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(54) Benævnelse: **UDSTYR TIL BRYDNING OG TØRRING AF PLASTFILMAFFALD TIL GENBRUG**

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DESCRIPTION

Scope of the invention

[0001] This invention falls within the area of equipment for plastic recycling, more specifically, this invention concerns an equipment that performs the breaking/disintegrating/ decompacting and drying of the plastic submitted to washing and compacting, more specifically, to an equipment joinable to a compacting equipment, for breaking and drying of plastic film waste for recycling after the washing process. These stages are part of the plastic film recycling process.

Context of the invention

[0002] With increasing awareness of the environmental problems that result from the use of plastics, and the impossibility of, in a short period of time, replacing the products manufactured in this material by others that are equally durable and with equivalent costs, its recycling is increasingly the option chosen to process plastics that are no longer useful in the role they were performing.

[0003] The facilities to recycle plastic and the equipment that enables this recycling were thus born.

[0004] A recycling system is defined as a facility consisting of a set of devices that are serially connected and that, having independent functions, interact with each other and enable the complete processing of waste until a product that can be reused as raw material is obtained.

[0005] This process usually consists of the following phases:

1 - Grinding
2 - Washing or decontamination
3 - Drying
4 - Granulation or pelletizing

Grinding

[0006] In this phase of the process, the material is reduced to a size that enables the following phases to be carried out. Depending on the materials to be processed, this phase may be interleaved with washes until the material is the size and state of cleanliness that enable it to be moved on to the next phase.

Washing or decontamination

[0007] In this phase, the goal is to separate the material from the contaminants that accompany it, be they soil (in agricultural films or others), remnants of various products (in packaging), paper, glues or even incompatible plastic materials. The devices used in this stage vary depending on the materials to be processed and may act alone or jointly to obtain the best result.

Drying

[0008] The goal is for the material, after this operation, to present a level of humidity between 2% and 5%.

[0009] The grinded and washed material carries with it considerable amounts of water and, despite being separated in the transport worms that make the connection between the system's various devices, and that are endowed with perforated plate bottoms to facilitate this separation, excess water must be removed so the material can be processed, in the next phase, by the extruder, granulator or pelletizer. This operation is performed by high-rotation centrifuges in perforated plate tanks, enabling the outflow of liquids and other impurities that are separated in the centrifugation process. In some materials, such as film, it is necessary to use more than one centrifuge and to operate them serially to obtain the desired result.

[0010] Another method used for drying uses heat sources, removing moisture from the material by evaporation. This process is, however, extremely expensive, since it requires large amounts of energy to generate the necessary heat.

[0011] A third method consists of compressing the material in equipment suitable for this purpose, with the excess water being removed by compacting the material. An example of one of these devices can be found at https://www.compactor-runi.com/shop/machines/runi-sk370 and in figure 4 of this patent application.

[0012] The material, after this operation, is deposited in bigbags (industrial bags made with flexible and resistant material to transport products in bulk), transported to storage silos or sent directly to the extruder that will carry out its granulation or pelletizing.

Granulation or pelletizing

[0013] This operation completes the recycling cycle by providing material with a level of purity that enables it to be reused in the production of a plethora of goods.

THE SOLUTION

[0014] In the cases where the water is removed by compacting the material, it leaves the drying equipment as a clump/aggregated/compacted.

[0015] Taking into account that the purpose of all this processing is the granulation or pelletizing of the material, it becomes necessary to break/disintegrate/decompact the material, since the equipment that performs the granulation of the plastic requires the material to be loose.

[0016] One of the existing solutions is to throw the clumps vertically, so that when they hit the ground, they disintegrate.

[0017] The equipment of this invention enables solving this problem, through the coupling of the compacting machine to a device that disintegrates, separates and feeds the material, and that additionally takes advantage of the air flow necessary for the disintegration and separation to promote a final reduction of the humidity, so that it falls within the ideal values, that is, that it presents a level of humidity between 2% and 5%.

[0018] The invention is an equipment for breaking and drying plastic waste to recycle according to claim 1, a use according to claim 8 and a process for breaking and drying plastic waste according to claim 9.

Background to the invention

[0019] Some documents were found that mention equipment for disintegrating/breaking/decompacting material, focusing on soil, especially for agricultural soil.

[0020] In plastics, but not specifically for film plastic, some documents were found that present equipment for disintegrating/decompacting. However, these documents concern equipment for disintegrating/decompacting material arriving at factories from the collection points for materials to be recycled. This equipment is not designed for breaking/disintegrating/decompacting plastic film. This equipment is not designed to break. Examples of this equipment can be found at: https://www.eggersmann-recyclingtechnology.com/en/brt-hartner/products/feed-hopper -dosing-hopper-with-decompactor-brt-hartner-dc/ or at https://www.eggersmann-recyclingtechnology.com/en/brt-hartner/products/bale-breaker-brt-hartner-bb/.

[0021] No equipment was found to carry out the breaking/ disintegrating/decompacting of plastic film waste after it has gone through washing and compacting in a plastic recycling process.

Advantages of the invention

[0022] Compared to the solutions mentioned above, the method presented in this invention and implemented by the equipment described in this document, i.e., the compression of the material to remove excess water, carried out in a device suitable for this purpose, with this stage being complemented by another, carried out in the equipment of this invention, which breaks/disintegrates/decompacts the material and promotes an additional drying, presents several advantages over the other methods already known.

- It enables a continuous operation, replacing several devices used in the conventional plastic drying processes during its recycling;
- It increases productivity compared to the conventional processes;
- It reduces consumption by up to 75% when compared to other technologies used;
- It reduces the noise and vibrations inherent to the process;
- It eliminates fines (material with very small granulometry);
- It feeds equipment downstream of the recycling process in a direct, continuous and stable way, without the need for intermediate silos.

