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

(11) EP 1 127 620 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**29.08.2001 Bulletin 2001/35**

(51) Int Cl.[7]: **B02C 13/28**

(21) Application number: **01100927.1**

(22) Date of filing: **17.01.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **17.01.2000 DK 200000070**

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## (54) Impact crusher

(57) There is described an impact crusher with a rotor (18) supporting a row of swingles (13) inside a milling chamber. The swingles (13) are suspended pivotably on support plates (15). Between the support plates are disposed fillers (21) having recesses (22) for each swingle (13) which is disposed along the circumference in a plane perpendicularly to the axis (20) of rotation of the rotor. Hereby is formed a closed drum preventing material from flowing inside the action area of the swingles. Hereby is achieved a substantial energy saving and an improved quality of the processed product.

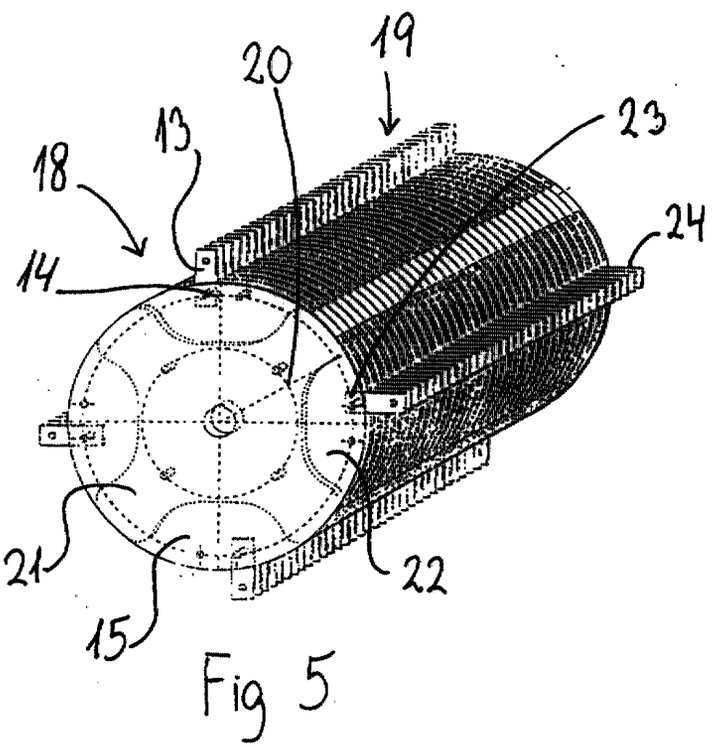


Fig 5

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## Description

**[0001]** The present invention concerns an impact crusher with a rotor provided with several rows of swingles along its length, the swingles extending perpendicularly to the rotational axis of the crusher, and the rotor being disposed inside a largely cylindrical screen having an elongate opening for inserting material and through which processed material leaves the crusher, where the rotor comprises a closed drum in the space within the swingles with recesses in its surface for accommodating the suspended ends of the swingles, while the active ends of the swingles extends outside the surface of the drum. The invention furthermore concerns a rotor for such an impact crusher.

**[0002]** Impact crushers or hammer mills have been known for many years for grinding different materials including corn. Thus they have been widely used in combination with transport blowers and/or suction ventilators that contribute to convey processed material out through the screen and possibly further via transport pipelines. Alternatively, further transport of processed material occurs by means of screw conveyors or conveyor belts disposed under an after container or so-called dome wherefrom dust-containing air is tapped from the top and discharged to the outside via a filter.

**[0003]** The impact crusher has thus been used for industrial production of feedstuffs by grinding corn and admixing additional materials. The processed and mixed product is usually conveyed further on to a pelletizing machine for making the feed in pellet form. It is by such an application that the present invention has appeared. However, the invention yields further advantages by application in other areas, as for example the crushing of ore.

**[0004]** The Danish feed production is 5,700,000 tons per year. It is estimated that almost all the production is ground in impact crushers. The grinding is an energy intensive process, and it is thus estimated that about 55,290,000 kWh are used annually which by the present electricity cost of DKK 0,45 per kWh corresponds to a total energy cost of DKK 24,880,500 per year.

**[0005]** Existing impact crushers are based on constructional principles developed in the USA in 1895 and which later on have been further developed by a number of European manufacturers, also including Danish manufacturers.

**[0006]** The product development in the area mostly concerned increased capacity (larger mills) and making more effective the grinding lines (screen before the mills for sifting off fine parts before the grinding etc.).

**[0007]** In the feedstuff industry, the impact crusher is one of the most energy consuming production machines. Depending on the degree of fineness, the energy consumption of the impact crusher may constitute up to 30% of the total energy consumption of the feedstuff plant.

**[0008]** The traditional rotor in an impact crusher is built up by a row of swingles extending in parallel with the axis of rotation, or which extend helically around the circumference of the rotor. The swingles are fastened pivotably to the drum which is built up from drum plates disposed at mutual distance, allowing fitting of the swingles between two succeeding plates.

**[0009]** Material introduced in the impact crusher has a tendency to be passed into the interspace between two plates during the processing. Due to the rotation of the rotor, this material may have long retention time in the impact crusher and be processed several times by the swingles. Hereby the material, or a part of the material, can be crushed to unnecessarily and/or undesirably small particle sizes. For example, well-defined particle sizes for animal feed are required for efficient absorption of nutrients from the feed.

**[0010]** Furthermore, a part of the supplied power by the repeated processing is deposited as heating of the processed material. This is unwanted from an energy view and because there is simultaneously the risk of detrimental oxidation of free fatty acids contained in the feed.

