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(54) Apparatus for separating liquid and solid substances, in particular for extracting juice from fruit and the like.

(57) A grape press constituted by a cylindrical or truncated-cone tank (3) provided with a series of semi-elliptical partitions (11) adapted to form, together with respective membranes (15), a plurality of pressure chambers (13). Successive pressing regions (23, 25, 27), with related discharge devices (21, 31, 33, 35), are arranged parallel to the pressure chambers. The product is fed continuously at one end of the tank and is advanced by rotating the tank, since the partitions are arranged so as to form a half-helix. The pressure chambers and the pressing regions are actuated alternatively in order to perform the intended pressing cycles.

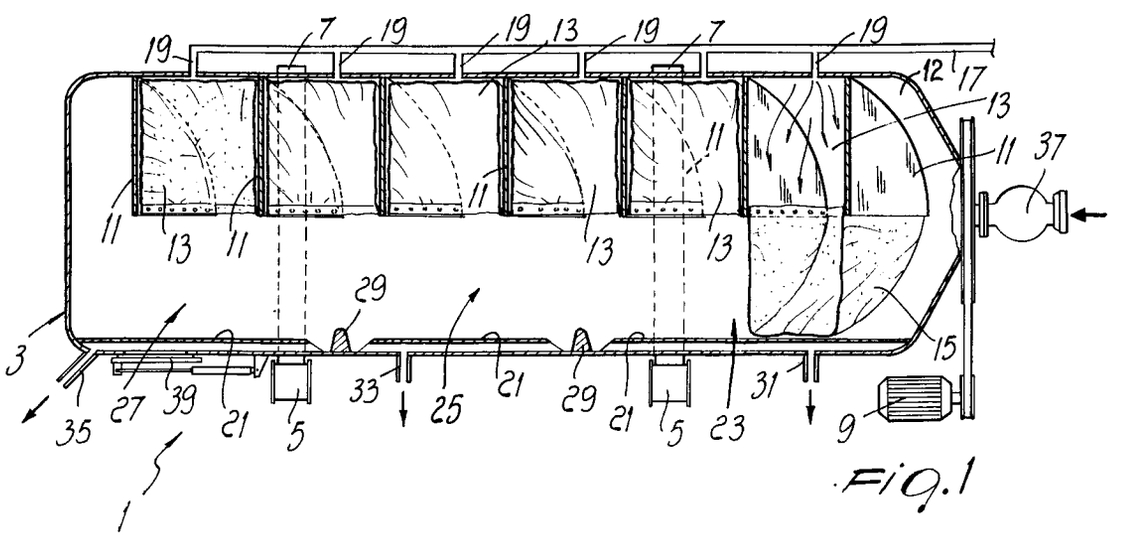

Fig.1

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The present invention relates to an apparatus for separating liquid and solid substances, in particular for extracting juice from fruit and the like.

Grape presses are known which are constituted by a tank divided into a pressure chamber and into a pressing chamber by means of a flexible membrane.

The product to be processed is fed into the pressing chamber, and the pressure chamber is fed with pressurized fluid (air or water) so that the membrane acts on the product and presses it. Normally, the process provides for various pressing cycles at variable pressure, and the tank can rotate in order to allow better draining of the product.

A new press which operates under low pressure, or vacuum, rather than with high pressure, has recently been introduced and is described in Italian patent application no. MI91U000603 in the name of this same Applicant.

In this type of press, a vacuum is generated in the pressing chamber which contains the product, so that the membrane, which is pushed by the ambient pressure and possibly by a slight overpressure which is present in the pressure chamber, acts on the product and presses it.

Both the high pressure and the vacuum presses ensure optimum processing of the product, but they have the severe disadvantage, from the point of view of production, that they cannot be fed continuously. The processing cycle in fact entails that the press must be loaded with a preset amount of product, which is subjected to a certain number of pressing cycles. Only after the depleted product has been discharged, and after the optional washing, is it possible to perform a new loading operation and thus a new processing cycle.