Brief description of the figures

[0023] These and other characteristics can be easily understood using the attached drawings, which are to be considered as mere examples and in no way restrictive of the scope of the invention. In the drawings, and for illustrative purposes, the measurements of some of the elements may be exaggerated and not drawn to scale. The absolute and relative dimensions do not correspond to the real ratios for the embodiment of the invention.

[0024] In a preferential embodiment:

Figure 1 presents a view of the invention's equipment.

Figure 2 shows a cross-sectional view of the invention's equipment.

Figure 3 shows a view of the integration of the compacting equipment with the invention's equipment.

Figure 4 shows a view of the compacting machine.

Figure 5 shows a view of the disintegrator.

Figures 6a and 6b show two embodiments of the rotating blade.

Figure 7 shows a view of the conveyor.

Figure 8 shows a view of the integration of the conveyor with the ventilator.

Figure 9 shows a view of the ventilator.

Figure 10 shows a view of the ventilator where its interior can be seen.

Figure 11 shows a view of the ventilator where the various components inside it and the transmission can be seen.

[0025] The elements and components of the equipment are marked in the figures:

1 -
Intake hopper

2 -
Breaker
2.1 - Rotating blade
2.1.1 - Protrusion
2.1.1.1 - Lateral protrusions
2.1.1.2 - Central protrusion
2.2 - Breaker engine

3 -
Discharge hopper

4 -
Dosing feeder
4.1 - Worm screw
4.2 - Support frame
4.3 - Roller bearing
4.4 - Gearmotor

5 -
Ventilator
5.1 - Ventilator inlet port
5.2 - Ventilation grilles
5.3 - Ventilator outlet port
5.4 - Turbine
5.5 - Fan blades
5.6 - Transmission
5.7 - Ventilator motor

C -

Compacting machine
C.1 - Outlet port of the compacting machine
C.2 - dosing feeder inlet

Detailed description of the invention

[0026] The application of the principles described herein is not limited to the specific embodiments presented. The principles described herein can be used with any plastic film compression equipment to extract excess water that arises from the material washing stage. This stage is part of the plastic recycling process.

[0027] Additionally, although some of the presented embodiments incorporate multiple new features, these features can be independent and do not all need to be used together in a single embodiment.

[0028] Throughout the text, "material" means plastic film waste in the state in which it is found at any stage of the recycling process.

[0029] With reference to the figures, the invention concerns equipment that performs the breaking and drying of the plastic film, which is in the recycling process, after having been submitted to washing and compacting.

[0030] This equipment operates in three stages:

1st - Breaking/disintegration/decompacting

2nd - Separation and feeding

3rd - Drying and transport

[0031] In the disintegration stage, the plastic film waste coming out of the compacting machine (C) enters the intake hopper (1) which has a parallelepiped shape, with the face facing the compacting machine (C) open, inside which the rotating blade (2.1) of the breaker (2), which is set in motion by the breaker engine (2.2) and which has a specific geometry adapted to the dimensions of the compacting machine (C).

[0032] The specific geometry of the rotating blade (2.1) depends on the size of the outlet port of the compacting machine (C.1) for the plastic film clumps.

[0033] The rotating blade (2.1) has a substantially parallelepiped shape which in an

embodiment incorporates at least one protrusion (2.1.1) on the face facing the compacting machine (C) .

[0034] In a first embodiment (Figure 6a) the rotating blade (2.1) has three protrusions, being two lateral protrusions (2.1.1.1) and one central protrusion (2.1.1.2). The lateral protrusions (2.1.1.1) have a substantially rectangular triangular prismatic shape and the central projection (2.1.1.2) has a substantially acutangular triangular prismatic shape. In this embodiment, the outer face of the lateral protrusions (2.1.1.1) is substantially coplanar with the outer face of the rotating blade (2.1).

[0035] In a second embodiment (Figure 6b) the rotating blade (2.1) has three protrusions, being two lateral protrusions (2.1.1.1) and one central protrusion (2.1.1.2). The lateral protrusions (2.1.1.1) have a substantially prismatic pentagonal oblique convex shape and the central protrusion (2.1.1.2) a substantially triangular prismatic shape. In this embodiment, the outer lateral face of the lateral protrusions (2.1.1.1) is substantially coplanar with the outer lateral face of the rotating blade (2.1) and the oblique face of the lateral protrusions (2.1.1.1) is adjacent to the outer lateral face of the lateral protrusions (2.1.1.1).

[0036] After the plastic has been properly disintegrated by the rotating blade (2.1), the separation and feeding phase begins. This phase begins with the plastic falling, which, due to gravity, drops into the discharge hopper (3) where a dosing feeder (4) that incorporates a worm screw (4.1) separates it further. This dosing feeder (4), in addition to the worm screw (4.1), consists of a support frame (4.2) to which a roller bearing (4.3) and a gearmotor (4.4) are attached. For reasons of stability and operability, the support frame (4.2) is fixed inside the compacting machine (C), and the passage of the dosing feeder (4) is carried out through the dosing feeder inlet (C.2). This stage, in addition to disintegrating and separating the plastic, enhances the correct and stable feeding for the 3rd stage, since the worm screw (4.1) of the dosing feeder (4) carries the correct amount to the ventilator (5).

[0037] The 3rd stage, during which drying and transport take place, is carried out in the ventilator (5). The material guided by the dosing feeder (4) enters the ventilator (5) through the ventilator inlet port (5.1) by means of the air flow caused by the movement of the turbine (5.4), which is put into operation by the ventilator motor (5.7) that transmits the movement to the transmission (5.6), which in turn is transmitted to the turbine (5.4) and is conducted to the fan blades (5.5) that promote its final separation, being then sent to the ventilator outlet port (5.3) and then fed to the equipment downstream of the disintegrator and dryer equipment, so that the plastic waste, properly cut, washed and separated is granulated or pelletized.