**[0011]** Furthermore, repeated processing will make the processed particle rounds, something which can make difficult a subsequent formation of pellets with good cohesion.

**[0012]** The material has a tendency of falling through the rotor toward the bottom of the impact crusher and leave the processing chamber via a relatively small part of the periphery at the bottom of the chamber. In practice, a large amount of the materials are sucked out through the screen due to the action of transport ventilators or suction ventilators. This causes that the processing chamber of the impact crusher cannot be utilised fully and thereby an optimal economy is not achieved.

**[0013]** In spite of the wide application, previously there has not been indicated an impact crusher relieving the above drawbacks.

**[0014]** It is the purpose of the present invention to indicate an impact crusher and a rotor for use in such a mill where the above drawbacks are relieved and where it is possible to reduce the energy consumption and simultaneously to produce a processed material with better properties with regard to an ensuing pelletizing and/or an ensuing nutritional value.

**[0015]** This is achieved according to the present invention with an impact crusher which is peculiar in that the recesses have side walls in the circumferential direction of the rotor where at least a part extends with largely radial orientation, and that every recess has a magnitude allowing free rotation of the swingle inside the recess without hitting the walls of the recess.

**[0016]** The rotor according to the invention is peculiar in that it comprises a closed drum in the space within the

swingles with recesses in its surface for accommodating the suspended end of the swingles, while the active ends of the swingles extend outside the surface of the drum.

**[0017]** It is a characteristic of the impact crusher that the quality of the processed product appears with uniform particle size and with very edged structure due to short retention time in the impact crusher.

**[0018]** Measurements and analyses have been made on the test-/prototype, showing an electricity saving of 23 -28 %, a uniformly ground product and no increase in the noise level.

**[0019]** By means of the used fillers, a uniform product distribution is attained in the action area of the swingles and a conveying along around the whole screen circumference, whereby the grinding energy is utilised optimally.

**[0020]** The new rotor is furthermore constructed so that the ventilation loss becomes the least possible which is also contributing to reducing the air demand.

**[0021]** The most significant advantage of the new closed rotor construction in which 4 swingles are used along the circumference in a plane perpendicular to the axis of rotation is that 4 primary grinding zones are achieved compared with 1 grinding zone in traditional rotor construction. This gives a better utilisation of the supplied energy.

**[0022]** The decisive advantage of the new impact crusher is thus the possibility of grinding a uniform product with a saving in the energy consumption. As it appears from the performed tests and measurements, these advantages are achieved.

**[0023]** As recesses have a side wall in the direction of circumference extending largely radially or, alternatively, with curvatures extending around a largely radial orientation, the material hit by such side walls will be mechanically flung out against the screen. By using the kinetic energy in the material there is achieved a saving compared with the energy used when the material in prior art impact crushers are sucked out by means of conveyor blowers and/or suction ventilators. By having between two and six swingles, preferably four, along the circumference in each plane perpendicular to the axis of rotation, a substantial increase of the active area of the screen, where material may pass out from the grinding chamber, is achieved. Hereby the retention time in the chamber is reduced. This implies that the swingles works on the material to a lesser degree which thereby may leave the grinding chamber with a more edged shape.

**[0024]** The side wall of the recesses will have different rotation depending on the rotational speed and the intended use of the impact crusher. With less diameter and greater rotational speed used by making animal feed it is preferred to have side walls extending largely radially. By impact crushers with large diameter and less rotational speed it is preferred that the side walls of the recesses are designed as indicated in claim 5. This has appeared to yield the best efficiency of the mill.

**[0025]** With an impact crusher as indicated in claim 2, there is established a single construction where the motor is constructed from a stack of plates, alternating support plates and fillers filling out the space between the support plates. Hereby the closed drum is formed in a simple way with the possibility of making the desired length from simple basic elements.

**[0026]** With respect to weight saving, the filling surfaces of the drum are formed by synthetic material as indicated in claim 3. For achieving further weight reduction, the rotor will preferably be hollow.

**[0027]** It is possible to use different number of swingles disposed in a plane perpendicular to the axis of rotation. Thus between two and six swingles are used. However, practical tests have shown that no appreciable improvement of the efficiency is achieved if more or less than four swingles are used.

**[0028]** By normal use, the inlet opening will be situated in an upward facing part of the screen surrounding the grinding chamber. Hereby, outlet openings may be formed around the remaining part of the circumference of the screen as the surface, where the material is thrown against the screen, will be conveyed round along the circumference of the screen as the recesses are rotated, and thereby the ejection of the material by the side walls will constantly circulate inside the grinding chamber.

**[0029]** The rotor will preferably be made in such a way that the suspended ends of the swingles are situated within the circumference covered by the closed drum, whereas the active ends of the swingles will extend outside the surface of the drum. Hereby, the active end of the swingles will extend out in an area where the material is forced to be in a cylindrical shell at the inner side of the screen. This will prevent the material from penetrating in behind the recesses at the inner of the drum and hereby reduce the risk of an increased retention time of the material in the impact crusher.

