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	(72) Inventor: Benthum, Martinus Antonius Julius 5481 VN Schijndel (NL)
(30) Priority: 07.05.2007 NL 2000633	(74) Representative: van Westenbrugge, Andries et al Nederlandsch Octrooibureau Postbus 29720 2502 LS Den Haag (NL)

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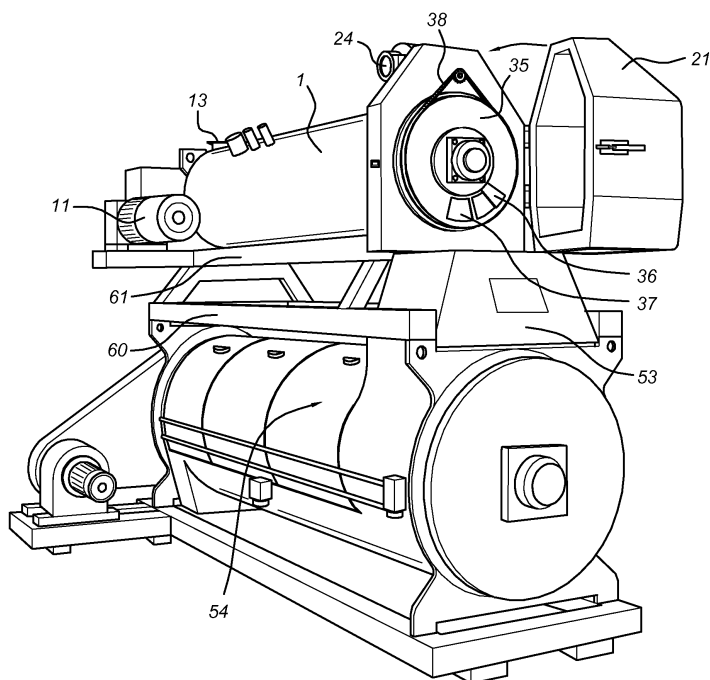
Mixing device

(57)

Mixing device (1) provided with an inlet (13), a conveyor member for conveying a substance fed in via the inlet in a conveying direction, a heating element for heating the substance, a motor (11) for driving the conveyor member, an outlet which is situated at a distance from the mixing element in the conveying direction, which outlet can be closed off by means of a movable closure element (35) which is connected to a drive device (24) for closing and opening the outlet by means of the closure element, and a temperature sensor situated near the out-

let, in which the temperature sensor, the motor and the drive device are connected to a control unit which is designed to close the closure element at a predetermined temperature and to rotate the motor of the conveyor member in a transport direction of rotation until a predetermined pressure has built up, and then to reverse the direction of rotation of the motor at least once until a predetermined set temperature value is reached, upon which the control device moves the closure element, opens the outlet and the motor rotates in the transport direction of rotation.

Fig 5



Description

[0001] The invention relates to a mixing device provided with an inlet, a conveyor member for conveying a substance fed in via the inlet in a conveying direction, a heating element for heating the substance, a motor for driving the conveyor member, an outlet which is situated at a distance from the mixing element in the conveying direction, which outlet can be closed off by means of a movable closure element which is connected to a drive unit for closing and opening the outlet by means of the closure element, and a temperature sensor situated near the outlet.

[0002] In a mixing device or mixer of this type, various substances are fed in, such as granular and/or pulverulent ingredients for, for example, animal feed or a foodstuff, a fertilizer, etc. in order to be mixed and to be heated with steam. The mixed and heated substance can then be fed to a pelletizing press via a conditioning unit, in which it remains for a predetermined residence time until, for example, pasteurization has been achieved, where the mixed substance is extruded to form pellets by a mould.

[0003] When starting up the mixing device, the latter is relatively cold and the first product which is fed in at the standard throughput does not reach the desired temperature. Consequently, it is necessary to initially remove a predetermined amount of substance, which may be as much as a few hundred kilos at a filling level of the mixing device of approximately 200 kg, from the mixing device, resulting in significant production losses. If the first product of a production run has not reached the desired temperature and has to be re-used, a relatively complex bypass conveying device is required which connects the discharge of the mixing device to the inlet thereof. As a result thereof, the mixing device requires significantly more space.

[0004] In addition, it has been found that a closure element of the outlet of known mixing devices in the form of a slide which can be moved in a closing manner over an outlet which is situated in the sleeve surface of a cylindrical housing of the mixing device often leads to leakage.