[0038] The drying of the material is carried out in the material's path between the ventilator inlet port (5.1) and the ventilator outlet port (5.3), solely due to the circulation of air inside the ventilator (5).

[0039] The ventilation grilles (5.2) are of vital importance for the entire process, as they avoid stopping the equipment in the event that the ventilator inlet port (5.1) becomes blocked.

Sometimes the rotating blade (2.1) does not disintegrate the material and the material falls into the discharge hopper (3) and therefore into the dosing feeder (4), still in a clump. This clump is guided by the worm screw (4.1) into the ventilator inlet port (5.1), blocking it due to its size. With the ventilator inlet port (5.1) blocked, the air flow circulating inside the equipment falls to values close to zero, causing the pressure inside the equipment to drop, which leads to clogging of the pipe that routes the material to the ventilator outlet port (5.3). Since the ventilation grilles (5.2) are placed in an area next to ventilator inlet port (5.1), therefore placed in an area next to the clump's location, the entry of air through the ventilation grilles (5.2) allows pressure to continue to exist inside the ventilator (5), preventing it from stopping.

[0040] This clump will eventually be disintegrated due to the continuous motion of the worm screw (4.1) and of the fan blades (5.5).

Patentkrav

1. Udstyr til brydning og tørring af plastfilmaffald til genbrug, hvor det omfatter:
- en tilførselstragt (1),
- en bryder (2), der omfatter en roterende klinge (2.1),
- en udledningstragt (3),
- en doseringsføder (4), der omfatter en snekkeskrue (4.1), og
- en ventilator (5), der omfatter en ventilatorindgangsport (5.1), ventilationsriste (5.2), en ventilatorudgangsport (5.3), en turbine (5.4), ventilatorklinger (5.5), en transmission (5.6) og en ventilatormotor (5.7),
hvor udstyret er konfigureret således, at plastfilmen i et nedbrydningstrin kommer ind i tilførselstragten (1), og således, at, efter plastikken er blevet ordentligt nedbrudt af den roterende klinge (2.1), begynder separations- og tilførselsfasen med, at plastikken på grund af tyngdekraften falder ned i udledningstragten (3), hvor doseringsføderen (4) adskiller den yderligere, og således, at det 3. trin, hvor tørring og transport finder sted, udføres ind i ventilatoren (5), hvor materialet, der ledes af doseringsføderen (4), kommer ind i ventilatoren (5) gennem ventilatorindgangsporten (5.1) ved hjælp af luftstrømmen, der forårsages af bevægelsen af turbinen (5.4), der sættes i drift af ventilatormotoren (5.7), der overfører bevægelsen til transmissionen (5.6), der igen overføres til turbinen (5.4), og ledes til ventilatorklingerne (5.5), der fremmer dets endelige adskillelse, idet det sendes til ventilatorudgangsporten (5.3).

2. Udstyr ifølge krav 1, hvor bryderen (2) yderligere omfatter en brydermotor (2.2).

3. Udstyr ifølge et hvilket som helst af de foregående krav, hvor doseringsføderen (4) yderligere omfatter en støtteramme (4.2), et rulleleje (4.3) og en gearmotor (4.4).

4. Udstyr ifølge et hvilket som helst af de foregående krav, hvor den roterende klinge (2.1) har en i det væsentlige parallelepipedisk form.

5. Udstyr ifølge et hvilket som helst af de foregående krav, hvor den roterende klinge (2.1) omfatter mindst ét fremspring (2.1.1) på den flade, der vender mod komprimeringsmaskinen (C).

6. Udstyr ifølge krav 5, hvor den roterende klinge (2.1) har tre fremspring, der er to sidefremspring (2.1.1.1) og et midterfremspring (2.1.1.2), idet sidefremspringene (2.1.1.1) har en i det væsentlige rektangulær trekantet prismeform, og midterfremspringet (2.1.1.2) har en i det væsentlige akutangulær trekantet prismeform, idet sidefremspringenes (2.1.1.1) ydre flade er i det væsentlige koplanar med den roterende klinges (2.1) ydre flade.

7. Udstyr ifølge krav 5, hvor den roterende klinge (2.1) har tre fremspring, der er to sidefremspring (2.1.1.1) og et midterfremspring (2.1.1.2), idet sidefremspringene (2.1.1.1) har en i det væsentlige femkantet skrå konveks prismeform, og midterfremspringet (2.1.1.2) har en i det væsentlige trekantet prismeform, idet den ydre sideflade af sidefremspringene (2.1.1.1) er i det væsentlige koplanar med den roterende klinges (2.1) ydre sideflade, og sidefremspringenes (2.1.1.1) skrå flade støder op til sidefremspringenes (2.1.1.1) ydre sideflade.