**[0030]** The invention will be explained more closely hereafter with reference to the accompanying schematic drawing, where:

| | |
|---|---|
| Fig. 1 | shows a first embodiment of an impact crusher according to the invention incorporated in a machine plant, |
| Fig. 2 | shows an alternative and preferred embodiment of a placing of the impact crusher according to the invention in a machine plant, |
| Figs. 3 and 4 | illustrates examples of prior art embodiments of impact crushers, |
| Fig. 5 | shows a drum for an impact crusher according to the invention, |
| Figs. 6 and 7 | illustrates partial views of the details in an impact crusher according to the invention, |

Figs. 8 and 9 illustrates two sectional views of an impact crusher according to the invention and an impact crusher according to prior art, respectively,

Fig. 10 shows a side view of a filler for an impact crusher according to the invention, and

Fig. 11 illustrates a further embodiment of a filler for an impact crusher according to the invention.

**[0031]** In the succeeding detailed description, simultaneous reference to several of the Figures of the drawing will be given. Furthermore, identical or corresponding elements will be designated with the same reference numbers, and no specific explanation will be given in connection with each single Figure.

**[0032]** Fig. 1 shows an impact crusher 1 according to the invention built up over a dome 2 where air and material pass down onto the underside of the impact crusher. Material is removed via a conveyor 3 and dust saturated air 4 is conducted via a nozzle filter 5 to the outside via transport blower 6.7 indicates an air intake at the top of the impact crusher, and 8 indicates a conveyor for introducing material at an opening in the top of the impact crusher. In the lower part of Fig. 1 is illustrated a view from above of the plant. From this appears that the impact crusher is oriented with a motor 9 driving the rotor which is oriented perpendicularly to the direction of flow of the dust saturated air 4 in the dome. This influences the properties of the efficiency of the plant.

**[0033]** It is preferred to arrange the plant with the impact crusher 1 according to the invention located as illustrated in Fig. 2. In this plant, the impact crusher is placed with the rotor extending in parallel with the flow direction of the dust saturated air 4. Hereby is achieved a construction where the direction of rotation of the impact crusher does not have any influence on the efficiency of the plant.

**[0034]** Fig. 3 illustrates a prior art impact crusher with an inlet opening at the top of a screen 11 where processed material 12 passes through. The rotor comprises swingles 13 that are pivotably suspended about a journal 14 fastened on support plates 15 which constitute the rotor of the impact crusher. The rotor rotates about a central journal 16. As it appears from Fig. 4, which illustrates a partly sectional view, there will be interspaces between succeeding support plates 15 into which the material may fall when led via the opening 10. The material is preferably introduced batch-wise but may also be introduced continually.

**[0035]** In Fig. 5 is illustrated a rotor 18 for an impact crusher according to the invention. The swingles 13 are pivotably suspended on support plates 15 by a pin 14. Swingles 13 are disposed on rows 19 in parallel with the shaft 20 for the rotor 18. Around the circumference is disposed four swingles 13 in each plane.

**[0036]** Between the support plates there are provided fillers 21 which are provided with recesses 22 opposite to each swingle 13. The recess 22 has an extension so that a swingle may freely pivot inside the formed recess. The fillers 21 thus closes the central part of the drum except within the area where the swingles are. It is noted that the recesses 22 may have less dimension that shown in Fig. 5 so that the size of the recesses largely corresponds to only accommodating the suspended ends 23 of the swingles 13 so that all of the active ends 24 of the swingles are largely outside the circumferential surface formed by the plates of the drum. With this construction, material can only be in the area outside the drum and within the screen, i.e. in active working area of the swingles 13 as indicated by 25 in Figs. 6 and 7. The rotor will rotate in the direction of rotation 26, and the material will be thrown against the inner side of the drum 11 and be thrown out when having a size which is less than the apertures of the screen. In Fig. 3 is illustrated how material passes at one side and partly through the inner of the drum for only leaving the impact crusher through the bottom. In Fig. 6 is illustrated how the material is distributed over a substantial part of the circumference and has the possibility of leaving the grinding chamber and a large part of the circumference of the screen.

**[0037]** The penetration of the material through the screen is assisted by its being flung out according to the tangential line 28 illustrated in Fig. 8. The tangential lines are largely perpendicular to side walls 29 in the recesses 22, the side walls 29 being located forward as seen in the direction 26 of rotation of the rotor. It may be said that opposite to each of the tangential ejection lines 28, an area corresponding to a so-called acceleration zone 30 from a traditional impact crusher occurs, as indicated in Fig. 9. Thus there will be a greater circumference which is utilised, and simultaneously the mechanical energy occurring by the action of the side walls 29 on the particles will contribute to increasing the efficiency of the penetration of the material.

**[0038]** From Fig. 8 appears that the support plates are made with four wings 31 between each of the cavities 22. These wings are preferably made with cavities 32. Also the central part 33 of the fillers will be provided with cavities 34 for reasons of saving weight.

**[0039]** In practice it has appeared advantageous to shape the fillers with two different shapes which are illustrated in Figs. 10 and 11, respectively. The embodiment illustrated in Fig. 10 shows the wings 31 formed with a curvature where at least the side wall 29 facing against the direction of rotation 26 has a lower part 35 at the bottom 36 of the recess curving in direction along the direction of rotation, and that the outer part 37 of the side wall has a curvature curving in direction against the direction 26 of rotation. This embodiment has, however, appeared particularly advantageous in connection with impact crushers used for making animal feed for pigs with particle sizes that have to be in the magnitude 1 mm or larger for reasons of nutrient absorption in the animals. In such a rotor, the rotational speed will be 1500 rpm and the diameter be about 850 mm, whereby a peripheral speed of about 82 m/s is achieved.