[0005] It is therefore an object of the present invention to provide a mixing device in which loss of product is prevented. In particular, it is an object of the invention to provide a mixing device by means of which the entire initial product contents of the mixing device can be used, even during start-up of a new production run. It is a further object of the invention to provide a mixing device which can be closed in a leak-proof manner. Finally, it is an object of the invention to provide a mixing device which, together with a further processing device, can be combined to form a compact unit.

[0006] To this end, the invention provides a mixing device having a temperature sensor which is situated near the outlet, in which the temperature sensor, the motor and the drive device are connected to a control unit which

is designed to close the closure element at a predetermined temperature and to rotate the motor of the conveyor member in a transport direction of rotation until a predetermined pressure has built up, and then to reverse the direction of rotation of the motor at least once until a predetermined set temperature valve is reached, upon which the control device moves the closure element and opens the outlet and the motor rotates in the transport direction of rotation.

[0007] When a production run is started, the outlet initially remains closed. By feeding in new material, the pressure in the mixing device rises and the resistance on the conveying device increases. As a result, the power (the current) through the motor of the conveying device increases. When a threshold pressure value or current value of the motor current is achieved, the supply of product is stopped and the direction of rotation of the motor is reversed so that the substance in the mixing device is displaced in the direction of the supply. This process is repeated until the temperature sensor near the outlet measures the desired product temperature, for example 70°C- 80°C. As soon as this desired set temperature value is reached, the outlet is opened, the supply of product is resumed and the conveying device is driven continuously in the direction of the outlet so that the product discharged from the mixing device is uniformly heated.

[0008] As the first product of a production run now also has the correct processing temperature, all of the product can be used effectively and loss of product is minimized. As the first product also has the correct temperature, a complex bypass system at the outlet of the mixing device can be omitted, so that the latter can be of compact design. As a result of the omission of a bypass system, the homogeneity of the product is increased, and the risk of undesired mixing with other products when changing the product composition is reduced. In addition, it is no longer necessary to clean the bypass conveying device. Due to the fact that loss of product no longer occurs, it is not necessary to remove and store discharged product, so that the hygiene of the production is improved.

[0009] In one embodiment, the mixing device comprises a substantially cylindrical housing having a sleeve surface and two end faces, in which the conveyor member extends along a longitudinal axle of the cylindrical housing and in which the outlet is situated in an end face. As a result, it is possible to achieve a leak-free sealing which can withstand the relatively high buildup of pressure which occurs while conveying product with the outlet closed. By positioning the outlet in the end face, no product residues remain in the area of the outlet, so that undesirable cooling of the product is prevented. Furthermore, the outlet in the end face is readily accessible so that the outlet is easy to clean.

[0010] The outlet may comprise a slot in the form of a segment of a circle in the end face, in which the closure element comprises a plate which is rotatable about the longitudinal axle and which bears against the end face in a sealing manner, which plate comprises a slot in the

form of a segment of a circle which can be rotated over the slot of the outlet. Due to this rotatable closure element, a metered opening of the outlet is achieved, in which the degree of opening can be accurately set.

[0011] Preferably, a further processing device is connected to the mixing device according to the invention, with an inlet of the further processing device being directly connected to the outlet of the mixing device. If this further processing device is of cylindrical design, it is positioned with a longitudinal axle parallel to the mixing device, with a supply which is connected to the discharge of the mixing device via a vertical connecting duct. This results in a stacked configuration, with the cylindrical mixing device and the cylindrical further processing device being connected together via a frame to form a compact assembly covering a relatively small floor area.

[0012] Some embodiments of a mixing device according to the invention will be explained in more detail with reference to the attached drawing, in which:

Fig. 1 shows a longitudinal section through a mixing device according to the invention, having a closable outlet in an end face,

Fig. 2 shows a top view of the mixing device from Fig. 1,

Fig. 3 shows a diagrammatic representation of an alternative mixing device having a closable outlet in a sleeve surface,

Figs. 4a and 4b show a front view and a lateral cross section, respectively, of a closure element according to the invention,

Fig. 5 shows an assembly of a conditioning device and a mixing device according to the invention placed on top of the latter, and

Fig. 6 shows a diagrammatic illustration of a supply device, a mixing device according to the invention, a conditioning device and a pelletizing press.