8. Anvendelse af udstyret ifølge krav 1 i en proces til genbrug af plastfilmaffald.

9. Fremgangsmåde til brydning og tørring af plastfilmaffald ved anvendelse af udstyret ifølge krav 1, hvor følgende trin er indbefattet:
a) Brydningstrin
- Plastfilmaffaldsklumper indføres i udstyret gennem en tilførselstragt (1),
- Bryderens (2) roterende klinge (2.1), der roterer inden i tilførselstragten (1), udfører brydning/nedbrydning/dekompression af plastfilmaffaldsklumperne,
b) Adskillelses- og dosistilførselstrin
- Plastfilmaffaldet falder ned i en udledningstragt (3),

- en doseringsføder (4), der er integreret i udledningstragten (3) og indeholder en snekkeskrue (4.1), udfører en yderligere adskillelse,
- Plastfilmaffaldet ledes til ventilatoren (5),

c) Tørrings- og transporttrin

- Plastfilmaffald, der ledes af doseringsføderen (4), kommer ind i ventilatoren (5) gennem ventilatorens indgangsport (5.1) på grund af luftstrømmen, der forårsages af bevægelse af turbinen (5.4), der drives af ventilatormotoren (5.7), der overfører bevægelse til transmissionen (5.6), der igen overføres til turbinen (5.4),
- Ventilationsgitre (5.2), der er placeret i et område ved siden af ventilatorindgangsporten (5.1), garanterer trykket inden i ventilatoren (5) i tilfælde af blokering af ventilatorindgangsporten (5.1),
- Plastfilmaffaldet ledes til ventilatorklingerne (5.5), der fremmer dets endelige adskillelse, og ledes derefter til ventilatorudgangsporten (5.3),
- Plastfilmaffaldet ledes til udstyret nedstrøms for disintegrator- og tørreudstyret.