**[0040]** The alternative embodiment on filler 21 shown in Fig. 11 is a corresponding side wall 29, which is oriented largely radially, and is approximately straight except a curvature at the outer end 37 of the side wall 29. This embodiment belongs particularly to impact crushers used in making fish feed and pet feed where a very fine grinding of the product is to be established, for example with particle sizes down to under 850 micrometer. Such a crusher motor will have a rotational speed in the magnitude 2900 rpm and a diameter of about 400 mm. This will result in a peripheral speed of about 92 m/s. In practice, the shown embodiment has appeared to be suitable for such application of the impact crusher.

**[0041]** Specific embodiments of the impact crusher have been explained in the above. However, it will be possible to design this or the rotor of the impact crusher in other ways than specifically illustrated. Thus it will be possible to make the rotor as a closed cylindrical body with recesses provided for placing the swingles 13 as alternative to the recesses established by using fillers between the support plates. Only it is important that the rotor will appear as a closed unit which prevents material from flowing within the area that can be processed by the swingles.

**[0042]** Specific selections of material are indicated but other materials having required strength and low weight will also be suitable for use by making the rotor of the impact crusher.

## EXAMPLE

**[0043]** Schematic draft of the machine plant is shown in Fig. 1. By the measurements, the impact crusher was mounted with a diameter 3 mm densely perforated screen.

**[0044]** The impact crusher was driven by an electric motor with 315 kW power, voltage of 400 V, current of 545 A, cos. j of 0,87 and rotational speed of 1485 rpm.

**[0045]** The suction blower was also powered by an electric motor yielding 22 kW, voltage of 400 V, current of 41 A, cos. j of 0,86 and rotational speed of 1470 rpm.

DESCRIPTION OF MEASURING METHOD

**[0046]** The hopper of the impact crusher was filled with the described mixture of raw materials before the grinding was initiated. During the measurements, the following was registered:

Charge size

**[0047]** Charge size was determined by means of the weighing out scales under the raw material silos.

Time

**[0048]** The time was registered from the impact crusher starting to grind and until it stopped the grinding, more explicitly from the ammeter passing 150 A toward full load current until it passed the same level on the way to idling.

Current consumption

**[0049]** The current consumption of the impact crusher and the suction blower were registered on a tongs ammeter mounted in the fuse panel.

**[0050]** Two identical measurements were performed where 100 % pure Danish spring barley was ground. Barley lying in the hopper was supplied to the impact crusher over an automatic load control unit.

**[0051]** In the subsequent measurements, the same formulas as indicated under measurement 1 were used in subsequent measurements.

**Measurement 1 - impact crusher with traditional rotor**

**[0052]**

- Charge size 2000 kg
- Time 8 min.
- Voltage 400 V
- Current consumption, impact crusher motor 495 A
- Current consumption, ventilator motor 40 A

**[0053]** Calculation of power consumption

$$N = V3 \times u \times I \times \cos.\varphi/1000$$

Mill motor: 298.4 kW
Ventilator motor: 23.8 kW
TOTAL POWER CONSUMPTION 322.2 kW

**[0054]** Calculation of capacity (2000 x 60)/(1000 x 8): 15 t/h

| Calculation of specific electricity consumption | | |
|---|---|---|
| Grinding | 298.4 / 15: | 19.9 kWh/t |
| Suction | 23.8/15: | 1.6 kWh/t |
| TOTAL | 322.2/15 | 21.5 kWh/t |

**Measurement 2 - impact crusher with new rotor**

**[0055]**

- Charge size 2000 kg
- Time 7.25 min
- Voltage 400 V
- Current consumption, impact crusher motor 415 A
- Current consumption, ventilator motor 40 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 250.1 kW |
| Ventilator motor | 23.8 kW |
| TOTAL POWER CONSUMPTION | 273.9 kW |

**[0056]** Calculation of capacity 16.6 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 15.1 kWh/t |
| Suction | 1.4 kWh/t |
| TOTAL | 16.5 kWh/t |

**[0057]** By testing both rotors (the new and the traditional) with 100 % pure Danish barley in ground product, an increase in capacity of 1.6 t/h and a less total specific electricity consumption of 5 kWh/t were registered by using the new rotor.

**[0058]** In both test cases new screen and new swingles were used.

TEST RUNS WITH THE NEW ROTOR TYPE

**[0059]** In order to verify energy saving possibilities, tests have been run with directions of rotation of the impact crusher, air consumption and power measurements on the pig mixtures below.

**[0060]** Four identical measurements were performed where grinding was performed on a pig mixture consisting of:

| | | |
|---|---|---|
| 1375 kg | Danish spring barley | 55.0 % |
| 235.5 kg | wheat | 9.5 % |
| 250 kg | rape cakes | 10.0 % |
| 200 kg | soy meal | 8.0 % |
| 125 kg | wheat bran | 5.0 % |
| 37.5 kg | fish meal | 1.5 % |

(continued)

| | | |
|---|---|---|
| 50 kg | malt spires | 2.0 % |
| 2275 kg | mixture | 91.0% |
| 225 kg | fat, molasse, vitamins and minerals | 9.0 % |
| 2500 kg | charge size | 100.0 % |
| Note: 9 % of the mixture (225 kg), i.e. fat, molasse, vitamins and minerals, were supplied directly to hopper and mixer. | | |

**Measurement 1 - impact crusher with new rotor**

**[0061]** Direction of rotation - clockwise as seen in Fig. 1

- Amount of grind 2275 kg
- Time 4.77 min
- Voltage 400 V
- Current consumption, impact crusher motor 470 A
- Current consumption, ventilator motor, (air damper ½ open) 30 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 283.3 kW |
| Ventilator motor | 17.9 kW |
| TOTAL POWER CONSUMPTION | 301.2 kW |

