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(54) **A METHOD AND A DEVICE FOR FILLING POWDER MATERIAL IN A BAG**

(57) The present invention relates to a device (100) for filling powder material in a bag (190), the device (100) comprising an outer casing (110), a main casing (120), a motor casing (130), an impeller (150), a sealing arrangement (160), characterized in that the sealing arrangement (160) comprises a pressurized space (164), wherein the pressurized space (164) is provided with a fluid inlet (166) and a fluid outlet (168) for feeding fluid from the fluid inlet (166) to the fluid outlet (168), wherein the sealing arrangement (160) is monitored by a control unit (165), the control unit (165) being configured to control a flow of the fluid passing through the fluid inlet (166) and the fluid outlet (168) and to detect a leakage or blockage in the sealing arrangement (160) by monitoring a parameter representative of an amount of the fluid passing through the pressurized space (164).

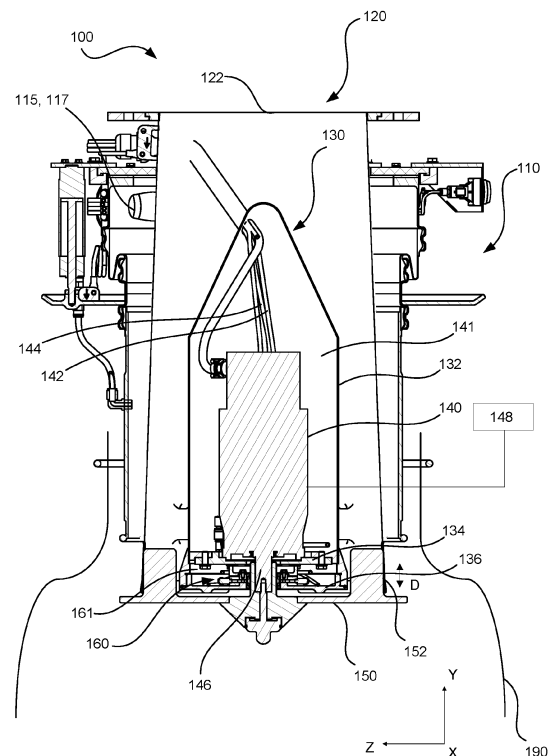


Fig. 3

Description

Technical Field

[0001] The inventive concept relates to a method and a device for filling powder material in a bag.

Background Art

[0002] Powder materials such as food powders have become more popular over the last years. An example of food powder is powdered milk which has a considerably longer shelf life than liquid milk and does not need to be refrigerated. Powdered materials are typically filled in large bags in order to be stored and/or transported to different locations. Filling of powder material in bags is conventionally performed with spinning heads comprising a motor and a spinning disc. The spinning disc of the spinning heads may be a safety hazard to an operator. In addition, powder material not handled correctly may represent a fire hazard or create a risk of explosion. Therefore, there is a need to provide an improved device for filling powder material in bags that improves the safety and health protection of workers potentially at risk.

Summary

[0003] It is an object of the inventive concept to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object of the inventive concept to provide a method and a device for filling powder material in a bag which improves the safety for the workers concerned.

[0004] Another object is to provide a device and a method for filling powder material in a bag which provides an improved fire safety and a reduced risk of explosions.

[0005] Another object is to provide a device and a method that offers hygienic filling of powder material in a bag.

[0006] According to an aspect of the present inventive concept there is provided a device for filling powder material in a bag, the device comprising an outer casing comprising a fixed upper part and a movable lower part, a main casing, arranged inside the outer casing, the main casing comprising an inlet and an outlet for the powder material, wherein the movable lower part of the outer casing is configured to open and close the outlet of the main casing by being moved to an open position and a closed position respectively, a motor casing, arranged inside the main casing, the motor casing comprising a motor, a fluid inlet pipe, and a fluid outlet pipe, an impeller arranged under the motor and fixedly attached to a shaft of the motor to rotate at the outlet of the main casing such that the powder material is distributed by the impeller when the motor is rotated, a sealing arrangement, arranged around the shaft of the motor to seal the motor casing, wherein the sealing arrangement comprises a pressurized space, wherein the pressurized space is pro-

vided with a fluid inlet connected to the fluid inlet pipe and a fluid outlet connected to the fluid outlet pipe for feeding fluid from the fluid inlet to the fluid outlet, wherein the sealing arrangement is monitored by a control unit, the control unit being configured to control a flow of the fluid passing through the fluid inlet and the fluid outlet and to detect a leakage or blockage in the sealing arrangement by monitoring a parameter representative of an amount of the fluid passing through the pressurized space.

[0007] The pressurized space of the sealing arrangement seals an end or a bottom plate of the motor against powder intrusion and hence increases fire safety and reduces the risk of an explosion. The control unit of the sealing arrangement monitors and controls the flow of the fluid passing through the fluid inlet and the fluid outlet. The flow of the fluid passing through the fluid inlet may be pre-set i.e. a constant flow rate or a constant pressure. The control unit may monitor a flow rate or a drop in pressure of the fluid passing through the fluid outlet. Thereby, the control unit of the sealing arrangement may monitor a pressure inside the pressurized space of the sealing arrangement to ensure that the pressure inside the pressurized space of the sealing arrangement is higher than the atmospheric pressure and also higher than a pressure of the motor casing i.e. to reduce the risk that the powder material enters into the motor casing and even worse into the motor. Thereby, the device may provide a safety stop system by allowing for stopping the motor if a leakage is detected. Typically, if the control unit monitoring the flow of fluid passing through the fluid inlet and the fluid outlet may detect a change in flow rate or pressure, this may be indicative of a leakage in the sealing arrangement. Thereby, the safety stop system may prevent a fire or an explosion of the motor emanating from ingress of powder material into the motor. In other words, the motor may be stopped if a leakage in the sealing arrangement is detected. Stopping the motor and consequently the filling of the bag may thus prevent powder material from entering the motor casing or motor.

[0008] The motor may be a servo motor instead of e.g. an induction motor typically used in conventional spinning heads. The use of a servo motor provides a constant torque at all speeds, thus being less likely to stall. Moreover, a servo motor provides an accurate speed control.

[0009] By the "powder material" is hereby meant a dry bulk solid material composed of fine particles that may move freely when being filled in a bag. Examples of powder materials are food powder such as milk powder, whey powder and infant formula.

[0010] The sealing arrangement may comprise an upper seal and a lower seal, circumferentially arranged around the shaft of the motor, wherein the pressurized space is formed between the upper seal and the lower seal. Thereby, the upper seal and the lower seal, i.e. the double seal arrangement, may allow for monitoring the parameter representative of the amount of the fluid passing through the pressurized space and hence detecting

if a leakage is at hand.