DRAWINGS

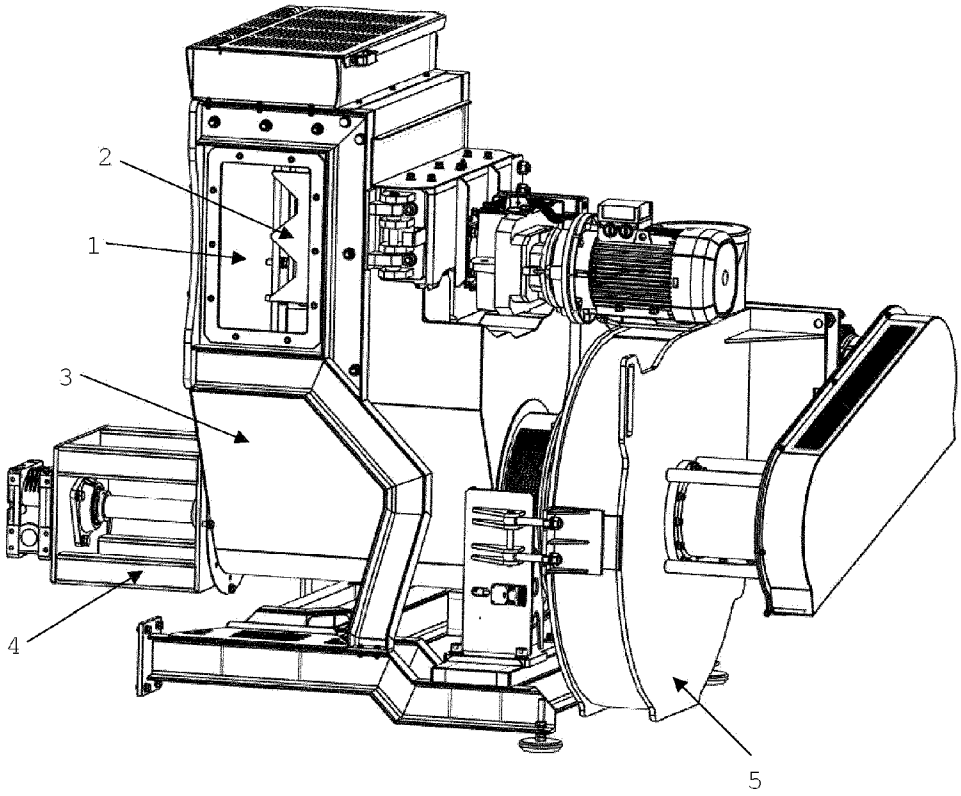

Figure 1

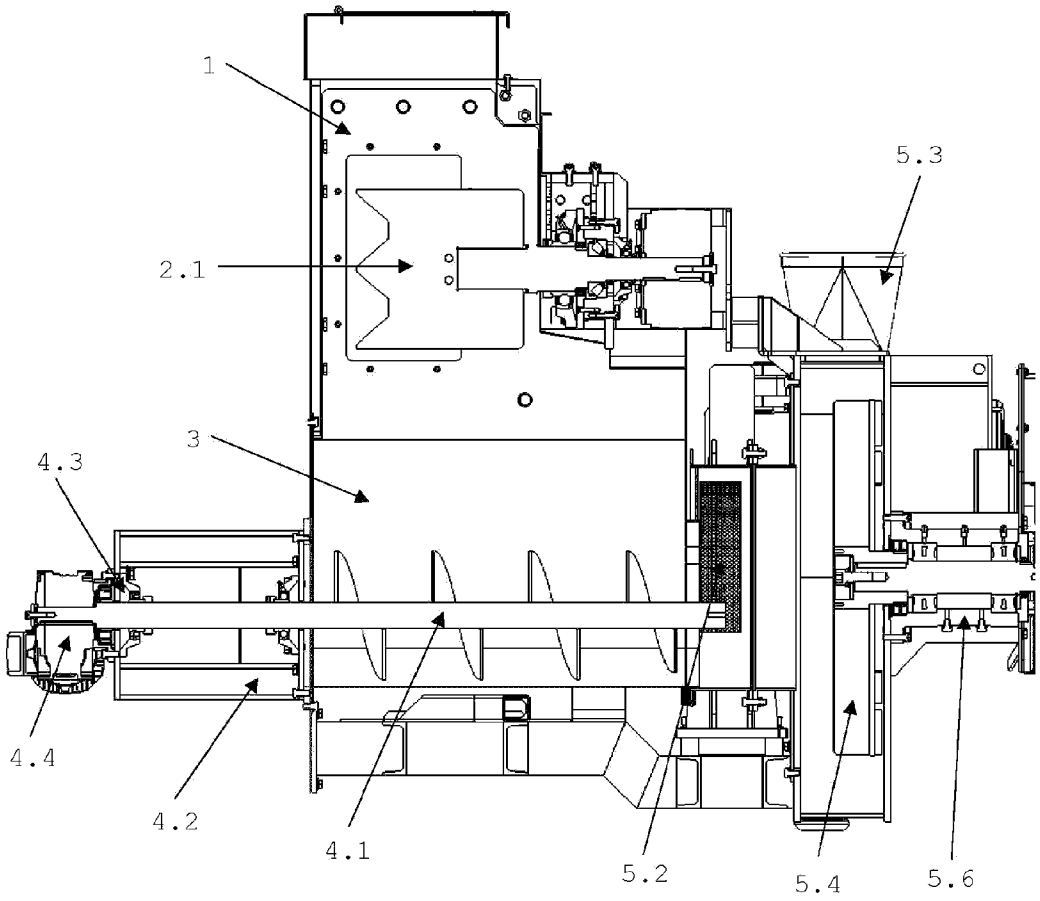

Figure 2

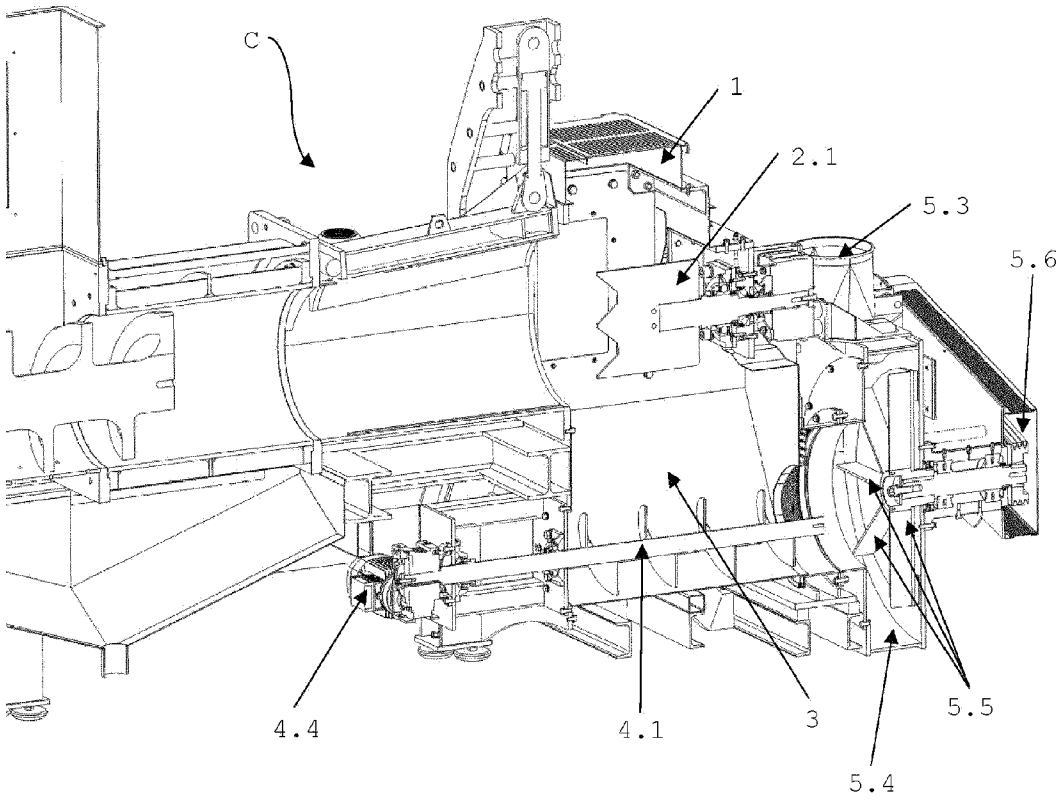

