned figures from 1 to 3, 1 denotes in its entirety a bag-breaking ma-

chine for separating the material from a plurality of single-use bags 2 containing the material. The bags 2 can be, for example, usual paper, jute, plastic or other type bags, containing a preferably loose material in power or granular form, such as for example cement, lime, forage, feeds and the like.

[0016] The machine 1 comprises a channel 3 which is elongate, fixed and superiorly provided with at least one loading opening for one or more bags 2 to be loaded into the machine. A hopper, of known type and not illustrated in the figures, can be located above the discharge opening to facilitate introduction of the bags into the channel.

[0017] The transversal section of the channel 3 is approximately U-shaped. The channel 3 is provided with a discharge end 4 through which the broken bags 2 and the loose material can exit from the channel 3.

[0018] The machine 1 is equipped with a conveyor screw 5 comprising a ribbon-shaped metal sheet which is spiral-wound and predisposed coaxially inside the channel 3. The screw is rotatable about its own axis on command of motor means of known type. The conveyor screw 5 is for breaking the bags 2 and transferring them, together with the material contained therein, towards the discharge end 4 of the channel, in an advancement direction which is parallel to the longitudinal axis of the channel 3 itself. The conveyor screw 5 does not exhibit a support shaft, rather affording at its centre a free space which extends along the longitudinal axis of the channel 3 - about which the screw 5 winds. The screw 5 has a free end situated in proximity of the discharge end 4 of the channel 3, while the opposite end is constrained to a pivot, rotatable about a rotation support on command of the above-cited motor.

[0019] A plurality of cutting blades 6 is predisposed on the lateral internal wall of the channel 3. The blades 6 are fixed and have the task of cutting the bags 2. The blades 6 are situated on a side of the channel 3, more precisely on the side towards which the bags 2 are nudged by effect of the rotation of the conveyor screw 5. In other words, the conformation of the screw 5 and its rotation direction are such that the bags 2 are squeezed towards the side of the channel 3 the blades 6 are located on. The blades 6 which are closest to the discharge end 4 of the channel exhibit an inclination which is practically equal to the inclination of the conveyor screw 5. The furthest blades 6 from the discharge end 4 have practically no inclination, i.e. they are practically parallel to the direction of the axis of the conveyor screw 5.

[0020] The channel 3 can be provided with an upper wall 7, basically a cover, predisposed in proximity of the discharge end 4 to cover the screw 5 at least partially. The upper wall 7 converges in the advancement direction of the bags 2, that is, towards the discharge end 4 of the channel 3. The internal surface of the upper wall 7 exhibits fixed cutting blades 8 for slashing the bags 2. In the illustrated embodiment the blades 8 on the upper wall 7 converge towards the discharge end 4 of the channel 3.

[0021] The machine 1 comprises a screening device 9, predisposed downstream of the channel 3. The bags 2 and the loose material exiting from the discharge end 4 are separated here. The screening device 9 comprises a tubular sieve 10 which can be rotated on command. The tubular sieve 10 is made at least partially of plastic, preferably polyurethane. In the illustrated embodiment the perforated lateral surface of the sieve 10 comprises a plurality of curved rectangular sectors made of polyurethane, set side-by-side and solidly joined one to another along joint lines 11 parallel to the sieve 10 axis. In the example the sieve 10 comprises five curved sectors. In order to realise various-diameter sieves 10, a different number of sectors can be joined together, which are the same as those illustrated but have different curvatures.

[0022] The tubular sieve 10 is solidly constrained to a cogged crown wheel 12, externally of which there are three sprockets 13 which are angularly equidistant and are enmeshed with the crown wheel 12. At least one of the sprockets 13 can set the sieve 10 in rotation on command of a motor (not illustrated). The profiles of the cogs of the sprockets 13 and the crown wheel 12 are conformed and reciprocally enmeshed in such a way that the sprockets 13 transmit an irregular and non-continuous motion to the crown wheel 12. The enmeshing can be made in such a way that during transmission of drive there are moments when there are no teeth actually pulling, or in any case where there is discontinuity in transmission. It could, for example, be arranged that the contact between the cogs occur at or near the foot of the cog, so that the transmission ratio of the crown wheel 12 and the sprocket 13 were altered. In any case, the irregular transmission means that the sieve 10 is made to vibrate. This results in an effective screening without there being any need for a special sieve-vibrating device.