[0011] The outer casing may comprise a gas inlet pipe and a gas outlet pipe. Thereby the gas inlet pipe may be used to inflate the bag being filled with a gas e.g. air or nitrogen, prior to filling the powder material in the bag. The gas outlet pipe may be used to allow for escaping the gas used to pre-inflate the bag while filling the powder material in the bag. The gas inlet pipe and the gas outlet pipe may hence allow for an improved filling of the powder material in the bag. The gas inlet pipe and the gas outlet pipe may have the form of one single pipe unit, operating as an inlet pipe at one time and as an outlet pipe at another time.

[0012] The motor casing may comprise a shell, an inner end plate and an outer end plate. The inner end plate may be arranged in between the shell and the outer end plate and may circumferentially abut the shell. The outer end plate may be arranged at a distance D from the inner end plate. The distance D may at least be 2,5 cm. The distance D may provide a minimum required second space to fit the sealing arrangement therein. In addition, the distance D may allow for improved hygiene and safety. The shell and the inner end plate may form a first space in which the motor is arranged. The inner end plate and the outer end plate may form a second space in which the sealing arrangement is arranged. The shell may have a main opening on one side. For instance, the shell may have a truncated conical shape or a truncated hemisphere shape. The inner end plate and the outer end plate may be arranged at the same side as the main opening of the shell. The outer end plate may be arranged at the distance D from the main opening of the shell.

[0013] The outer end plate may be provided with threads and may be adapted to be screwed onto the motor casing. The fluid inlet pipe and the fluid outlet pipe may be wound around the shaft of the motor when the outer end plate is screwed onto the motor casing. Thereby, the outer end plate, the fluid inlet pipe and the fluid outlet pipe may conveniently be screwed onto the motor casing e.g. screwed to an outer surface of the shell. In addition, the outer end plate, the fluid inlet pipe and the fluid outlet pipe may conveniently be unscrewed e.g. for maintenance. A length of the fluid inlet pipe and the fluid outlet pipe may be long enough to account for the screwing such that the fluid inlet pipe and the fluid outlet pipe may be wound around the sealing arrangement arranged around the shaft of the motor.

[0014] The shaft of the motor may be earthed. Thereby, the safety of the device may be improved. The earthing of the motor shaft may also prevent or at least decrease creation of static charges causing discomfort to operators. The device for filling the powder material may be earthed at other parts, such as at the movable lower part or at the fixed upper part to further improve the device safety such as earthing a top flange.

[0015] The motor may comprise a motor control unit, the motor control unit may be configured to control a speed of the motor and to stop the motor when the speed

of the motor deviates from a predetermined value when the motor is in use. Thereby, the safety of the device may improve. Hence, the safety and health protection of workers working with the device may also improve. The predetermined value may be determined based on a type of the powder material being filled by the device into the bag. The predetermined value is a value that represents the desired speed of the motor and may be loaded to the motor control unit e.g. a programmable logic controller (PLC) which controls the speed of the motor and compares that with a feedback signal provided by an external drive unit. The feedback signal may be obtained by using a sensor that measures the actual speed of the motor. The motor control unit may control the speed of the motor, reduce and/or stop the motor upon detecting that the actual speed deviates from the predetermined value when the motor is in use.

[0016] The outer casing may further comprise an inflatable bellows, circumferentially arranged around the movable lower part of the outer casing. The inflatable bellows may be configured to fix the bag to the movable lower part of the outer casing by being inflated to expand towards an inner side of a bag opening. The inflatable bellows may further improve hygiene of the device by making band clamps, screws and similar, conventionally used to fix bags to the device superfluous. Such conventional band clamps, screws and similar may otherwise contaminate the product being filled into the bag.

[0017] The device may further comprise a bellows pressure control unit. The bellows pressure control unit may be configured to monitor a pressure of the inflatable bellows. The bellows pressure control unit may hence monitor to ensure that the inflatable bellows is properly sealed to an opening of the bag. Thereby, the bellows pressure control unit may detect a leakage if the inflatable bellows does not properly seal the opening of the bag. This may in turn reduce the risk of an explosion.

[0018] The outer casing may further comprise an air piston arrangement. The air piston arrangement may be configured to move the movable lower part of the outer casing between the open position and the closed position. The air piston arrangement may comprise three air pistons e.g. triple cylinders. The three air pistons may improve the stability when moving the movable lower part of the outer casing. The use of three air pistons may prevent or at least decrease spilling the powder material around the device. This may in turn prevent or at least reduce loss of powder material due to spilling. There may be a tapered skirt shaped connection in between the fixed upper part and the movable lower part. The tapered skirt shaped connection may facilitate moving the movable lower part of the outer casing between the open position and the closed position. The tapered skirt shaped connection may also enhance hygiene of the device.

[0019] The air piston arrangement may further comprise a position control unit, the position control unit may be configured to monitor a position of the air piston arrangement by monitoring a parameter representative of

the position of the air piston arrangement. The position control unit may hence provide an improved control on the air piston arrangement. The position control unit may monitor the position of the triple hygienic cylinders by e.g. reading a position of magnetic travelers which may be arranged on the triple hygienic cylinders.

[0020] The outer casing may further comprise a shield plate, circumferentially arranged around the fixed upper part of the outer casing. The shield plate may act as a catch plate and may hence prevent unwanted objects or dirt to fall into a bag being filled. This may in turn improve the hygiene of the bag being filled by the device.

[0021] According to another aspect of the present inventive concept there is provided a method for filling food powder in a bag by means of a device described above. The method comprises the steps of attaching an opening of the bag around the movable lower part of the outer casing of the device, activating the motor of the device, opening the outlet of the main casing of the device, by moving the movable lower part of the outer casing to the open position, and providing the powder material into the inlet of the main casing of the device, thereby distributing the powder material into the bag by the impeller such that the bag is filled with the powder material.

[0022] The method may further comprise inflating the bag with a gas by means of the gas inlet pipe, prior to the step of providing the powder material into the inlet of the main casing of the device. The method may further comprise vibrating the bag e.g. by placing the bag on a vibration platform. The step of vibrating the bag may be performed prior to the step of providing the powder material into the inlet of the main casing of the device. The step of vibrating the bag may be performed at the same time as the step of providing the powder material into the inlet of the main casing of the device. The method may further comprise controlling a flow of a fluid passing through the fluid inlet and the fluid outlet of the sealing arrangement of the device by means of the control unit. The method may further comprise controlling a pressure inside the bag by, if required, venting the pre-inflated gas to offset a volume of the powder being filled in the bag.

[0023] This aspect may generally present the same or corresponding advantages as the former aspect, and will not be discussed in detail here to avoid undue repetition.

[0024] By "food powder" is hereby meant a food in the form of a powder. Examples of food powders are dairy powders such as milk powder, whole milk powder, skim powder. Other examples of powders are lactose powder, baby formulas, whey powder, cocoa powder, and coffee powder.