Figure 3

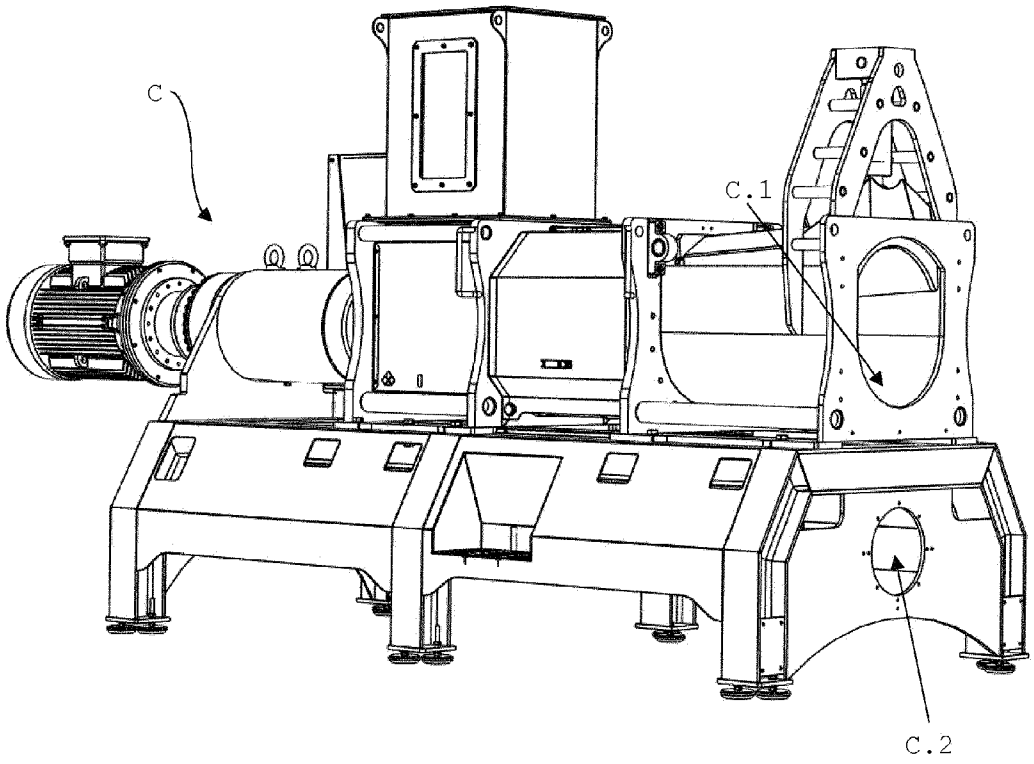

Figure 4

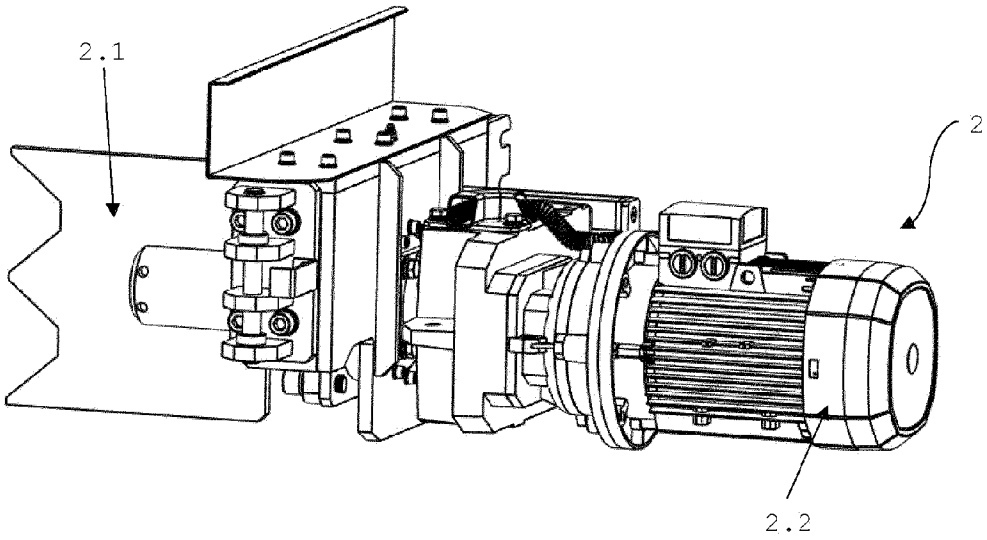

Figure 5

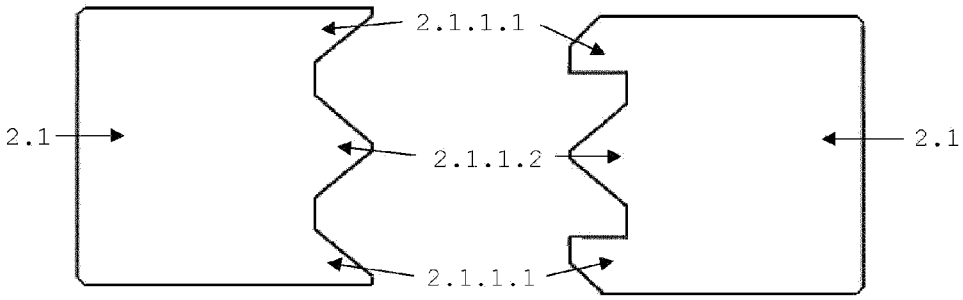