[0023] A hopper 14 is located below the screening device 9 for receiving the powder or granular material which has passed through the grid of the sieve 10 and for directing the sieved material to a screw conveyor 15 which then sends it on to its destination.

[0024] During operation, the bags 2 to be opened are introduced, either manually or by known-type loading means, into the hopper and thereafter into the channel 3. The conveyor screw 5 is made to rotate and both slashes the bags 2 in several places, nudging them against the blades 6 which cooperate in the cutting operation, and transfer the bags and the loose material (which begins to pour out of the slashed bags 2) towards the discharge end 4.

[0025] The sheet metal which constitutes the screw 5 can cut both with its external edge and its internal edge, the former having a greater diameter than the latter. The absence of the support shaft for the screw 5 i.e. the existence of a free space situated coaxially and internally of the screw 5, not only enables the internal edge of the

screw 5 to perform a slashing action, but also facilitates the introduction of the bags 2 into the channel 3, especially in between the steps of the screw 5. Also, the free space in the centre of the screw 5 aids the gripping of the bags 2 by the screw 5, improving the cutting action but also facilitating transport of the bags 2 towards the discharge end 4. Consequently, it has been found that the motor rotating the screw 5 is relatively less stressed. The bags 2 are opened by the screw 5 and the blades 6 and 8 arranged along the channel 3; subsequently the opened bags 2 exit, together with the loose material, through the discharge end 4 and collect on the bottom of the rotating sieve 10. The loose material passes through the sieve 10 and is conveyed to the user, while the opened and by-now empty bags 2 are removed via an open end of the sieve 10.

[0026] It has been found that a machine made according to the invention can effect a good screening of the loose material. It has also been found that the use of a sieve made of plastic material (polyurethane) reduces the operative noise of the screening device.

[0027] Figure 4 illustrates a second embodiment of the machine, comprising many identical elements to the ones found in the first illustrated embodiment of figures 1 to 3. For the sake of simplicity the like elements in the two machines are denoted using the same reference numbers.

[0028] In the machine of figure 4, at the discharge end 4 of the channel 3 there is a bag-cutting device 16 comprising a plurality of blades 17 facing internalwards so as to interact with the bags 2 exiting from the channel 3. The blades 17 are constrained to one or more deformable elements 18 which can assume a non-deformed configuration, in which all the blades 17 occupy at least partially the passage through which the bags 2 pass when exiting from the discharge end 4, and a deformed configuration, in which the deformable elements 18 are spread externalwards to allow the bags 2 to pass through. In this case the blades 17 are mounted on deformable elements 18 constituted by a plurality of trapeze-shaped flexible tongues, having their longer sides solidly constrained to a flanged body 19 fixed to the channel 3 and their shorter sides free. The tongues, which are made of plastic, are arranged side-by-side in a circumferential direction around the discharge end 4, and when in the rest position they are inclined inwardly, giving rise all together to a trunco-conical body. The deformable elements 18 are conformed and arranged in such a way as to form an outlet mouth which stretches when the bags 2 are passing through as they exit from the discharge end 4 of the channel 3. Each elastically-deformable element 18 is able to bend outwardly by effect of the passage of one or more bags 2 exiting from the channel 3 and entering the screening device 9. The cutting device 16 can be further provided with elastic elements predisposed to press the deformable elements 18 internally of the outlet mouth of the discharge end 4. In crossing the cutting device 16 the bags 2 are subjected to a further cutting action on the part of the blades 17 predisposed on the deformable elements 18. This cutting action contributes to further improving the effectiveness of the screening operation.

[0029] The machine of figure 4, differently to that of figures from 1 to 3, does not exhibit the upper wall 7 equipped with blades 8. It would be possible, however, to make a machine (not illustrated) comprising both a cutting device having blades situated on flexible organs, as in the machine of figure 4, and an upper wall with fixed blades, as in the machine of figures from 1 to 3.