This problem can be overcome by providing a plurality of presses, so that at least one is always ready for loading fresh product. This is of course possible only for large manufacturers with high production volumes, and is in any case costly from the economic point of view and in terms of occupied space.

Presses are known which are capable of operating with a continuous feed; these presses are substantially constituted by a screw rotating inside a cylinder. The product is loaded at one end of the cylinder, and the depleted product is extracted at the other end. The quality of the product which can be obtained with this type of press, however, is poor, so that these presses are not normally used except for particular purposes.

A European Patent Application No. 0341098 discloses a press constituted by a drum having a plurality of chambers each having a membrane and an independent source of pressure. A means for moving the product to be pressed is constituted by an Archimedean screw supported by a shaft. The shaft rotates independently from the drum. Although this type of press achieves a continuous operation, it is nevertheless susceptible of improvement.

The aim of the present invention is to provide a grape press which can operate continuously and provides, at the same time, high quality of the obtainable product.

Within the scope of this aim, an object of the invention is to provide a press which operates with the principle of membrane presses, both with the high-pressure system and with the low-pressure, or vacuum, system.

Another object of the invention is to provide a press which can operate according to any type of processing cycle required.

This aim, these objects and others which will become apparent hereinafter are achieved by an apparatus for separating liquid and solid substances, in particular for extracting juice from fruit and the like, comprising a longitudinal tank provided with an inlet for the product to be processed, with an outlet for the depleted product, with pressure means adapted to act on said product to be processed in order to separate the liquid substance from said product to be processed, and with means for discharging said liquid substance;
characterized in that it comprises: a plurality of half-partitions which are arranged substantially transversely with respect to the longitudinal axis of said tank and define a series of sectors, each one of said sectors comprising a membrane, each membrane being fixed to two contiguous partitions and to the inner wall of said tank so as to define a pressure chamber; a plurality of pressing chambers, arranged parallel to said pressure chambers; said half-partitions being arranged at a certain angle with respect to the rotation axis of said tank so that a rotation of said tank is matched by an advancement of the product to be processed from one pressing chamber to the next.

Further characteristics and advantages will become apparent from the description of a preferred but not exclusive embodiment of the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic longitudinal sectional view of the apparatus according to the invention;

Figure 2 is a schematic transverse sectional view of the tank of the apparatus of Figure 1;

Figure 3 is a perspective view of the tank.

Figure 4 is a view similar to Fig. 3 of a tank according to a further aspect of the invention;

Figure 5 is a a schematic longitudinal sectional view of the apparatus according to still a further aspect of the invention.

With reference to the figures 1-3, the press, generally designated by the reference numeral 1,

comprises a container or tank 3, which is preferably cylindrical and has a horizontal axis. The tank comprises supporting means for a rotation of the tank about the horizontal axis and are constituted for example by pairs of wheels 5 for supporting the tank at rolling guides 7. The rotation of the tank is actuated by a gearmotor 9 in a per se known manner.

The tank 3 comprises a plurality of partitions 11 which have a substantially half-elliptical shape and are arranged so as to define a series of pressure chambers 13. The pressure chambers comprise a membrane 15 which has a substantially half-cylindrical shape and is fixed to the lower edges of each adjacent partition and to the two sides of the tank.

A pressurized fluid supply system comprises a manifold 17 and a series of inlets 19, controlled by respective valves, for the respective pressure chambers 13.

The lower region of the tank comprises a plurality of channels 21 which are arranged so as to define a series of contiguous pressing chambers or regions; in the case shown in the figures, three pressing regions 23, 25 and 27 are defined and are advantageously separated by semi-annular dividing walls 29.

The discharge channels 21 are connected to discharge ducts, respectively 31, 33 and 35, which correspond to the respective pressing regions 23, 25 and 27.

The tank finally comprises an inlet for the product to be pressed, which is advantageously constituted by a valve 37 arranged at one end of the tank, and a door 39 for the discharge of the depleted product, which is arranged substantially at the opposite end.

The apparatus according to the invention can operate both conventionally with fluid (air or water) at high pressure, and with the low-pressure system, substantially as described in the above mentioned Italian patent application no. MI91U000603.