Figure 6a Figure 6b

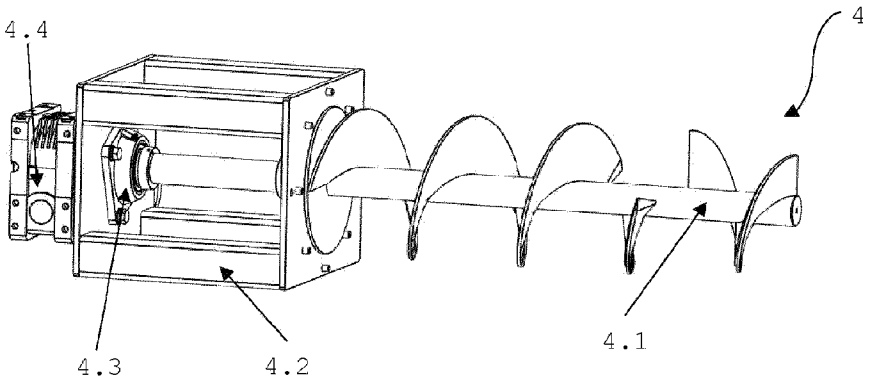

Figure 7

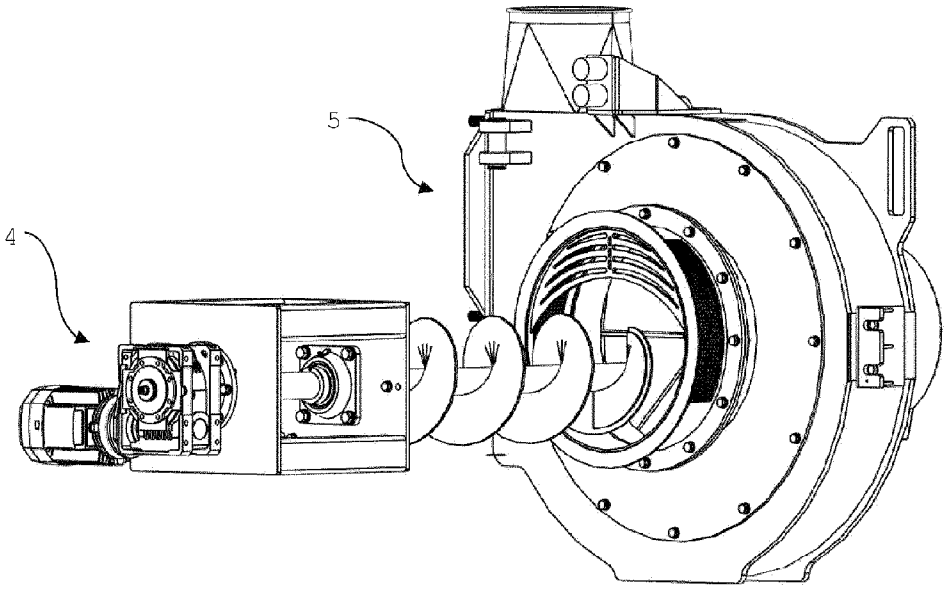

Figure 8