**[0062]** Calculation of capacity 28.6 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 9.9 kWh/t |
| Suction | 0.6 kWh/t |
| TOTAL | 10.5 kWh/t |

**Measurement 2 - impact crusher with new rotor**

**[0063]** Direction of rotation - clockwise as seen in Fig. 1

- Amount of grind 2275 kg
- Time 4.72 min
- Voltage 400 V
- Current consumption, impact crusher motor 470 A
- Current consumption, ventilator motor, (air damper fully open) 40 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 283.3 kW |
| Ventilator motor | 23.8 kW |
| TOTAL POWER CONSUMPTION | 307.1 kW |

**[0064]** Calculation of capacity 28.9 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 9.8 kWh/t |
| Suction | 0.8 kWh/t |

(continued)

| Calculation of specific electricity consumption | |
|---|---|
| TOTAL | 10.6 kWh/t |

**Measurement 3 - impact crusher with new rotor**

**[0065]** Direction of rotation - counterclockwise cf. Fig. 1

- Amount of grind 2275 kg
- Time 4.47 min
- Voltage 400 V
- Current consumption, impact crusher motor 470 A
- Current consumption, ventilator motor, (air damper ½ open) 30 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 283.3 kW |
| Ventilator motor | 17.9 kW |
| TOTAL POWER CONSUMPTION | 301.2 kW |

**[0066]** Calculation of capacity 30.5 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 9.3 kWh/t |
| Suction | 0.6 kWh/t |
| Total | 9.9 kWh/t |

**Measurement 4 - impact crusher with new rotor**

**[0067]** Direction of rotation - counterclockwise, cf. Fig. 1

- Amount of grind 2275 kg
- Time 4.38 min
- Voltage 400 V
- Current consumption, impact crusher motor 470 A
- Current consumption, ventilator motor, (air damper fully open) 40 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 283. 3 kW |
| Ventilator motor | 23.8 kW |
| TOTAL POWER CONSUMPTION | 307.1 kW |

**[0068]** Calculation of capacity 31.1 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 9.1 kWh/t |
| Suction | 0.8 kWh/t |
| TOTAL | 9.9 kWh/t |

MEASUREMENT WITH 75 % AIR AMOUNT (AIR DAMPER HALF OPEN)

**[0069]** It appears from the measurements that by 75 % amount of air, the specific electricity consumption is unchanged.

**[0070]** The results show a clear tendency to the direction of rotation of the impact crusher according to the invention having great influence on the capacity of the grinding. By changed direction of rotation, a capacity difference of 2.5 t/h is seen. This difference in capacity is probably due to changed air flow in the impact crusher due to the placement of the nozzle filter.

**[0071]** As it may be seen from Figure 1, the placing of the nozzle filter is not ideal. The preferred arrangement of the plant is shown in Figure 2.

**[0072]** Tests are showing that too great amount of air increases the wear on the end plates. Correct distribution of the air passage in the impact crusher is of decisive importance for an optimal economy.

TEST RUN WITH THE TRADITIONAL ROTOR TYPE

**[0073]** The purpose of this test run is to compare the traditional rotor type with the new rotor type by grinding pig mixtures.

| A pig mixture was ground, consisting of: | |
|---|---|
| 975 kg Danish spring barley | 39 % |
| 475 kg soy meal | 19 % |
| 125 kg wheat bran | 5 % |
| 125 kg oats | 5 % |
| 50 kg beet pellets | 2 % |
| 25 kg fish meal | 1 % |
| 1775 kg mixture | 71 % |
| 475 kg wheat | 19 % |
| 250 kg fat, molasse, vitamins and minerals | 10 % |
| 2500 kg charge size | 100 % |
| Note: 19 % wheat (475 kg) were supplied to the roller mill and the rest, i.e. 250 kg fat, molasse, vitamins and minerals, were supplied directly to hopper and mixer. | |

**Measurement 5 - impact crusher with traditional rotor**

**[0074]**

- Amount of grind 1775 kg
- Time 4.42 min
- Voltage 400 V
- Current consumption, impact crusher motor 480 A
- Current consumption, ventilator motor 40 A

| Calculation of power consumption | |
|---|---|
| Mill motor | 289.3 kW |
| Ventilator motor | 23.8 kW |
| TOTAL POWER CONSUMPTION | 313.1 kW |

**[0075]** Calculation of capacity 24.1 t/h

| Calculation of specific electricity consumption | |
|---|---|
| Grinding | 12.0 kWh/t |
| Suction | 1.0 kWh/t |

(continued)

| Calculation of specific electricity consumption | |
|---|---|
| Total | 13.0 kWh/t |

**[0076]** With basis in the previously mentioned measurements (measurement 1 - measurement 4) and the above measurement, an estimated net energy saving of 23 - 28 % may be expected in using the impact crusher according to the invention.