The operation of the apparatus will be described hereinafter with reference to the low-pressure system; operation with the high-pressure system is in fact substantially identical.

With the tank 3 in pressing position, i.e. with the partitions 11 arranged upward with respect to the pressing regions, the product to be processed is introduced, by means of the valve 37 and through the filling chamber 12, into the first pressing region 23 of the tank 3, at the first one of the pressure chambers 13.

By means of the discharge duct 31, low pressure is created in the first pressing region, whereas a slight overpressure may be created in the first one of the pressure chambers by sending air through the duct 17 and the respective inlet 19. The membrane 15 of the first one of the pressure chambers thus acts on the product and presses it, and the extracted liquid substance flows out through the channels 21 and the discharge duct 31.

Once the first pressing step has ended, the tank 3 is rotated through 360° so that the product is collected between the partitions 11, which constitute the first pressure chamber, and is moved forward until it arrives at the second pressure chamber. At this point, the tank is in pressing position again, further product is fed through the valve 37, and a second pressing cycle is performed on the old product while a first pressing cycle is performed on the freshly loaded product.

Upon each new rotation of the tank, the product advances toward the bottom of the tank, until it arrives in the last pressing region where, being depleted, it is discharged through the discharge door 39, while fresh product is continuously loaded at the inlet 37.

The discharge ducts 31, 33 and 35 are connected to respective sets of discharge channels for a differentiated separation of the product, and the pressing regions are advantageously separated by the dividing walls 29. It is apparent that the radial dimensions of the dividing walls, and the number of differentiated pressing regions, can vary according to the requirements.

In practice it has been observed that the invention achieves the intended aim and objects, allowing continuous processing while preserving the functional and quality characteristics typical of membrane presses.

By appropriately adjusting the low-pressure values at the ducts 31, 33 and 35 and the values of the overpressure (if any) at the inlets 19, as well as the number of pressing actions for each individual chamber and finally the rotation of the tank for the advancement of the product, it is possible to obtain any type of pressing cycle deemed most suitable.

Rotation of the tank, in addition to ensuring the advancement of the product, allows optimum draining; furthermore, the differentiated discharges allow to easily separate the first-choice product, which leaves the first outlet or outlets, from the products of progressively lower quality which exit from the outlets close to the end of the tank which is opposite to the loading end.

A press 101, according to a further aspect of the invention is schematically shown in Fig. 4 wherein like reference characters, added by 100, denote similar features to those of Figures 1-3.

Press 101 is provided with a tank 103 having a truncated cone shape with its larger flat face at the loading end.

This configuration in fact allows to contain the product more easily as its volume decreases, as the liquid portion is progressively eliminated, re-

ducing the pressing cycle times.

Similarly, the spacing of the partitions may also be reduced progressively toward the discharge end of the tank.

Fig. 5 shows a press 201 according to still a further aspect of the invention.

Press 201 comprises a plurality of partitions 211 forming a plurality of pressure chambers 213. Each pressure chamber 213 has a membrane 215 and is fed by a respective inlet 219, provided with an adapted valve and connected to a manifold 217.

The portion of the tank which is not affected by the pressure chambers is constituted by perforated plates 221 defining a plurality of pressing regions 227 corresponding to respective pressure chambers.

Drain trays 230 are provided underneath the tank 203 which is supported by wheels 205 and is adapted to rotate about an horizontal axis by means of a gearmotor 209.

The loading end of the tank (at the left end side with reference to Fig. 5) is provided with a pre-chamber, or loading chamber, constituted by a drum made of perforated plate and connected to the main portion of the tank so as to be rotatable independently. Drum 233 is connected to the main tank 203 at the rotatable joint 239 and is provided with an independent gearmotor 241 and with the loading valve 237 for feeding the product to be pressed.

Advantageously the drum 233 is provided with an Archimedean screw 243 adapted to move the product forward as the drum is rotated by means of the gearmotor 241.

The press illustrated in Fig. 5 is particularly adapted to operate with the high pressure system, wherein pressurized fluid is independently fed into the pressure chambers 213 causing the membrane 215 to press the product contained in the pressing regions 227. The liquid portion of the product exits the tank through the perforated plate and is gathered into the drain trays 230.