[0013] Fig. 1 shows a mixing device 1 having a cylindrical housing 2 with a sleeve 3 and end faces 5,6. Next to the longitudinal axle 7 of the mixing device, an axle 8 is placed with mixing elements 9, 10 attached thereto. The axle 8 is driven by a motor 11 via a drive belt 12. The mixing elements or blades 9,10 convey a substance P_i , such as flour or granular product which is fed to the interior of the housing 2 via an inlet 13, in a conveying direction T to an outlet 17 in the end face 6. Via the outlet, the heated and mixed substance P_o is discharged from the housing 2.

[0014] Via an opening 18 in the sleeve 3, steam S_i is supplied to the interior of the mixing device 1 at a pressure of, for example, 2 bar, in order to heat the contents thereof to, for example, 80°C. The housing is in communication with the surroundings by means of an opening 19. The heated and mixed substance P_o is discharged via the outlet 17 and through a substantially vertical duct 20 in a protective cover 21 to an adjoining processing station.

[0015] The outlet 17 can be closed by a rotatable plate

23 comprising an opening, which plate 23 is rotated about the longitudinal axle 7 by means of a drive motor 24. The drive motor 24 of the closure plate 23 and the motor 11 for driving the axle 8 are connected to a programmable control unit 27. The control unit 27 is also connected to a temperature sensor 28 situated near the outlet 17. If the temperature of the substance measured by the sensor 28 is below a predetermined value, as is the case when the mixing device is filled with substance P_i for the first time, the control unit 27 drives the drive motor 24 in such a manner that the outlet 17 is closed off by the closure plate 23. When the filling level of the mixing device consequently rises, the resistance which the axle 8 experiences and the current through the motor 11 increase. The input P_i is subsequently interrupted and when a predetermined value of the current through the motor 11 is reached, the control unit 27 reverses the direction of rotation of the motor 11. This process is repeated until the temperature sensor 28 indicates the desired set temperature value. In this case, the motor 11 is continuously driven in the conveying direction T by the control unit 27, the closure plate 23 is rotated to the open position and a continuous supply P_i and a continuous output P_o are achieved.

[0016] Fig. 3 shows an alternative embodiment of a mixing device according to the invention, in which identical parts are denoted by the same reference numerals which have been used for similar parts in Fig. 1. The product temperature in the mixing device 1 can also be increased using electrical heating elements or, alternatively, heat exchangers instead of using steam. In this case, the outlet 17 is situated in the sleeve surface 3 and can be closed by a slide 30 which is displaced by the electrical or hydraulic drive unit 31, controlled by the control unit 27.

[0017] Fig. 4a shows a front view of the end face 6 of the mixing device 1, comprising a front plate 35 having a slot 36 in the form of a segment of circle. A rear plate 40 which is positioned against the plate 35 is likewise provided with a slot 37 in the form of a segment of a circle, which is indicated by a broken line. The front plate 35 can be rotated about the longitudinal axle 7 by means of the motor 24 and a drive chain 38 which runs around the front plate 35 in such a manner that the opening 36 coincides with the opening 37 in the rear plate 40. The contact surfaces between the front and rear plates 35,40 are preferably made of bronze, at least on one side, in order to achieve a self-lubricating effect and to prevent wear.

[0018] Fig. 5 shows a mixing device 1 which is positioned on top of a cylindrical conditioning device using a frame 60, 61, in which the opening 37 is situated above an inlet 53 of the conditioning device 54, so that the mixed substance can be supplied to the conditioning device 54 directly from the mixing device 1. This results in a compact assembly of conditioning device 54 and mixing device 1 which takes up a relatively small floor area.

[0019] Fig. 6 shows a pelletizing station 50 which comprises a mixing device 1 according to the invention and

the conditioning device 54 connected thereto. A supply device 51 for the supply of a pulverulent or granular substance is connected to the inlet 13 of the mixing device 1 by an outlet 51. The connecting duct 20 of the mixing device 1, which is connected to the outlet 17, is directly connected to the inlet 53 of the conditioning device 54, without the use of a bypass system. The substance remains in the conditioning device 54 during a predetermined time at a predetermined temperature, for example for pasteurization, after which it is supplied, via outlet 55, to a pelletizing press 56, where the substance is kneaded by rotating rollers and extruded by a mould to form pellets.