Claims

1. A bag-breaking machine for separating material from a single-use bag containing the material, comprising:

   an elongate channel (3) into which one or more than one bag (2) containing material can be introduced, the channel (3) being provided with a discharge end (4) through which the bags (2) when broken and the material exit from the channel (3);
   a conveyor screw (5), comprising a spiral-wound metal sheet predisposed coaxially and internally of the channel (3), which conveyor screw (5) is rotatable on command about an axis thereof, and which conveyor screw (5) is able to transfer the bags (2), together with the material contained therein, towards the discharge end (4) of the channel (3) in an advancement direction which is parallel to a longitudinal axis of the channel (3); the bags (2) being at least partially broken open during a progress of the bags (2) along the channel (3);
   a screening device (9), predisposed to receive the bags (2) when broken and the material when said bags (2) and material exit from the discharge end (4), and for separating the bags (2) from the material;

   characterised in that the conveyor screw (5) affords at a central part thereof a free space which extends along the longitudinal axis of the channel (3) and about which the conveyor screw (5) winds.

2. The machine of claim 1, characterised in that it comprises a plurality of blades (6) predisposed on an internal lateral wall of the channel (3) for cutting the bags (2); the blades (6) being situated on a side of the channel (3) towards which the bags (2) are pushed by effect of a rotation of the conveyor screw (5).

3. The machine of claim 2, characterised in that at least a part of the blades (6) is inclined with respect

to the axis of the conveyor screw (5).

4. The machine of claim 3, characterised in that the blades (6) closest to the discharge end (4) of the channel (3) exhibit a greater inclination than an inclination of the blades (6) which are furthest from the discharge end (4); the inclination of the blades (6) closest to the discharge end (4) being about equal to an inclination of steps of the conveyor screw (5).

5. The machine of any one of the preceding claims, characterised in that the channel (3) comprises an upper wall (7), for covering the conveyor screw (5) at least partially; the upper wall (7) converging progressively in an advancement direction towards the discharge end (4) of the channel (3) and bearing internally thereof fixed cutting blades (8) for cutting the bags (2).

6. The machine of any one of the preceding claims, characterised in that:

the screening device (9) comprises a tubular sieve (10), rotatable on command, bearing a cogged crown wheel (12), externally of which at least one sprocket (13) is arranged for rotating the sieve (10);
the at least one sprocket (13) and the crown wheel (12) having cogs which are conformed and reciprocally enmeshed in such a way that the at least one sprocket (13) transmits a discontinuous and irregular drive to the crown wheel (12).

7. The machine of any one of the preceding claims, characterised in that the screening device (9) comprises a tubular sieve (10), rotatable on command, made at least partially of a plastic material, preferably polyurethane.

8. The machine of claim 7, characterised in that a perforated lateral surface of the sieve (10) comprises a plurality of curved sectors, made of a plastic material, which sectors are placed side-by-side and are solidly constrained one to another along joint lines (11) parallel to an axis of the sieve (10).

9. The machine of any one of the preceding claims, characterised in that it comprises, located at the discharge end (4) of the channel, a cutting device (16) provided with one or more blades (17) constrained to one or more deformable elements (18) which deformable elements (18) are conformed and arranged in such a way as to form a stretchable outlet mouth for allowing passage of the bags (2) exiting from the discharge end (4) of the channel (3), the one or more blades being able to interact with the bags (2).