Before entering the main tank the product is "statically" drained in the loading chamber, or drum, 233: without applying any pressure to the product, the drum is rotated by the gearmotor 241 and, while the product is fed into the main tank 203, a certain amount of liquid is drained into the drain tray 230 through the perforated plate 221 of the drum 233.

The apparatus according to the invention is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with technically equivalent elements.

The materials employed, as well as the dimensions, may be any according to the requirements and the state of the art.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Apparatus for separating liquid and solid substances, in particular for extracting juice from fruit and the like, comprising a longitudinal tank (3, 103, 203) and provided with an inlet (37, 137, 237) for the product to be processed, with an outlet (39, 239) for the depleted product, with pressure means (15, 115, 215) adapted to act on said product to be processed in order to separate the liquid substance from said product to be processed, and with means (21, 31, 33, 35, 221, 230) for discharging said liquid substance; characterized in that it comprises:
   a) a plurality of half-partitions (11, 111, 211) which are arranged substantially transversely with respect to the longitudinal axis of said tank and define a series of sectors, each one of said sectors comprising a membrane (15, 115, 215), each membrane being fixed to two contiguous partitions and to the inner wall of said tank so as to define a pressure chamber (13, 113, 213);
   b) a plurality of pressing chambers (23, 25, 27, 227) arranged opposite to said pressure chambers; said half-partitions being rigidly associated with said tank and being arranged at a certain angle with respect to the rotation axis of said tank, so that a rotation of said tank is matched by an advancement of the product to be processed from one pressing chamber to the next.

2. Apparatus according to claim 1, characterized in that it comprises dividing walls (29) which are arranged between said pressing chambers.

3. Apparatus according to claim 1 or 2, characterized in that said tank (3) is cylindrical, said partitions being formed substantially by semicircles arranged in one half of said cylindrical tank diagonally with respect to the longitudinal rotation axis of said cylindrical tank.

4. Apparatus according to one or more of the preceding claims, characterized in that said pressing chambers comprise discharge channels (21) which are arranged along the directrices of said tank (3, 103).

5. Apparatus according to one or more of the preceding claims, characterized in that said tank (103) is shaped like a truncated cone.

6. Apparatus according to one or more of the preceding claims, characterized in that said tank is fed continuously through a loading valve (37, 137, 237).

7. Apparatus according to one or more of the preceding claims, characterized in that said pressing chambers (13, 113, 213) operate at different high-pressure and low-pressure values.

8. Apparatus according to one or more of the preceding claims, characterized in that it comprises a pre-chamber constituted by a drum (233) connected to said tank (203) through a rotating joint (239), said loading valve (237) being connected to said drum, said drum being adapted to rotate independently from said tank (203), said drum being constituted by a perforated plate for draining at least part of the liquid portion of said product to be pressed.

9. Apparatus according to one or more of the preceding claims, characterized in that said drum comprises an Archimedean screw (243) adapted to move said product forward as said drum is rotated.

10. Apparatus according to one or more of the preceding claims, characterized in that said pressing chambers comprise a perforated plate adapted to drain said juice into drain trays provided below said tank.