Claims

1. Mixing device provided with an inlet (13), a conveyor member (8,9,10) for conveying a substance fed in via the inlet (13) in a conveying direction (T), a heating element (18) for heating the substance, a motor (11) for driving the conveyor member (8,9,10), an outlet (17,20) which is situated at a distance from the mixing element in the conveying direction, which outlet can be closed off by means of a movable closure element (23,30,35) which is connected to a drive device (24,38) for closing and opening the outlet by means of the closure element, and a temperature sensor (28) situated near the outlet, in which the temperature sensor (28), the motor (11) and the drive device (24,38) are connected to a control unit (27) which is designed to close the closure element (23,30,35) at a predetermined temperature and to rotate the motor (11) of the conveyor member (8,9,10) in a transport direction of rotation until a predetermined pressure has built up, and then to reverse the direction of rotation of the motor at least once until a predetermined set temperature value is reached, upon which the control device moves the closure element (23,30,35), opens the outlet (17,20) and the motor (11) rotates in the transport direction of rotation.
2. Mixing device (1) according to Claim 1, in which the mixing device comprises a substantially cylindrical housing (2) having a sleeve (3) and two end faces (5,6), in which the conveyor member (8,9,10) extends along a longitudinal axle (7) of the cylindrical housing and in which the outlet (17,20) is situated in an end face (6).
3. Mixing device (1) according to Claim 2, in which the outlet (17,20) comprises a slot (37) in the form of a segment of a circle in the end face, and in which the closure element comprises a plate (23,35) which is rotatable about the longitudinal axle and which bears against the end face (6,40) in a sealing manner, which plate (23,35) comprises a slot (36) in the form of a segment of a circle which can be rotated over

the slot (37) of the outlet (17,20).

4. Assembly of a mixing device (1) according to one of the preceding claims and a processing device (54) connected to the mixing device, in which an inlet (53) of the processing device is directly connected to the outlet (17,20) of the mixing device (1).
5. Assembly according to Claim 4 referring back to Claim 2, in which the processing device (54) is cylindrical and is positioned with a longitudinal axle parallel to the mixing device (1), with a supply (53) which is connected to the discharge (17,20) of the mixing device (1) via a substantially vertical connecting duct (20).
6. Mixing device (1) provided with a substantially cylindrical housing (2) having a sleeve (3) and two end faces (5,6), having an inlet (13), a conveyor member (8,9,10) arranged along a longitudinal axle (7) of the cylindrical housing for conveying a substance supplied via the inlet in a conveying direction (T), a motor (11) for driving the conveyor member, an outlet (17,20) which is situated at a distance from the inlet in the longitudinal direction, which outlet comprises a slot (37) in the form of a segment of a circle which is provided in the end face (6) and which can be closed off by means of a movable closure element which is connected to a drive unit (24) for closing or opening the outlet, which closure element comprises a plate (35) which is rotatable about the longitudinal axle (7) and which bears against the end face (6) in a sealing manner, which plate comprises a slot (36) in the form of a segment of a circle which can be rotated over the slot of the outlet.
7. Assembly of a mixing device (1) according to Claim 6 and a processing device (54) which is connected to the mixing device, in which an inlet (53) of the processing device (54) is directly connected to the outlet (17,20) of the mixing device.
8. Assembly according to Claim 7, in which the processing device (54) is cylindrical and is positioned with a longitudinal axle parallel to the mixing device, with a supply (53) which is connected to the discharge (17,20) of the mixing device via a substantially vertical connecting duct (20).