PRODUCT STRUCTURE

**[0077]** The sieve analysis shows that the particles leave the grinding chamber as soon as the desired fineness is attained, something which has positive influence on the pellet quality and the friction at the pressing rollers.

| SIEVE ANALYSIS FOR THE NEW ROTOR TYPE | |
|---|---|
| Product | Danish spring barley - newly harvested |
| Water content | 16% |
| Screen mesh | Diameter 3 mm densely perforated |

| Sieve | Residue |
|---|---|
| 1.0 mm | 24% |
| 0.7 mm | 23% |
| 0.62 mm | 15% |
| 0.4 mm | 18% |
| below | 20 % |

| SIEVE ANALYSIS FOR THE TRADITIONAL ROTOR TYPE | |
|---|---|
| Product | Danish spring barley - newly harvested |
| Water content | 16% |
| Screen mesh | Diameter 3 mm densely perforated |

| Sieve | Residue |
|---|---|
| 1.0 mm | 25% |
| 0.7 mm | 24 % |
| 0.62 mm | 13 % |
| 0.4 mm | 14 % |
| below | 24 % |

**Claims**

1. An impact crusher with a rotor provided with several rows of swingles along its length, the swingles extending perpendicularly to the rotational axis of the crusher, and the rotor being disposed inside a largely cylindrical screen having an elongate opening for inserting material and through which processed material leaves the crusher, where the rotor comprises a closed drum in the space within the swingles with recesses in its surface for accommodating the suspended ends of the swingles, while the active ends of the swingles extends outside the surface of the drum, **characterised in that** the recesses have side walls in the circumferential direction of the rotor where at least a part extends with largely radial orientation, and that every recess has a magnitude allowing free rotation of the swingle inside the recess without hitting the walls of the recess.

2. An impact crusher according to claim 1, **characterised in that** the rotor comprises swingles suspended pivotably at a peripheral edge on support plates which extend perpendicularly to the rotational axis, and that between the support plates there are disposed fillers having a thickness corresponding to the distance between the support surfaces and which at the periphery have recesses in a number and with position corresponding to the swingles on an adjacent support plate.

3. An impact crusher according to claim 1 or 2, **characterised in that** at least the closed drum of the rotor is made of a synthetic material, preferably PA6 GUSS, NATUR, with a reinforcing structure of steel.

4. An impact crusher according to any preceding claim, **characterised in that** between 2 and 6 swingles, preferably 4 swingles, are disposed along the circumference in a plane perpendicular to the axis of rotation.

5. An impact crusher according to any preceding claim, **characterised in that** at least the side walls of the recesses, which are directed in the direction of rotation, are curved, that a lower part of the side wall has a curvature in direction along the direction of rotation, and that an outer part of the side wall has a curvature in direction against the direction of rotation.

6. An impact crusher according to any preceding claim, **characterised in that** the rotor is hollow for reasons of weight saving.

7. An impact crusher according to any preceding claim, **characterised in that** the axis of rotation extends largely horizontally, and that the inlet opening is located at the upward facing part of the screen.

8. A rotor for an impact crusher according to any preceding claim, **characterised in that** it comprises a closed drum in the space within the swingles with recesses in its surface for accommodating the suspended end of the swingles, while the active ends of the swingles extends outside the surface of the drum.