[0025] The bag may comprise four outer columns being arranged symmetrically around a central column and separated by four respective walls from the central column of the bag. The four outer columns and the central column may extend transverse to the opening of the bag. Thereby the central column may act like an inner bag attached to the four outer columns, the four outer columns acting like an outer bag or more specifically like an outer

bag comprising a plurality of sections. The four outer columns may provide an increase volume utilization. The bag, subsequent to being filled with the powder material, may look from above like a square flexible package with no or little lateral bulge. Thereby, the bag may provide a greater volume efficiency, i.e. the bags may be packed more compact, as compared to standard bags with no distinct inner sections. In addition, the bag may more effectively absorb stresses generated by the powder material during handling and transport.

[0026] The method may further comprise filling the four outer columns of the bag with the food powder, and filling the central column of the bag with the food powder, subsequent to the filling of the four outer columns of the bag, by allowing overflowing the food powder from the four outer columns into the central column. Thereby, the food powder may uniformly be distributed into the four outer columns of the bag. This may be accomplished by providing the powder outlet with four openings that are directed towards a respective column of the bag. In addition, the overflow of the food powder from the four outer columns into the central column may allow an uniform distribution of the food powder from the four outer columns into the central column. Thereby, the four outer columns of the bag may have a same or at least similar height, subsequent to filling the central column.

[0027] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0028] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Figs. 1 and 2 illustrate side views of a device, used for filling powder material in a bag, in an closed and open position, respectively.

Fig. 3 illustrates a cross-sectional side view of the device shown in Figs. 1 and 2.

Fig. 4 illustrate a magnified cross-sectional side view of a sealing arrangement of the device shown in Figs. 1-3.

Figs. 5 and 6 illustrate a top view and a side view of a bag, respectively.

Fig. 7 is a block scheme of a method for filling food powder in a bag by means of the device shown in Figs. 1-3.

Detailed Description

[0029] With reference to Figs. 1-3 a device 100 is illustrated. The device 100 may be used for filling powder material in a bag 190. In the following the powder material, the device 100 in relation to filling the powder material in the bag 190 and the bag 190 will be described.

[0030] The powder material may comprise any type of

food powder material. Some examples of the food powder material are milk powder, whey powder and infant formula.

[0031] Fig. 1 shows a side view of a device 100. In Fig. 1, direction Y indicates a vertical direction. Directions X and Z indicate a first and a second horizontal direction. A size of the device 100 along the vertical direction Y may be in the range of 50 to 90 cm. A size of the device 100 along the horizontal directions X and Z may be in the range of 40 to 80 cm. The device 100 comprises an outer casing 110, as shown in Fig. 1. The outer casing 110 comprises a fixed upper part 112 and a movable lower part 114. Fig. 1 shows that the fixed upper part 112 and the movable lower part 114 are connected together with a tapered, skirt shaped connection TS. The tapered skirt shaped connection TS may be formed of e.g. flexible rubber. The device 100 further comprises a main casing 120. The main casing 120 is arranged inside the outer casing 110. The main casing 120 comprises an inlet 122 and an outlet 124 for the powder material. The inlet 122 of the main casing is shown in Fig. 1. Fig. 1 shows that the inlet 122 is arranged at an upper portion of the main casing 120. The movable lower part 114 of the outer casing 110 is configured to open and close the outlet 124 of the main casing 120 by being moved to an open position and a closed position, respectively. Fig. 1 shows that the outlet 124 of the main casing 120 is in the closed position.

[0032] Fig. 2 shows that the outlet 124 of the main casing 120 is in the open position. Fig. 2 shows that the outlet 124 is arranged at a lower portion of the main casing 120. In Fig. 2 the tapered, skirt shaped connection TS is compressed in between the fixed upper part 112 and the movable lower part 114.

[0033] Figs. 1 and 2 further shows that the outer casing 110 has an air piston arrangement 170. The air piston arrangement 170 shown in Figs. 1 and 2 is configured to move the movable lower part 114 of the outer casing 110 between the open position and the closed position. The air piston arrangement 170 may comprise a plurality of air pistons e.g. triple cylinders. The air piston arrangement 170 may be any conventional and commercially available air piston. The air piston arrangement 170 may further comprise a position control unit 172. The position control unit 172 may be configured to monitor a position of the air piston arrangement 170. The position control unit 172 may be configured to monitor a parameter representative of the position of the air piston arrangement 170. The position control unit 172 may be any suitable conventional and commercially available air position control unit capable of monitoring piston positions.

[0034] Figs. 1 and 2 further show that the outer casing 110 further comprises a shield plate 180. The shield plate 180 may be circumferentially arranged around the fixed upper part 112 of the outer casing 110. A width of the shield plate along the horizontal X and Z directions may be in the range of 64 to 66 cm. The shield plate 180 may be formed of stainless steel.

[0035] Figs. 1 and 2 further show that the outer casing

110 has an inflatable bellows 116. The inflatable bellows 116 may be circumferentially arranged around the movable lower part 114 of the outer casing 110. A height of the inflatable bellows 116 along the vertical direction Y may be in the range of 25 to 40 cm. The inflatable bellows 116 may be configured to fix the bag 190 to the movable lower part 114 of the outer casing 110 by being inflated such that it expands and is pressed towards the inner side of the opening of the bag 190, thereby holding the bag 190 in position. The inflatable bellows 116 may be formed of natural or synthetic rubber. The device 100 may further comprise a bellows pressure control unit 118. The bellows pressure control unit 118 may be configured to control and monitor a pressure of the inflatable bellows 116. The bellows pressure control unit 118 may be any suitable and commercially available pressure control unit. The monitoring of the pressure of the inflatable bellows 116 may include determining if the pressure is below a predetermined pressure value that represents sufficient sealing between the bellows 116 and a bag that is positioned with its inlet around the expanded bellows 116, where the bellows 116 press towards the interior circumference of the bag inlet. A ring 119 may be arranged around the bellows 116, such that the opening of the bag 190 may be pressed by the bellows towards the ring 119. This assists in providing more secure fastening of the bag 190 to the device 100.

[0036] Fig. 3 shows a cross-sectional side view of the device 100 shown in Figs. 1 and 2. The outer casing 110 comprises a gas inlet pipe 115 and a gas outlet pipe 117. The gas inlet pipe 115 and the gas outlet pipe 117 may utilize the same port or opening. The gas inlet pipe 115 and the gas outlet pipe 117 may utilize different ports. A gap is located between the outer casing 110 and the main casing 120 of the device 100. The gap may provide a space for the gas inlet pipe 115 and the gas outlet pipe 117. A size of the gap along the horizontal X and Z directions may be in the range of 6 to 7 cm.