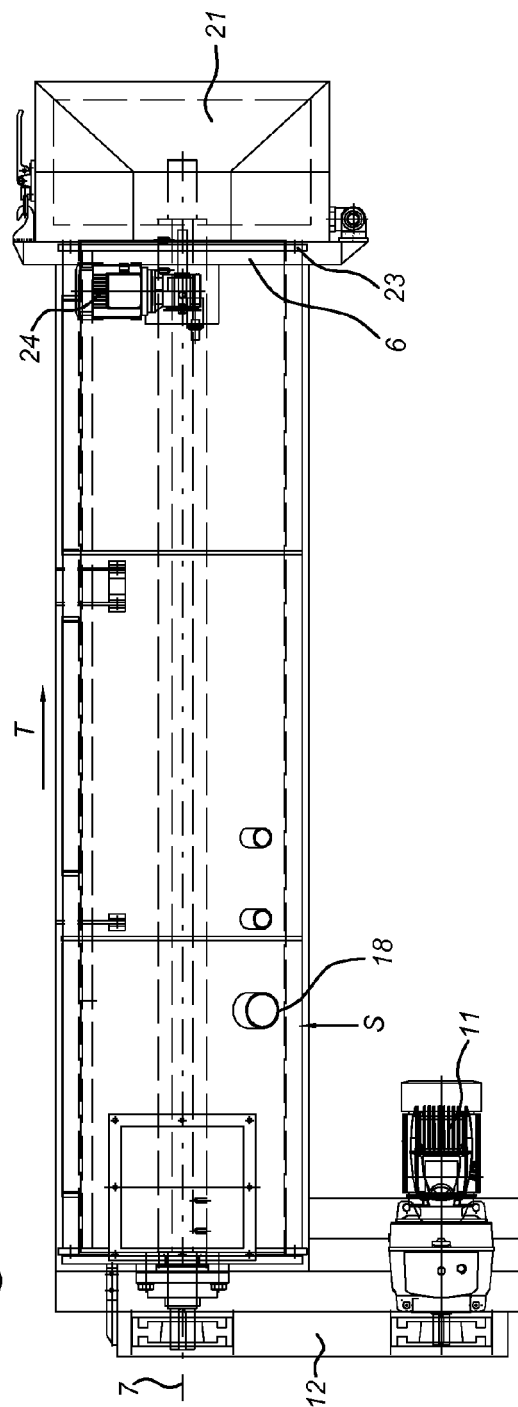
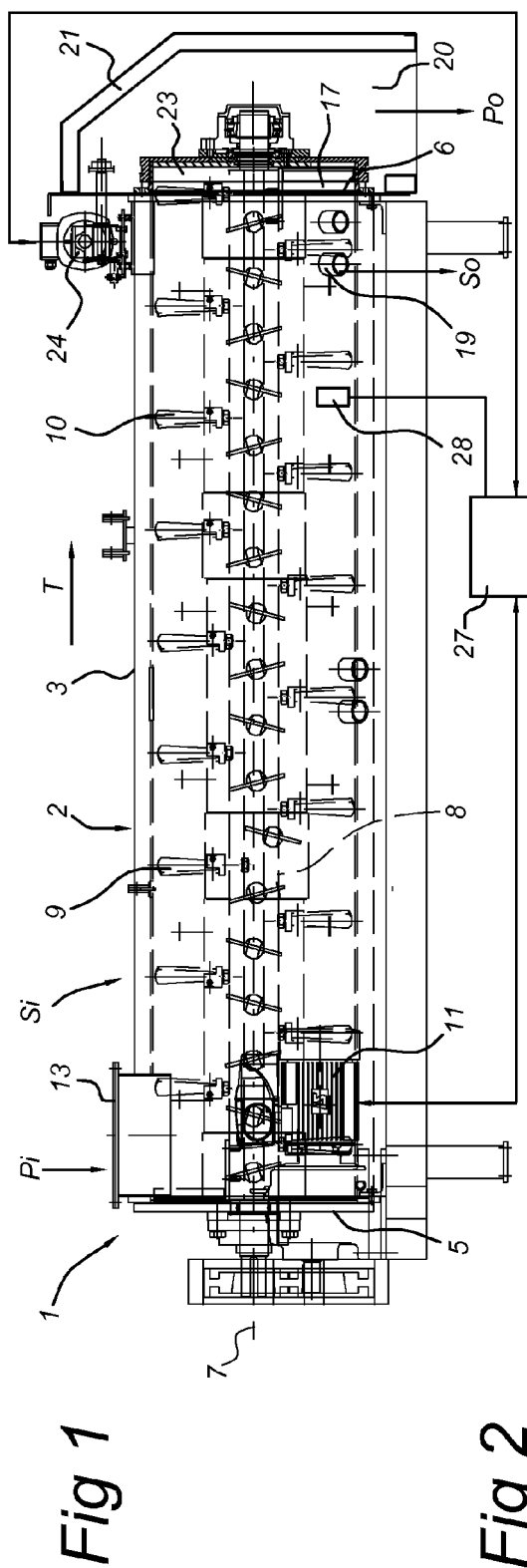