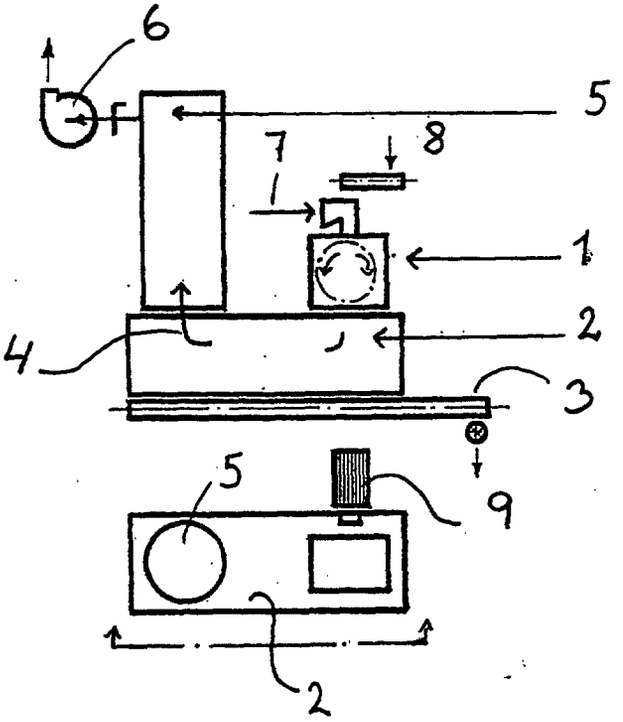


Fig 1

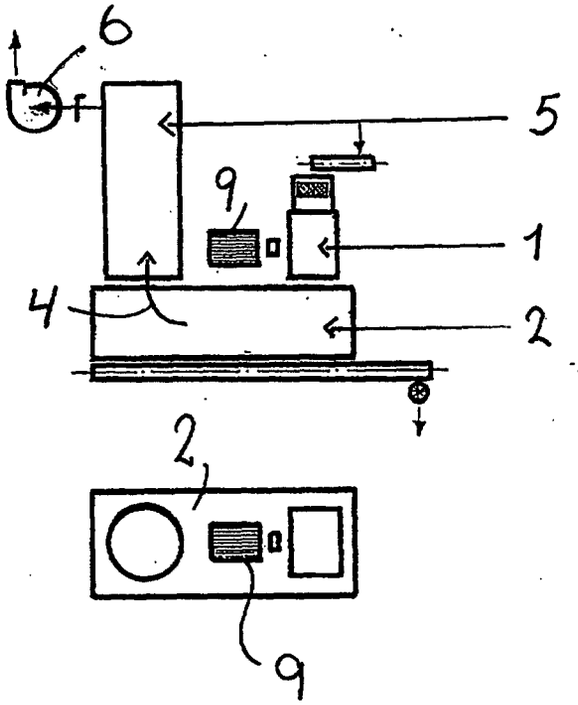


Fig 2

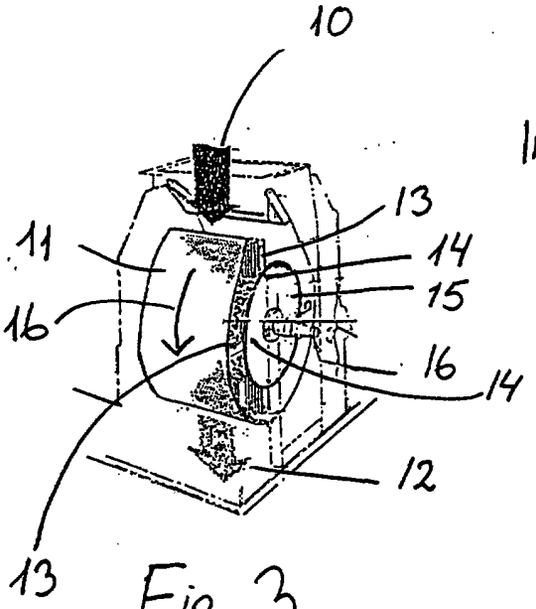


Fig 3

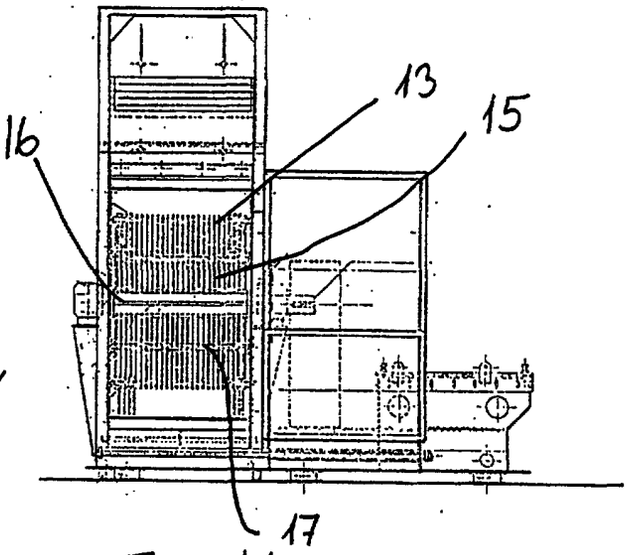


Fig 4

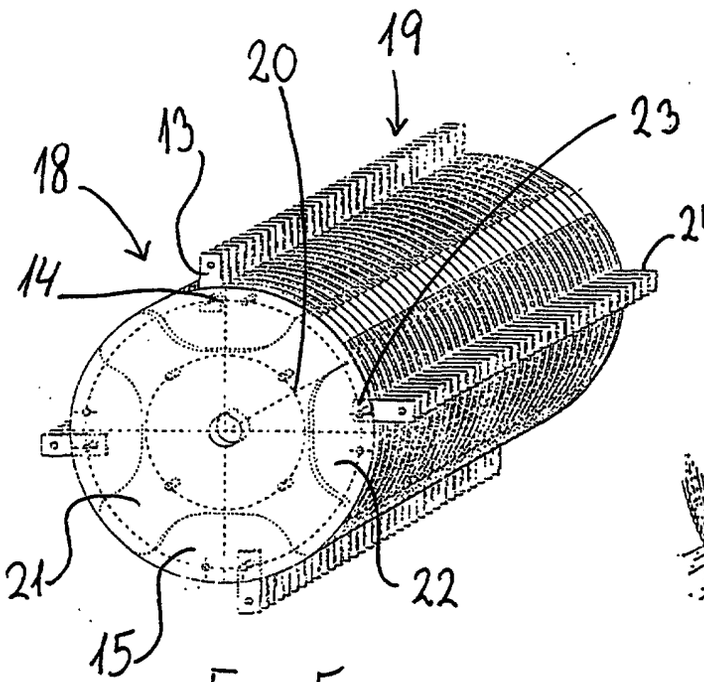


Fig 5

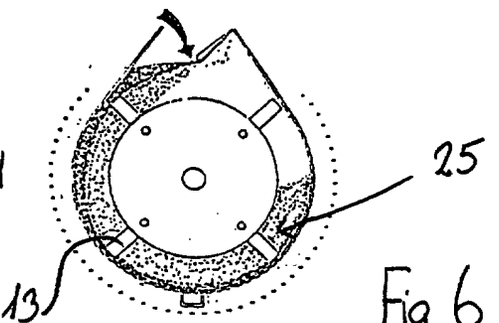


Fig 6

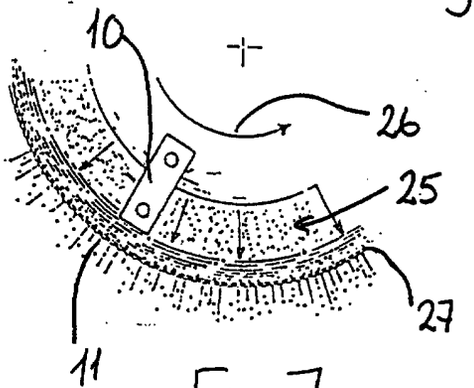


Fig 7

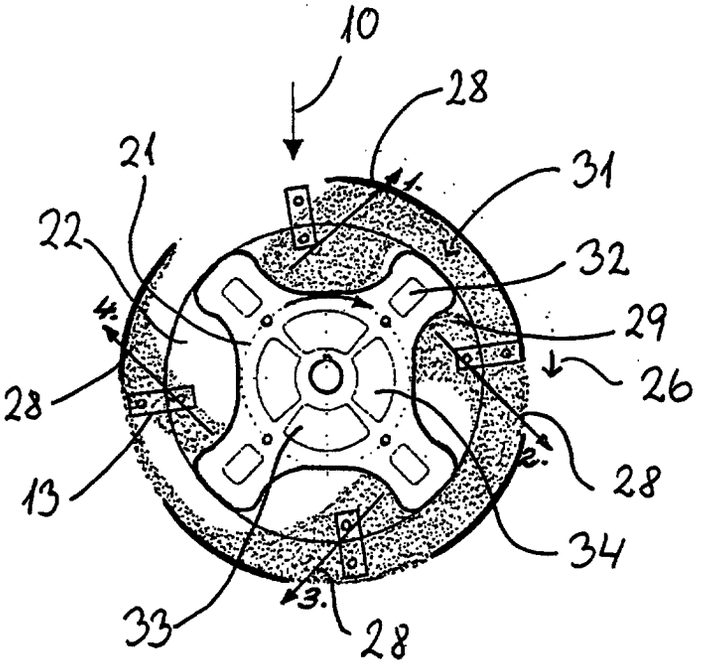


Fig 8

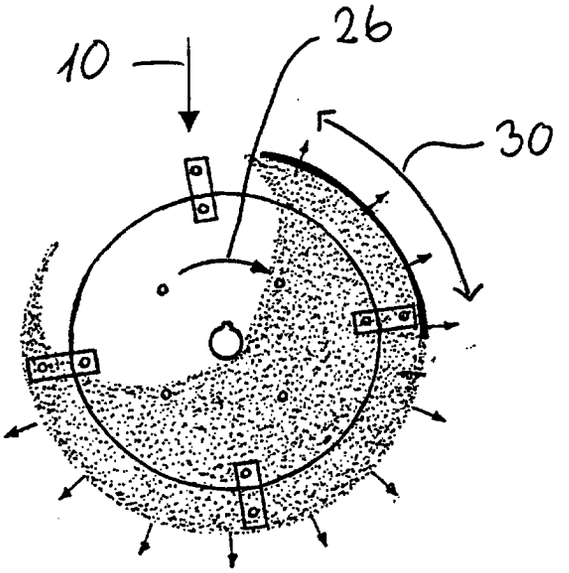