[0037] The device 100 comprises a motor casing 130. The motor casing 130 is arranged inside the main casing 120. The motor casing 130 may comprise a shell 132. The shell 132 of the motor casing 130 has an elongated, truncated conical shape. A tapered or pointy upper portion of the motor casing 130 is preferred since such a shape will counteract powder material from being accumulated at the top of the motor casing. The motor casing 130 may further comprise an inner end plate 134 and an outer end plate 136. The inner end plate 134 is arranged in between the shell 132 and the outer end plate 136. The inner end plate 134 circumferentially abuts the shell 132. The inner end plate 134 and the outer end plate 136 extend along the horizontal X and Z directions. The inner end plate 134 and the outer end plate 136 may be arranged parallel to each other. The outer end plate 136 may be arranged at a distance D from the inner end plate 134. The distance D may at least be 2,5 cm. The outer end plate 136 may be provided with threads. The outer end plate 136 may be provided with external and/or in-

ternal threads. The outer end plate 136 may be adapted to be screwed onto the motor casing 130. The outer end plate 136 may be screwed to an outer surface of the shell 132. The shell 132 and the inner end plate 134 of the motor casing 130 may form a first space 141. The inner end plate 134 and the outer end plate 136 may form a second space 161. The main casing 120 may further comprise a butterfly valve. The butterfly valve may control the flow of the powder material being provided into the inlet 122 of the main casing 120.

[0038] The motor casing 130 comprises a fluid inlet pipe 142 and a fluid outlet pipe 144. A fluid, such as air, may be supplied into the fluid inlet pipe 142. The fluid may exit via the fluid outlet pipe 144. The motor casing 130 further comprises a motor 140. The motor 140 may be arranged inside the first space 141. The motor may be a servo motor. Fig. 3 shows a shaft 146 of the motor 140. The shaft 146 of the motor 140 may be earthed. The motor 140 may further comprise a motor control unit 148. The motor control unit 148 may be configured to control a speed of the motor 140. The motor control unit 148 may stop the motor 140 upon detecting that the speed of the motor deviates from a predetermined value when the motor 140 is in use. The motor control unit 148 may comprise a PLC. The PLC may control the speed of the motor by setting it to operate with a speed that corresponds to the predetermined value. The PLC or another suitable computer unit may via speed sensors or other suitable means monitor the actual speed of the motor and compare that with the predetermined value. The predetermined value may be loaded to motor control unit 148 by an operator. The motor control unit 148 may stop the motor 140 upon detecting that the actual speed deviates from the predetermined value by more than 5-10% when the motor 140 is in use.

[0039] The device 100 comprises an impeller 150. The impeller 150 is provided with paddles, such as paddle 152. The impeller 150 is arranged under the motor 140. The impeller 150 is fixedly attached to the shaft 146 of the motor 140 to rotate at the outlet 124 of the main casing 120. The powder material is distributed by the rotation of the impeller 150 when the motor 140 is rotated. The impeller 150 and the paddle 152 may be any suitable conventional and commercially available impeller and paddle, respectively.

[0040] The device 100 comprises a sealing arrangement 160. The sealing arrangement 160 is arranged inside the second space 161. The sealing arrangement 160 is arranged around the shaft 146 of the motor 140. The sealing arrangement 160 seals the motor casing 130.

[0041] Fig. 4 shows a magnified cross-sectional side view of a sealing arrangement 160 of the device 100. The sealing arrangement 160 comprises an upper seal 162 and a lower seal 162'. The upper seal 162 and a lower seal 162' of the depicted sealing arrangement 160 are circumferentially arranged around the shaft 146 of the motor 140. The sealing arrangement 160 comprises

a pressurized space 164. The pressurized space 164 may be formed between the upper seal 162 and the lower seal 162'. The pressurized space 164 of the depicted sealing arrangement 160 is circumferentially arranged around the shaft 146 of the motor 140. The pressurized space 164 is provided with a fluid inlet 166. The fluid inlet 166 is connected to the fluid inlet pipe 142. The pressurized space 164 is provided with a fluid outlet 168. The fluid outlet 168 is connected to the fluid outlet pipe 144. The fluid inlet 166 and the fluid outlet 168 are provided for feeding fluid from the fluid inlet 166 to the fluid outlet 168. The fluid, such as air, supplied into the fluid inlet pipe 142 may hence enter the fluid inlet 166. From the fluid inlet 166, the fluid may enter the pressurized space 164. The fluid may exit the pressurized space 164 via the fluid outlet 168. From the fluid outlet 168, the fluid may exit the motor casing 130 via fluid outlet pipe 144. Parts of the fluid inlet pipe 142 and the fluid outlet pipe 144 may be wound around the shaft 146 of the motor 140. In the illustrated embodiment those parts of the pipes 142, 144 are also wound around the sealing arrangement 160. The fluid inlet pipe 142 and the fluid outlet pipe 144 may be detached by unscrewing the outer end plate 136.

[0042] Fig. 4 further shows that the sealing arrangement 160 is monitored by a control unit 165. The control unit 165 is configured to control a flow of the fluid passing through the fluid inlet 166 and the fluid outlet 168. The control unit 165 is configured to detect a leakage and/or blockage in the sealing arrangement 160. The control unit 165 detects the leakage by monitoring a parameter representative of an amount of the fluid passing through the pressurized space 164. The control unit 165 may indirectly monitor a parameter representative of an amount of the fluid passing through the pressurized space 164. The control unit 165 may directly monitor a parameter representative of an amount of the fluid passing through the pressurized space 164. The control unit 165 may directly monitor a flow rate of the fluid passing through the fluid inlet 166 and the fluid outlet 168. The control unit 165 may directly monitor a pressure of the fluid passing through the fluid inlet 166 and the fluid outlet 168. A pressure in the pressurized space 164, a flow rate of fluid passing through the pressurized space 164, and a difference in the amount of fluid entering the fluid inlet pipe 142 and the amount fluid leaving the fluid outlet pipe 144 are each examples of parameters that may represent an amount of fluid passing through the pressurized space 164. The control unit 165 may include a flow switch. A pressure of the pressurized space 164 may be in the range of slightly above atmospheric pressure to 4 bar.

[0043] Fig. 5 shows a top view a bag 190 which may be used to fill the powder material therein. The bag 190 comprises a central column 195. The bag 190 comprises four outer columns 192, 194, 196, 198. The four outer columns 192, 194, 196, 198 are arranged symmetrically around the central column 195. The four outer columns 192, 194, 196, 198 are separated by four respective walls

192', 194', 196', 198' from the central column 195 of the bag 190. The bag may offer a volume of 1.35 m³ upon filling. The volume of the bag, upon filling, may correspond to e.g. 800 Kg of regular whole milk powder.