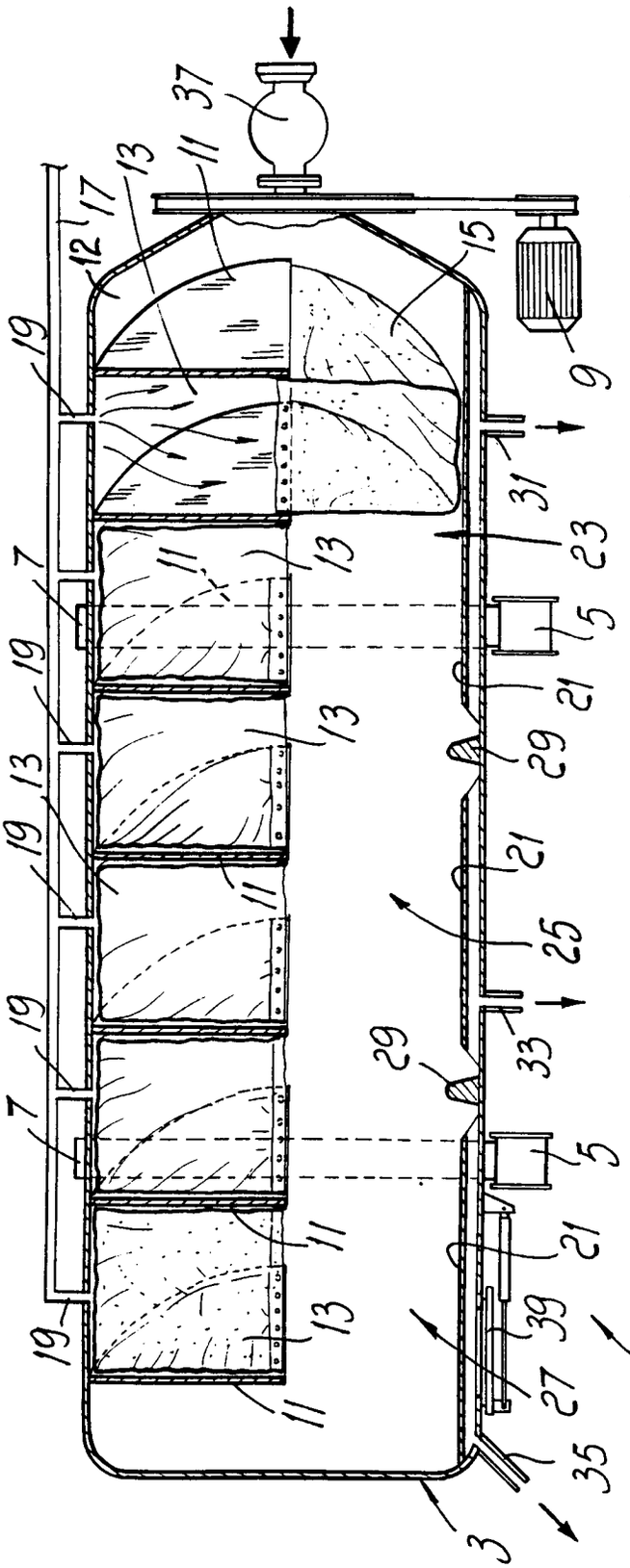

Fig.1

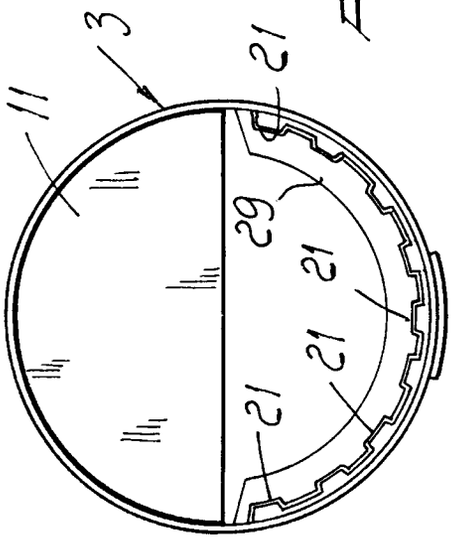

Fig.2