Fig 3

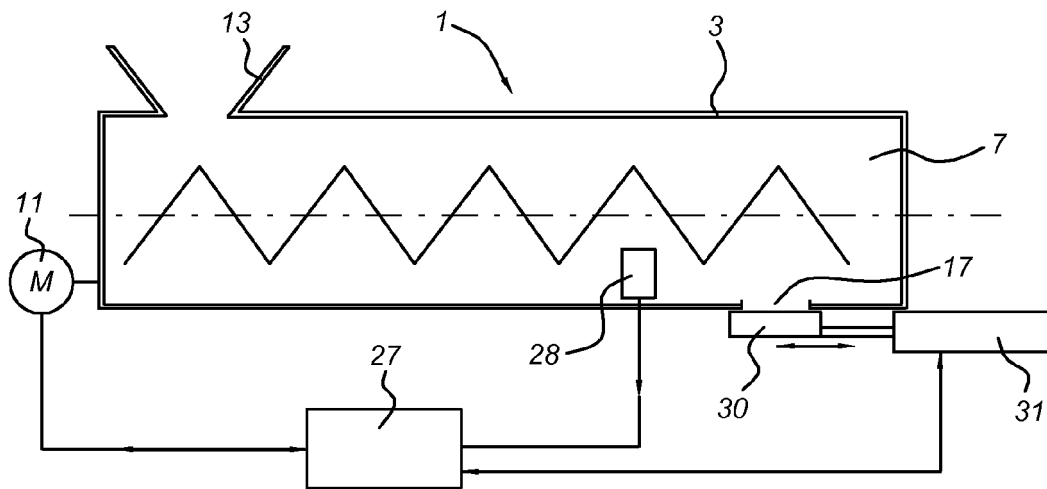


Fig 4a

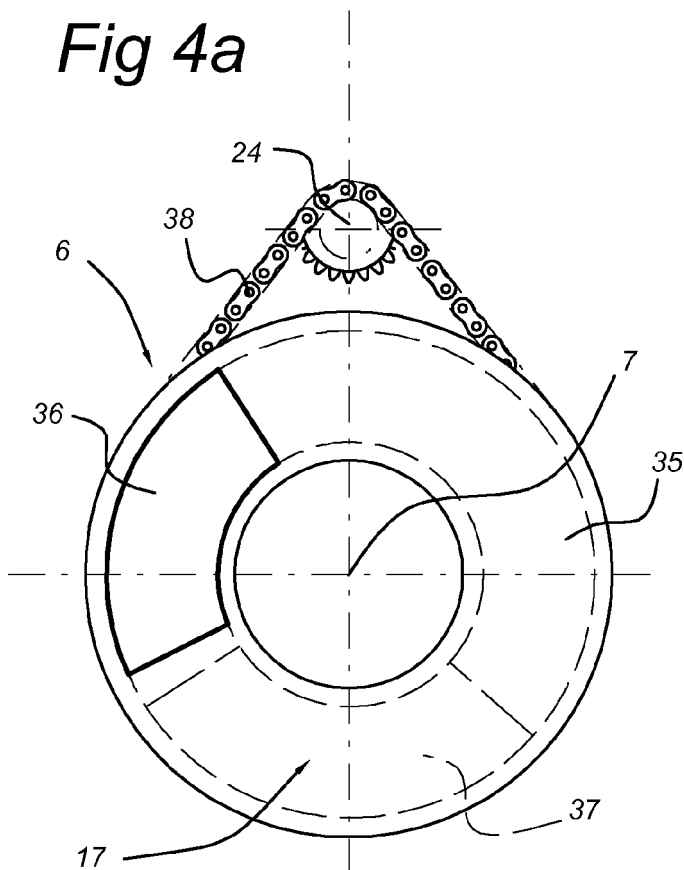
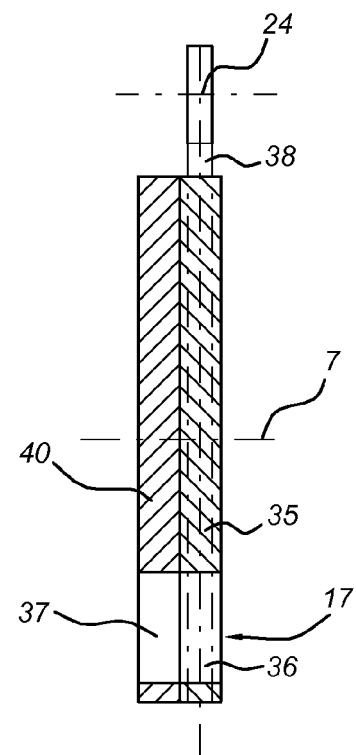