[0044] Fig. 6 shows a side view of the bag 190 of Fig 5. The four outer columns 192, 194, 196, 198 and the central column 195 may extend transverse to the opening 191 of the bag 190. Fig. 6 shows two 192 and 198 of the four outer columns 192, 194, 196, 198 and the central column 195 which extend along the vertical Y direction. The opening 191 of the bag 190 extends along the horizontal X and Z directions.

[0045] Fig. 7 shows is a block scheme of a method 200 for filling food powder in a bag 190 by means of a device 100. The filling of the food powder in the bag 190 is performed using the device 100, as described above. The method 200 comprises attaching 210 an opening of the bag 190 around the movable lower part 114 of the outer casing 110 of the device 100. The step of attaching the opening of the bag 190 around the movable lower part 114 of the outer casing 110 of the device 100 may be performed by an operator. Next the bellows 116 is expanded such that it is pressed towards the opening 191 of the bag 190 until it abuts the inner side of the opening 191. This fixates the bag 190 to the device 100.

[0046] The method 200 further comprises activating 220 the motor 140 of the device 100. The step of activating the motor 140 of the device 100 may be performed using the motor control unit 148, as described above.

[0047] The method 200 further comprises opening 230 the outlet 124 of the main casing 120 of the device 100, by moving the movable lower part 114 of the outer casing 110 to the open position. The moving of the movable lower part 114 of the outer casing 110 may be performed using position control unit (172) of the air piston arrangement 170, as described above.

[0048] The method 200 further comprises providing 240 the powder material into the inlet 122 of the main casing 120 of the device 100, thereby distributing the powder material into the bag 190 by the impeller 150 such that the bag 190 is filled with the powder material.

[0049] The method 200 may further comprises filling 250 the four outer columns 192, 194, 196, 198 of the bag 190 with the food powder. The step of filling 250 the four outer columns 192, 194, 196, 198 of the bag 190 may be performed, subsequent to the step of the providing 240 the powder material into the inlet 122 of the main casing 120 of the device 100.

[0050] The method 200 may further comprise filling 260 the central column 195 of the bag 190 with the food powder. The step of filling 260 the central column 195 of the bag 190 with the food powder may be performed subsequent to the step of filling 250 the four outer columns 192, 194, 196, 198 of the bag 190. The step of filling 260 the central column 195 of the bag 190 with food powder may be performed by allowing overflowing the food powder from the four outer columns 192, 194, 196, 198 into the central column 195. When that bag 190 is full the

bellows 116 are deflated so that the bag 190 can be removed and sealed, e.g. by an operator.

[0051] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

Claims

1. A device (100) for filling powder material in a bag (190), the device (100) comprising:

an outer casing (110) comprising a fixed upper part (112) and a movable lower part (114),
a main casing (120), arranged inside the outer casing (110), the main casing (120) comprising an inlet (122) and an outlet (124) for the powder material, wherein the movable lower part (114) of the outer casing (110) is configured to open and closed the outlet (124) of the main casing (120) by being moved to an open position and a closed position respectively,
a motor casing (130), arranged inside the main casing (120), the motor casing (130) comprising a motor (140), a fluid inlet pipe (142), and a fluid outlet pipe (144),
an impeller (150), arranged under the motor (140) and fixedly attached to a shaft (146) of the motor (140) to rotate at the outlet (124) of the main casing (120) such that the powder material is distributed by the impeller (150) when the motor (140) is rotated, and
a sealing arrangement (160), arranged around the shaft (146) of the motor (140) to seal the motor casing (130), wherein
the sealing arrangement (160) comprises a pressurized space (164), wherein the pressurized space (164) is provided with a fluid inlet (166) connected to the fluid inlet pipe (142) and a fluid outlet (168) connected to the fluid outlet pipe (144) for feeding fluid from the fluid inlet (166) to the fluid outlet (168), wherein the sealing arrangement (160) is monitored by a control unit (165), the control unit (165) being configured to control a flow of the fluid passing through the fluid inlet (166) and the fluid outlet (168) and to detect a leakage or blockage in the sealing arrangement (160) by monitoring a parameter representative of an amount of the fluid passing through the pressurized space (164).

2. The device (100) according to claim 1, wherein the sealing arrangement (160) comprises an upper seal (162) and a lower seal (162'), circumferentially arranged around the shaft (146) of the motor (140),

wherein the pressurized space (164) is formed between the upper seal (162) and the lower seal (162').

3. The device (100) according to claim 1 or 2, wherein the outer casing (110) comprises a gas inlet pipe (115) and a gas outlet pipe (117). 5
4. The device (100) according to any preceding claims, wherein the motor casing (130) comprises a shell (132), an inner end plate (134) and an outer end plate (136), 10
 wherein the inner end plate (134) is arranged in between the shell (132) and the outer end plate (136) and circumferentially abuts the shell (132),
 wherein the outer end plate (136) is arranged at a distance (D) from the inner end plate (134), the distance (D) being at least 2,5 cm,
 wherein the shell (132) and the inner end plate (134) form a first space (141) in which the motor (140) is arranged, and
 wherein the inner end plate (134) and the outer end plate (136) form a second space (161) in which the sealing arrangement (160) is arranged. 15
5. The device (100) according to claim 4, wherein the outer end plate (136) is provided with threads and adapted to be screwed onto the motor casing (130), such that the fluid inlet pipe (142) and the fluid outlet pipe (144) are wound around the shaft (146) of the motor (140) when the outer end plate (136) is screwed onto the motor casing (130). 25
6. The device (100) according to any preceding claims, wherein the shaft (146) of the motor (140) is earthed. 30
7. The device (100) according to any preceding claims, wherein the motor (140) comprises a motor control unit (148), the motor control unit (148) being configured to control a speed of the motor (140) and to stop the motor (140) when the speed of the motor deviates from a predetermined value when the motor (140) is in use. 35
8. The device (100) according to any preceding claims, wherein the outer casing (110) further comprises an inflatable bellows (116), circumferentially arranged around the movable lower part (114) of the outer casing (110), the inflatable bellows (116) being configured to fix the bag (190) to the movable lower part (114) of the outer casing (110) by being inflated. 40
9. The device (100) according to claim 8, wherein the device (100) further comprises a bellows pressure control unit (118), the bellows pressure control unit (118) being configured to monitor a pressure of the inflatable bellows (116). 45
10. The device (100) according to any preceding claims, 50

wherein the outer casing (110) further comprises an air piston arrangement (170), the air piston arrangement (170) being configured to move the movable lower part (114) of the outer casing (110) between the open position and the closed position.