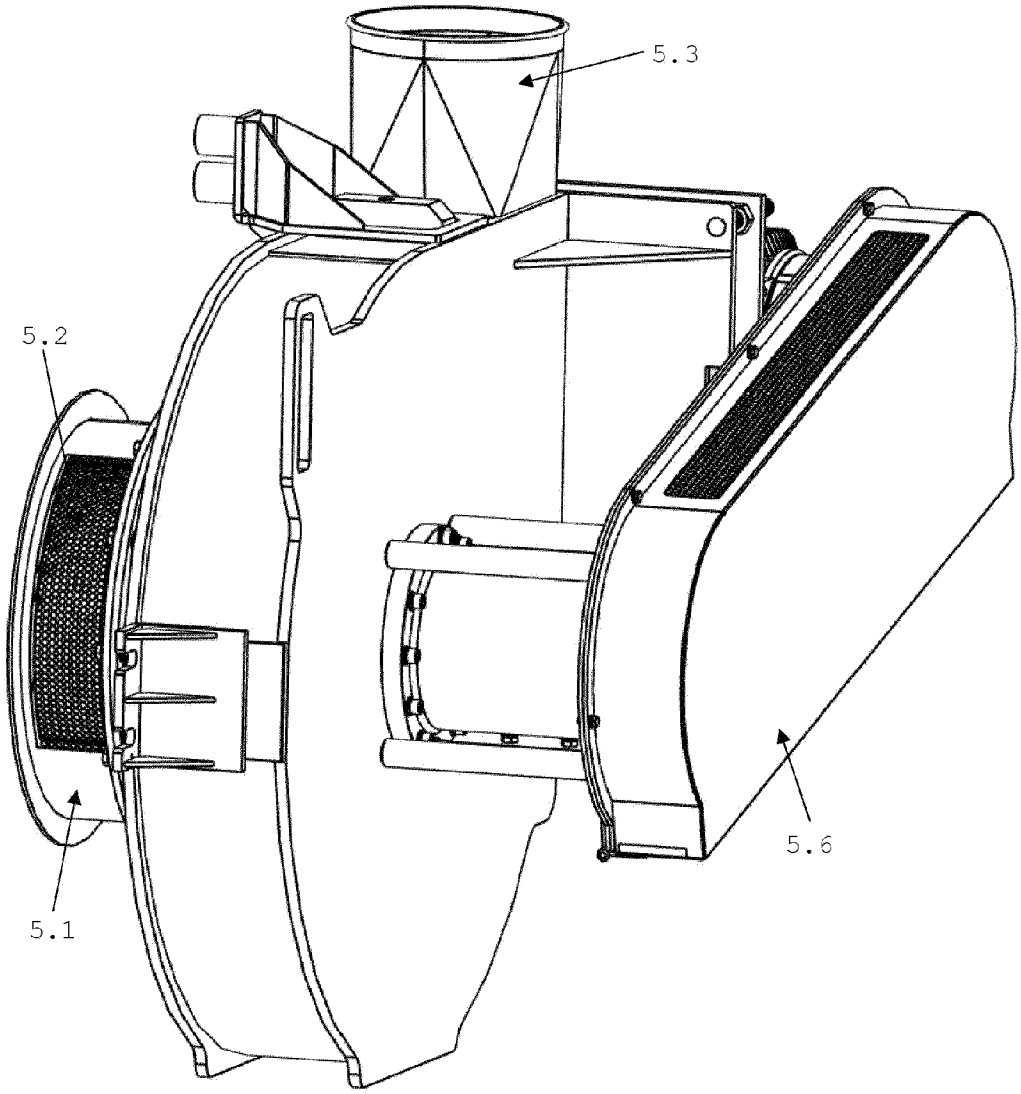

Figure 9

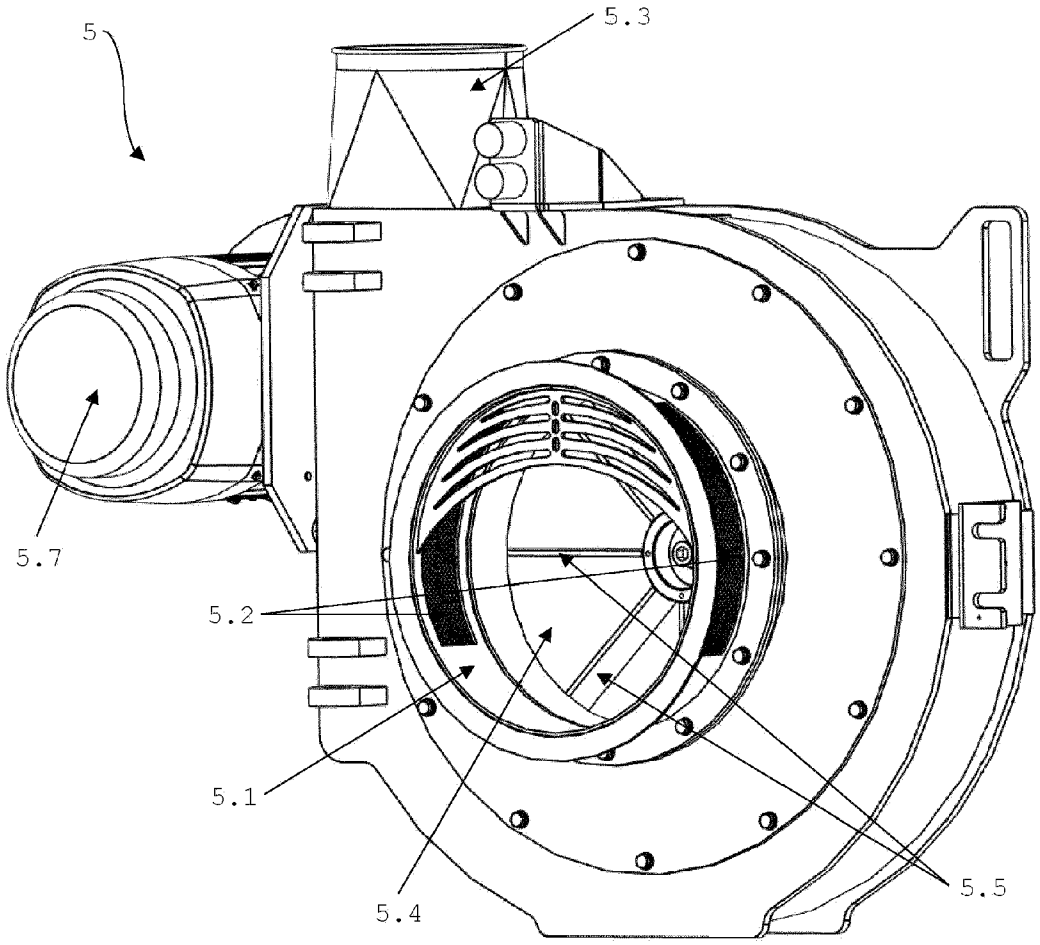

Figure 10

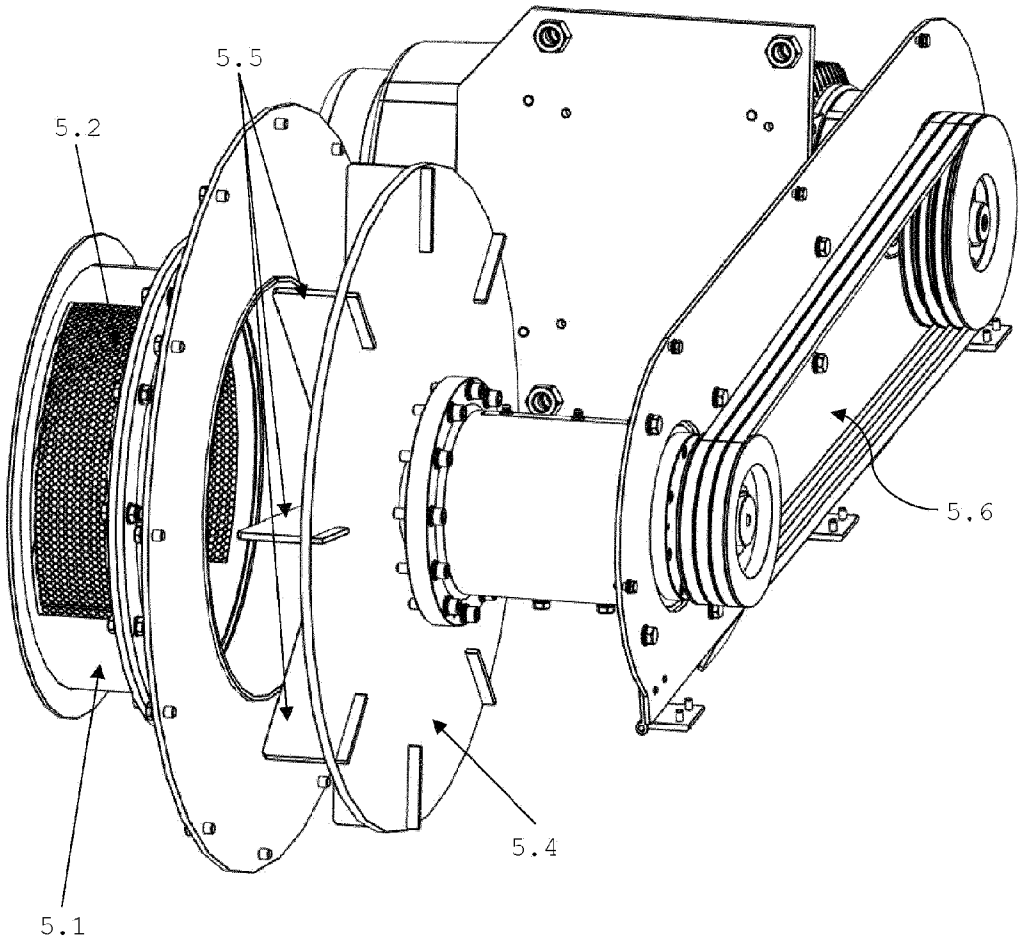

Figure 11