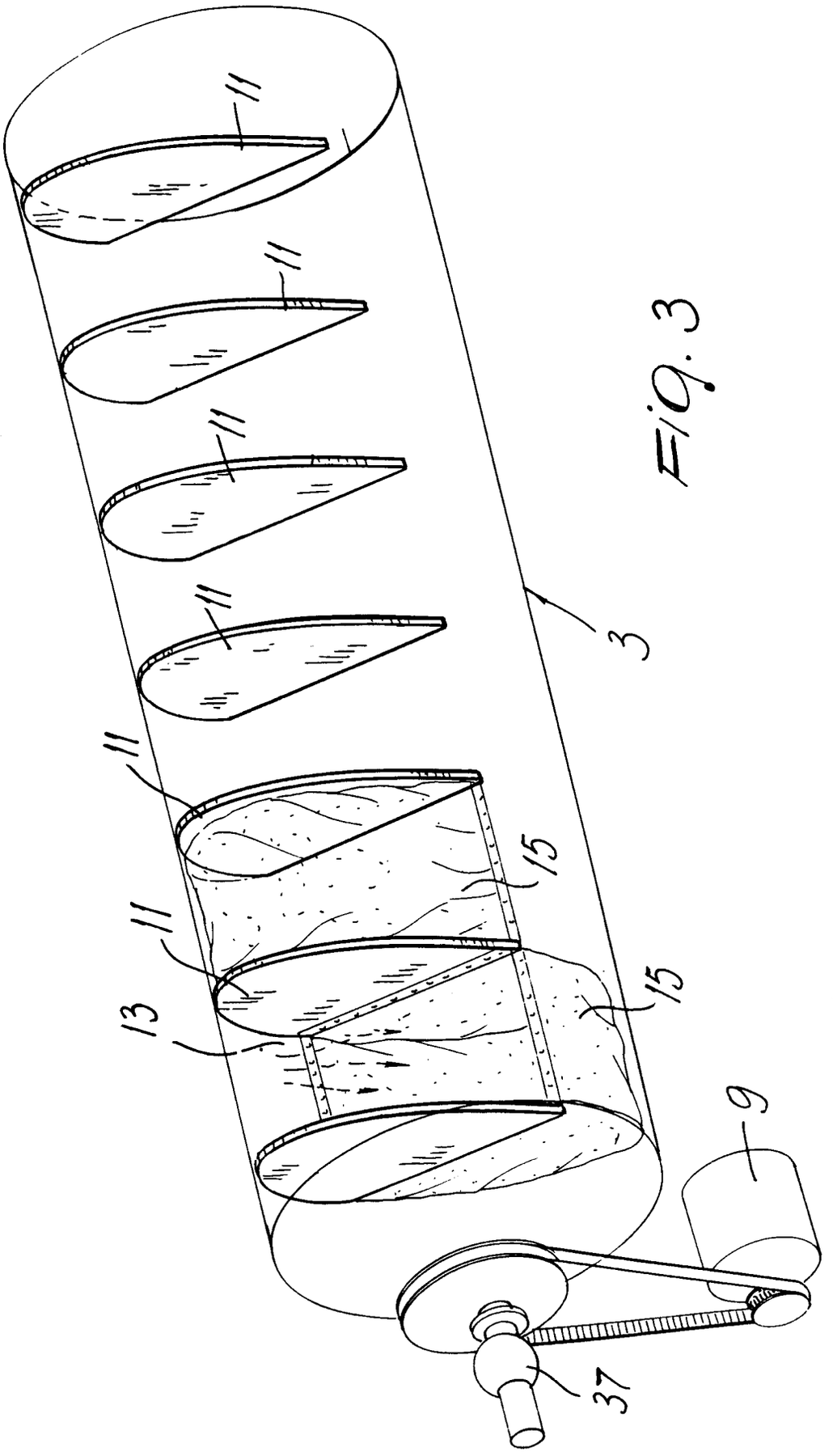

Fig. 3

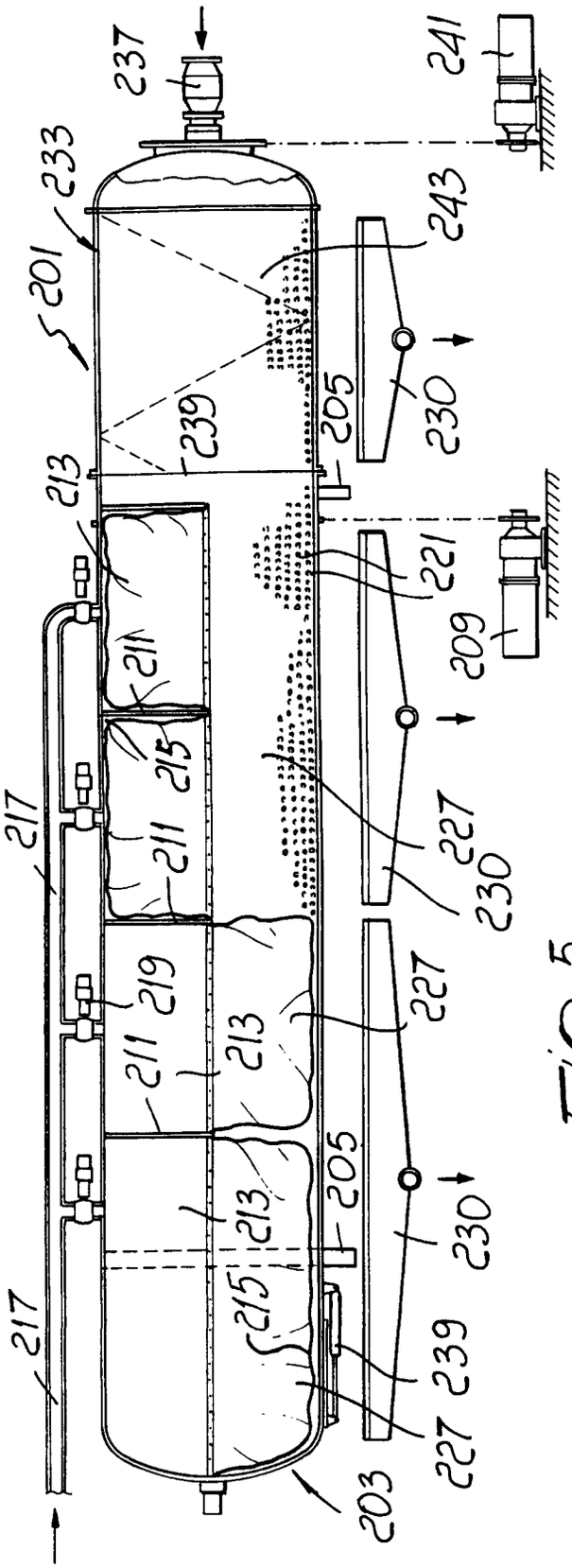
237
241
233
201
243
239
205
230
213
221