11. The device (100) according to claim 10, wherein the air piston arrangement (170) further comprises a position control unit (172), the position control unit (172) being configured to monitor a position of the air piston arrangement (170) by monitoring a parameter representative of the position of the air piston arrangement (170). 5
12. The device (100) according to any preceding claims, wherein the outer casing (110) further comprises a shield plate (180), circumferentially arranged around the fixed upper part (112) of the outer casing (110). 10
13. A method (200) for filling food powder in a bag (190) by means of a device (100) according to any one of the preceding claims, the method (200) comprising the steps of: 15
 attaching (210) an opening of the bag (190) around the movable lower part (114) of the outer casing (110) of the device (100),
 activating (220) the motor (140) of the device (100),
 opening (230) the outlet (124) of the main casing (120) of the device (100), by moving the movable lower part (114) of the outer casing (110) to the open position, and
 providing (240) the powder material into the inlet (122) of the main casing (120) of the device (100), thereby distributing the powder material into the bag (190) by the impeller (150) such that the bag (190) is filled with the powder material. 20
14. The method (200) according to claim 13, wherein the bag (190) comprises four outer columns (192, 194, 196, 198) being arranged symmetrically around a central column (195) and separated by four respective walls (192', 194', 196', 198') from the central column (195) of the bag (190), the four outer columns (192, 194, 196, 198) and the central column (195) extending transverse to the opening of the bag (190). 25
15. The method (200) according to claim 13 or 14, the method further comprising: 30
 filling (250) the four outer columns (192, 194, 196, 198) of the bag (190) with the food powder, and
 filling (260) the central column (195) of the bag (190) with the food powder, subsequent to the filling (250) of the four outer columns (192, 194, 196, 198) of the bag (190), by allowing overflow- 35

ing the food powder from the four outer columns
(192, 194, 196, 198) into the central column
(195).

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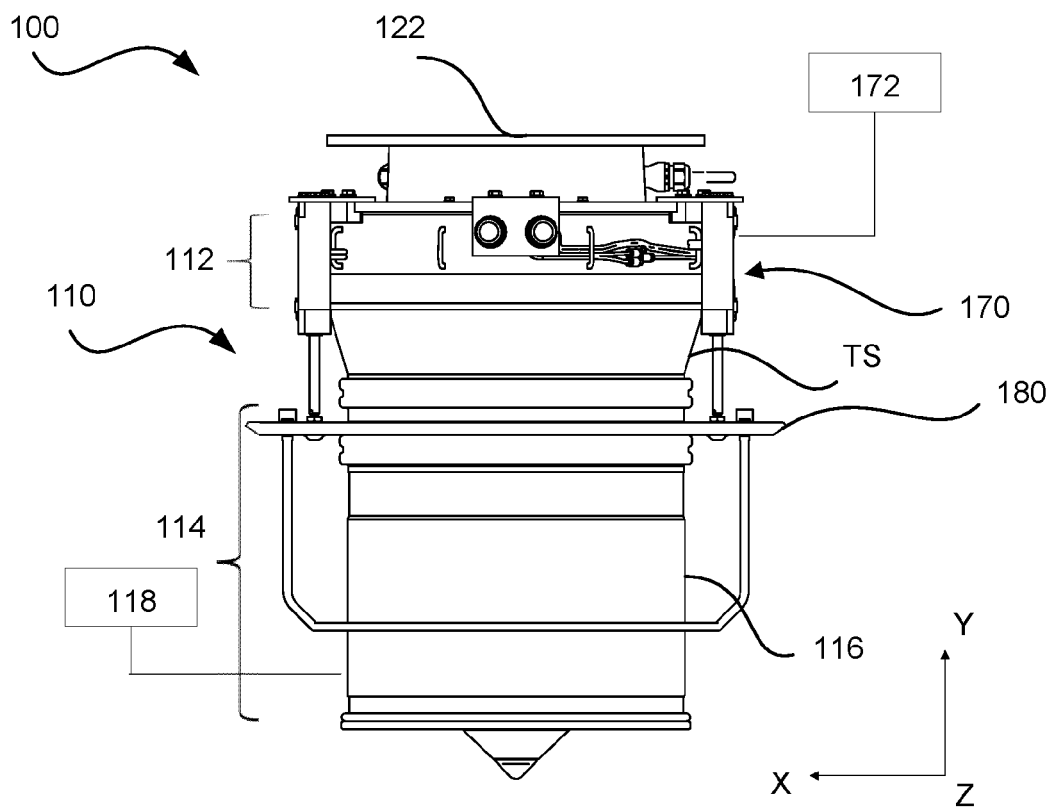