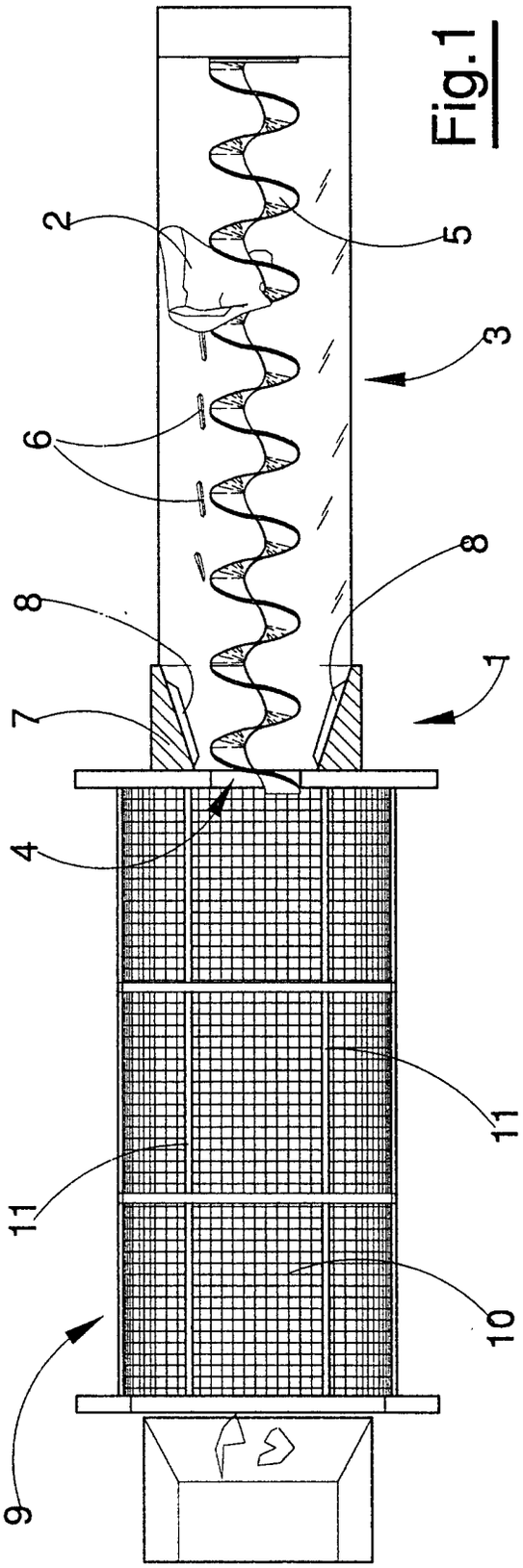


Fig.1

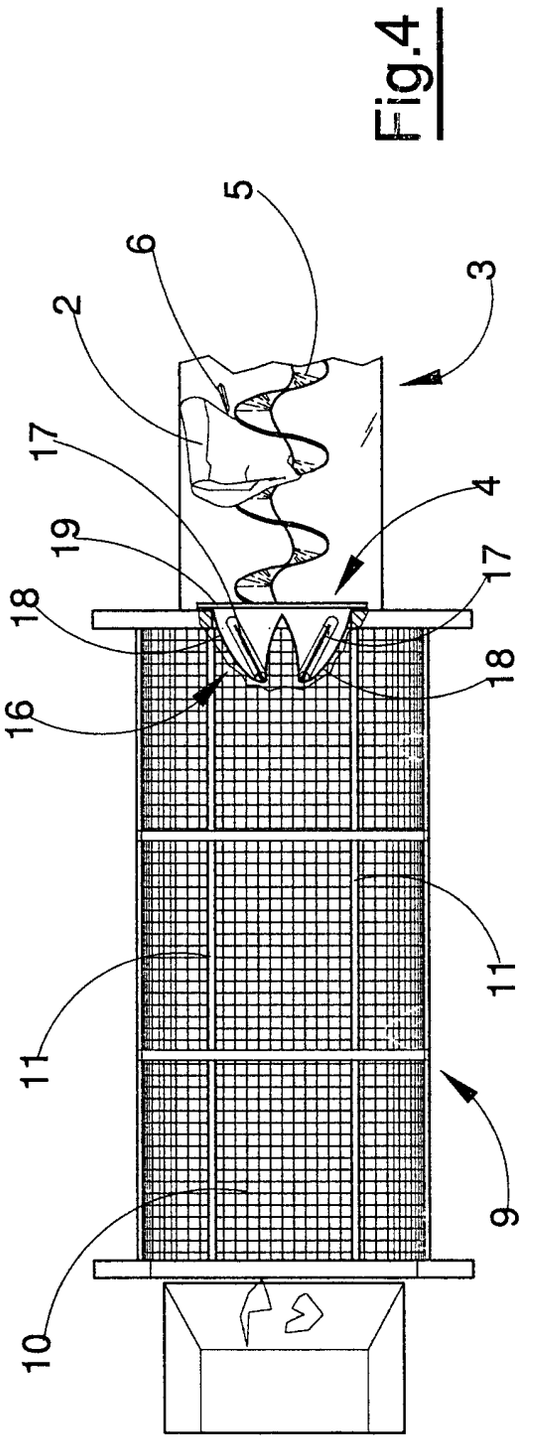


Fig.4

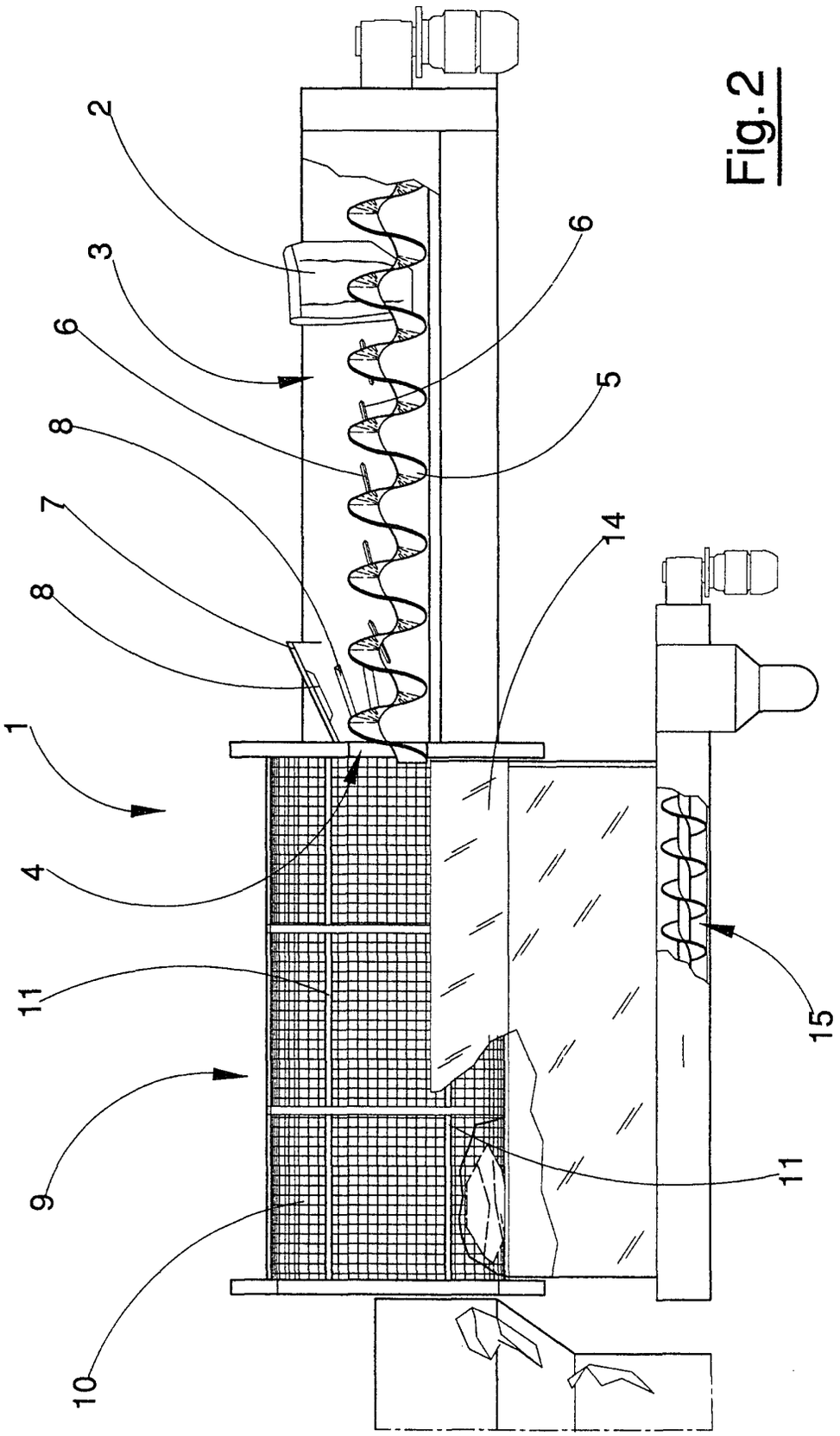