Fig 4b



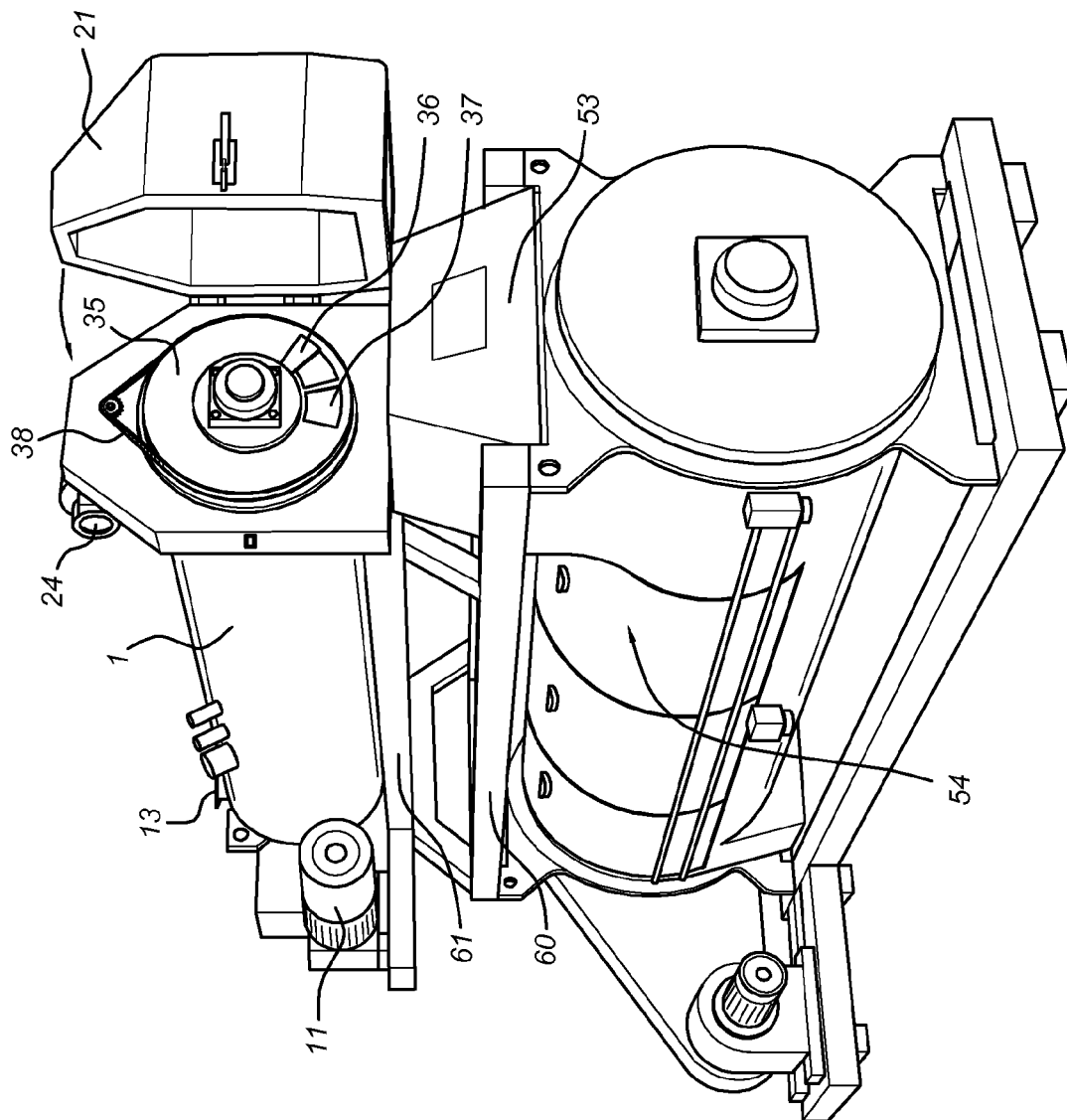


Fig 5

Fig 6