Fig. 1

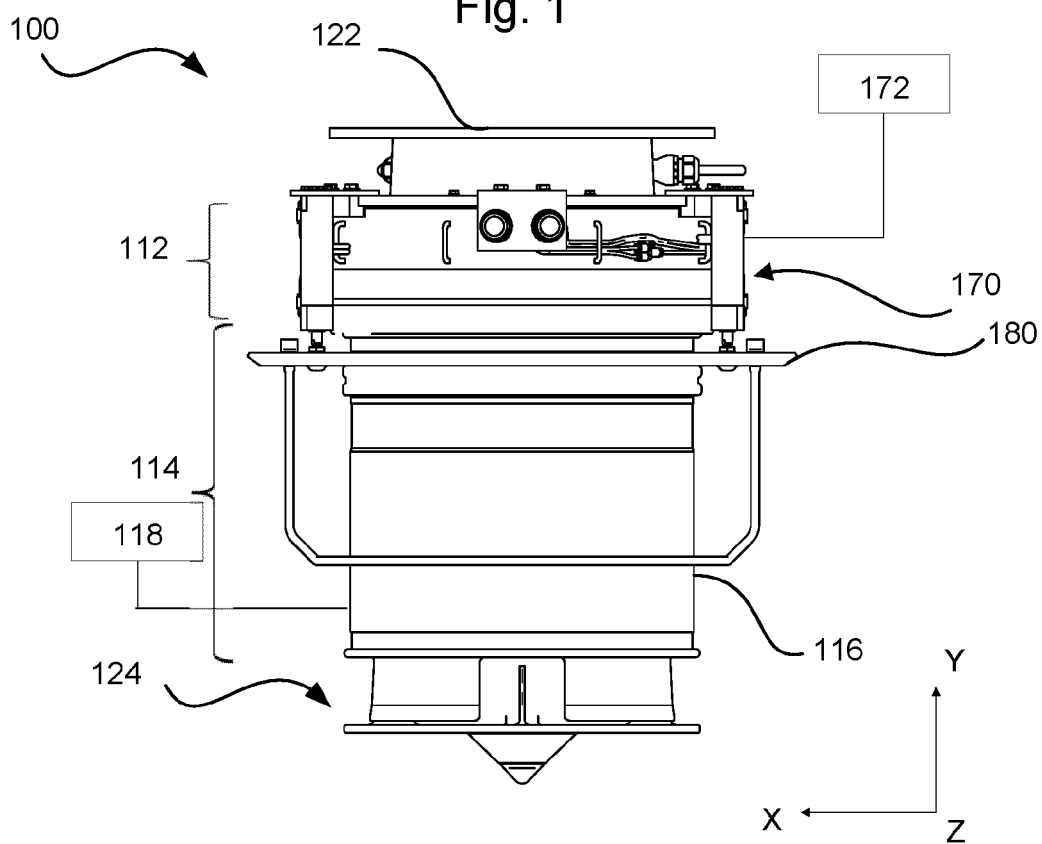


Fig. 2

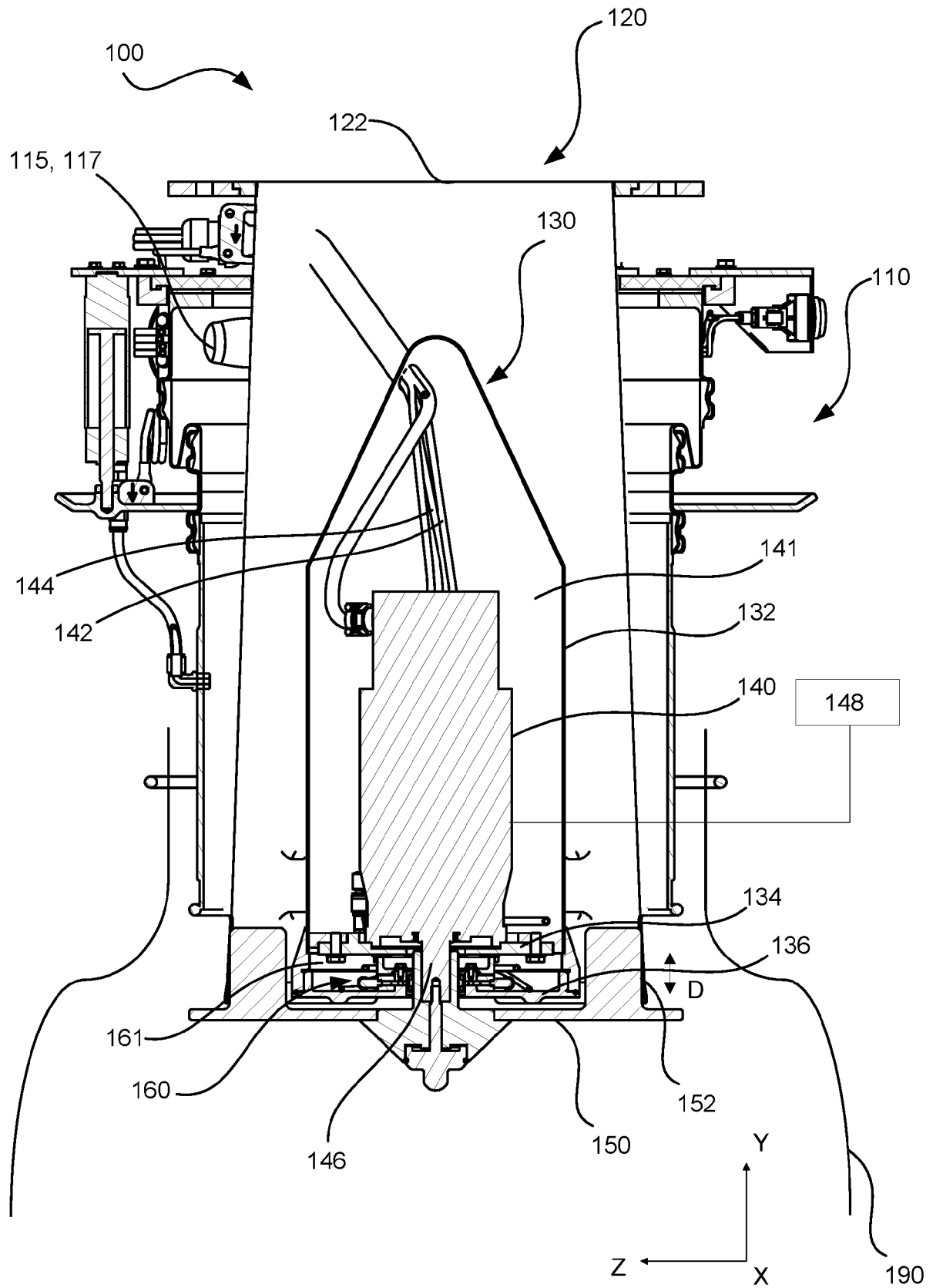
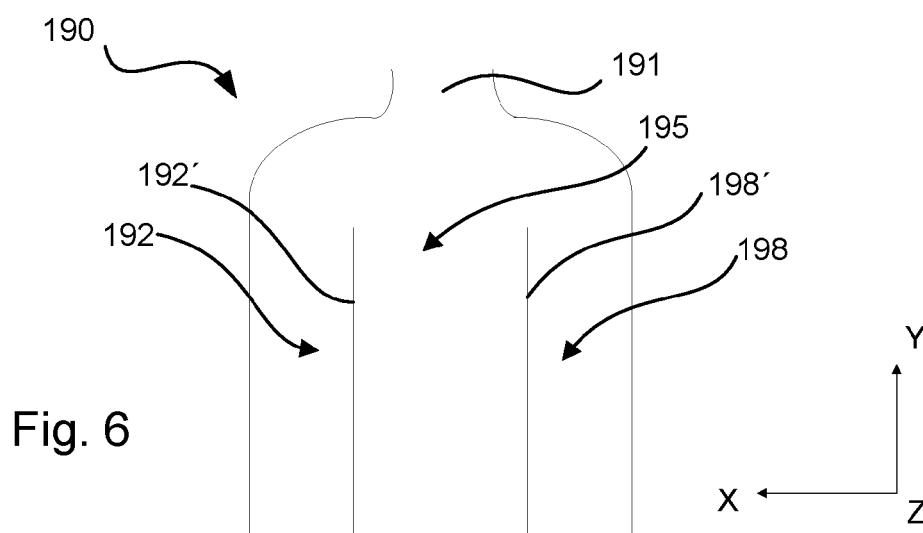
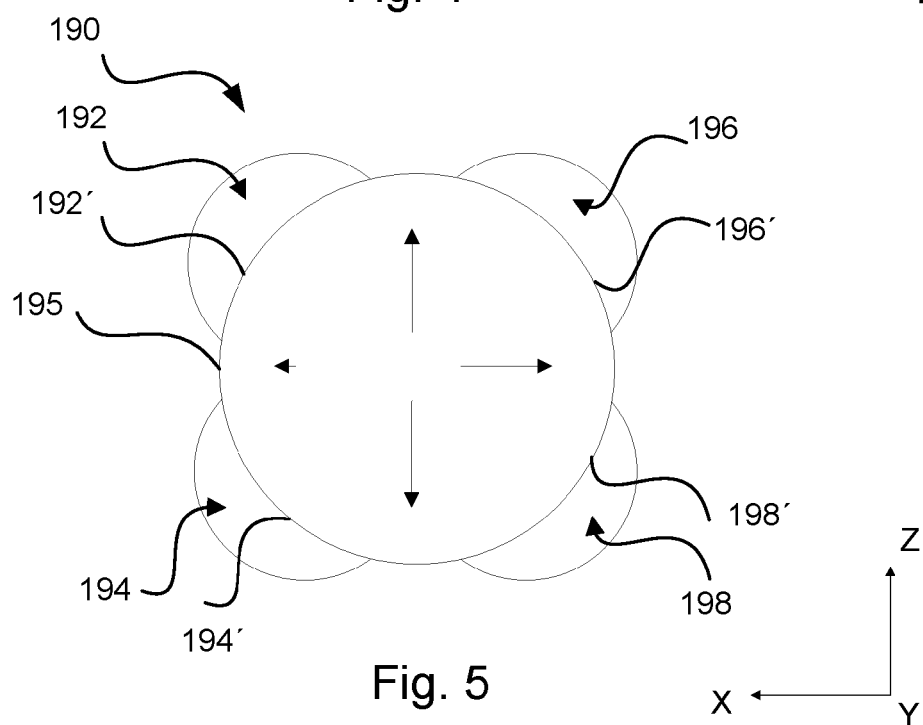
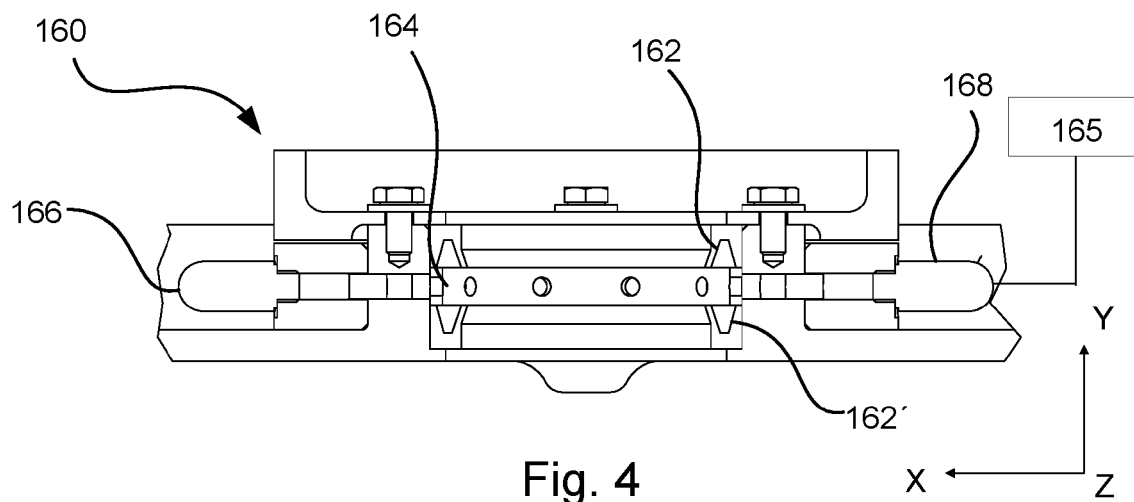