209
211
215
217
227
219
203

Fig. 5

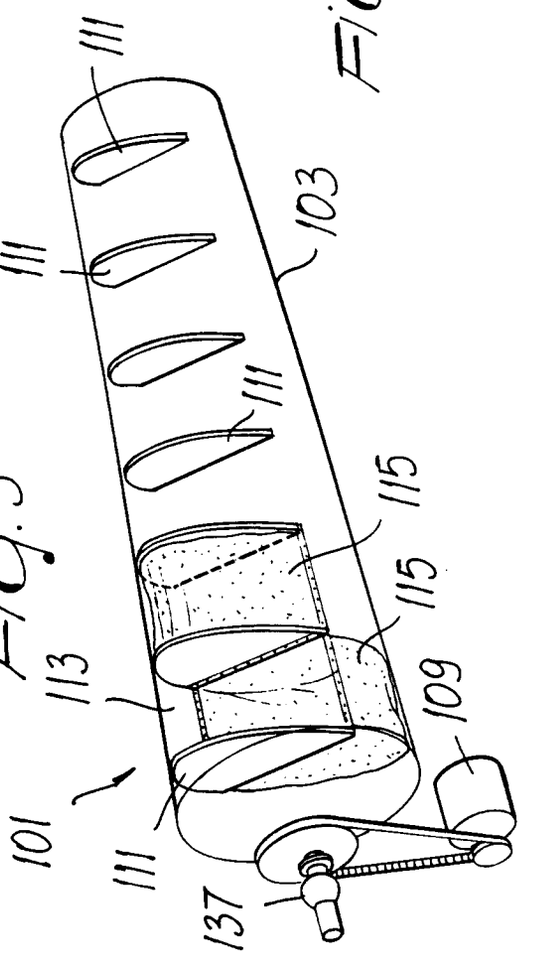
111
103
115
113
109
101
137

Fig. 4