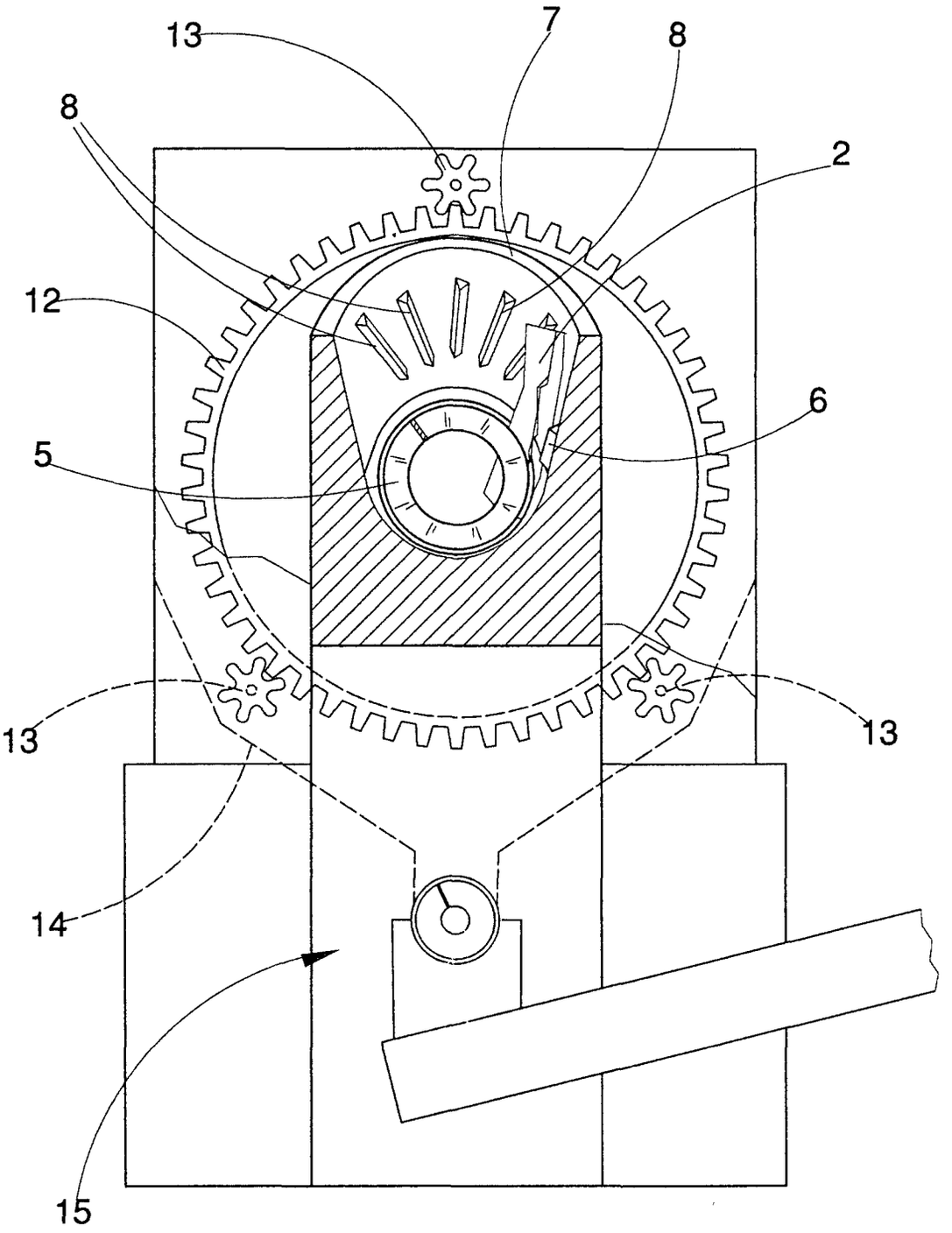


Fig.2

Fig.3



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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0084

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 July 2000	Jagusiak, A

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