Fig. 3



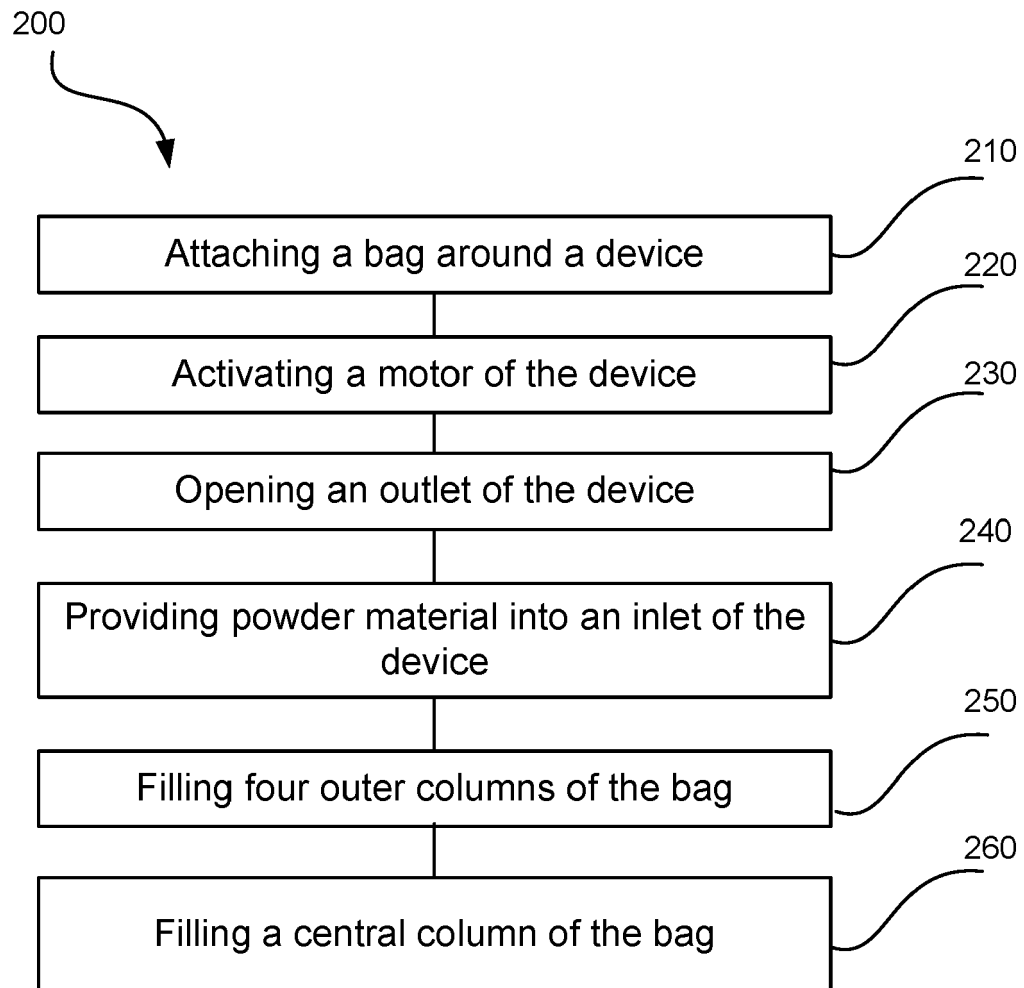


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 21 17 2205

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Place of search Munich		Date of completion of the search 29 June 2021	Examiner Ngo Si Xuyen, G
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The members are as contained in the European Patent Office EDP file on
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