Fig 9

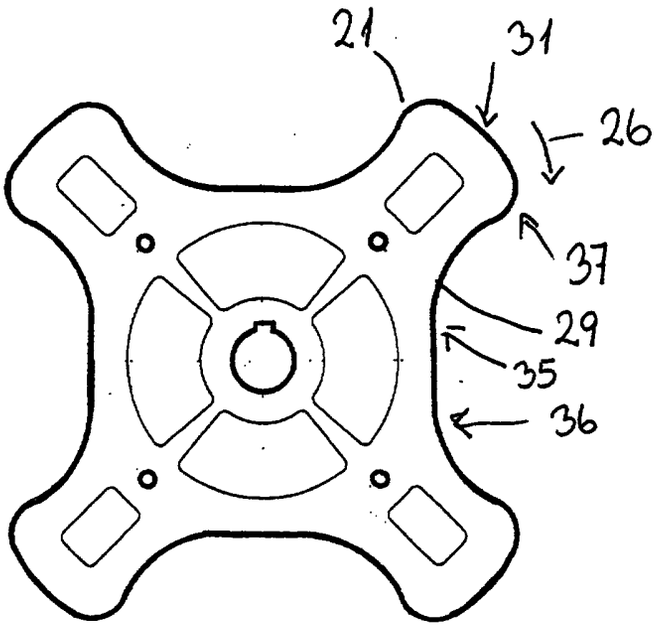


Fig 10

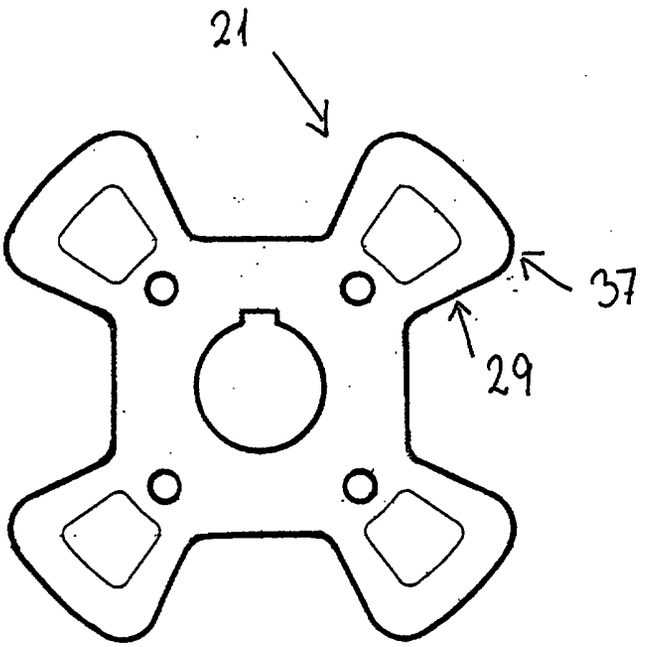


Fig 11

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 01 10 0927

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| Place of search | Date of completion of the search | Examiner |
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| THE HAGUE | 6 April 2001 | Verdonck, J |

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