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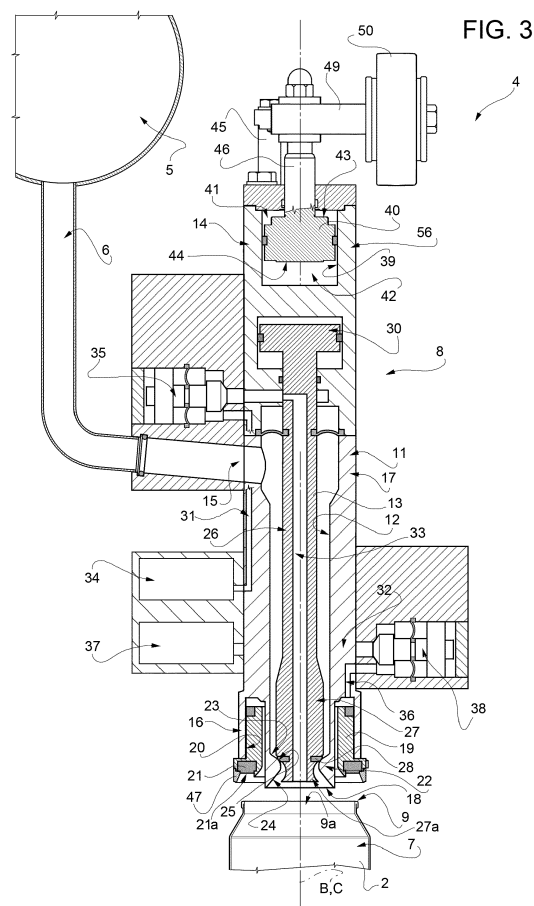
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(54) **A FILLING MACHINE FOR FILLING RECEPTACLES WITH A POURABLE PRODUCT UNDER PRESSURE**

(57) The invention relates to a filling machine (1) configured for filling receptacles (2) with a pourable product under pressure, comprising at least one filling device (4) having a longitudinal axis (C) and including: a filling valve (8) selectively operable to feed the pourable product to a respective receptacle (2) through an opening (9a) of this latter, a sealing member (21) having a sealing surface (21a) configured to coact with an edge (9) of the opening (9a), and a support member (55) configured to maintain the opening (9a) coaxial with the sealing member (21); at least one between the sealing (21) and support (55) members moves between a sealing position, in which it determines the fluid-tight contact between the edge (9) and the sealing surface (21a), and a release position, in which it maintains a given distance between the edge (9) and the sealing surface (21a); the filling device (4) further comprises actuator means (56) configured to control the movement of one between the sealing (21) and support (55) members between the release and sealing positions and comprising a fluid actuator (56); the filling machine (1) further comprises cam means (50, 51) configured to control the movement imposed by the fluid actuator (56) on one between the sealing (21) and support (55) members from the release position towards the sealing position.



## Description

**[0001]** The present invention relates to a filling machine configured for filling receptacles, in particular receptacles made of metallic material, such as cans, with a pourable product at a pressure greater than the atmospheric pressure, for example a carbonated beverage.

**[0002]** Filling machines typically used in this field essentially comprise a carousel rotating about a vertical axis, a tank containing the pourable product, and a plurality of filling devices carried peripherally by the carousel, connected to the tank by means of respective circuits or ducts and conveyed by the carousel along a circular transfer path.

**[0003]** In particular, the carousel receives a series of empty receptacles from an input star wheel and directs the filled receptacles towards an output star wheel.

**[0004]** Each filling device essentially comprises a support element designed to receive a respective receptacle and maintain it in vertical position, under the same device, and a filling valve configured to feed a predetermined volume of pourable product to said receptacle, while the filling device moves along the transfer path due to the rotary movement imparted by the carousel.

**[0005]** Typically, filling valves of known type essentially comprise:

- a vertical tubular body fixed to a peripheral portion of the carousel and defining a vertical flow channel for feeding the pourable product to a respective receptacle to be filled positioned below the tubular body;
- a shutter that slidably engages the tubular body and is movable inside the channel so as to enable or prevent outflow of the pourable product towards the respective receptacle; and
- an actuator configured to move the shutter inside the channel defined by the tubular body.

**[0006]** In particular, the tubular body has a longitudinal axis parallel to the axis of the carousel and terminates at a lower end with an axial discharge opening communicating fluidly, in use, with an end opening defined by an upper edge of the respective receptacle to be filled.

**[0007]** The channel defined by the tubular body comprises a stretch with a constant section, usually cylindrical, and a stretch with a variable section, positioned over the discharge opening and narrowing in the direction of this latter, to a section of minimum diameter.

**[0008]** The shutter is movable inside the channel of the tubular body between:

- a lower closed position, in which the shutter fluid-tightly closes the stretch with variable section of the channel, so as to interrupt the flow of the pourable product towards the discharge opening; and
- an upper open position, in which the shutter delimits, together with the stretch with variable section, an

annular passage communicating with the discharge opening, so as to enable the flow of the pourable product towards the end opening of the respective receptacle.

**[0009]** Generally, known filling valves further comprise two circuits at least partly formed inside the tubular body:

- a pressurizing/discharge circuit utilized to pressurize the respective receptacle to a predetermined pressure value greater than the atmospheric pressure value, before starting actual filling of the receptacle, and moreover to discharge the gas present in the receptacle during the filling operation with the pourable product; and
- a decompression circuit configured to carry out a decompression phase of the respective receptacle, at the end of filling.

**[0010]** In order to ensure correct positioning of the receptacle on the carousel during the filling operation, filling devices, of the type described above, typically comprise:

- an annular sealing sleeve, movable axially with respect to the tubular body and configured to co-operate fluid-tightly with the upper edge of the receptacle to be filled; and
- an actuator configured to control the axial movement of this sleeve.

**[0011]** In particular, the sealing sleeve is axially movable between an upper release position, in which it is detached from the respective receptacle, and a lower sealing position, in which it co-operates fluid tightly with the upper edge of the receptacle to be filled.

**[0012]** For this purpose, the sealing sleeve is provided with an annular gasket mounted at a lower axial end of the sleeve facing the receptacle, defining in use an axial abutment for the upper edge of the respective receptacle and configured to seal this latter to the filling valve during the filling process. In this way, the inner volume of this receptacle is maintained in a fluid-tight condition during this process.

**[0013]** Generally, the actuator that controls the axial movement of the sealing sleeve comprises a moving member arranged axially at the upper axial portion of the filling device and mechanically connected to the sealing sleeve so that an axial movement of the moving member corresponds to an axial movement of the sealing sleeve. The actuator further comprises at least one helical spring configured to exert a downward force on the moving member; this force consequently acts on the sealing sleeve, so as to determine an axial movement of this latter towards its sealing position. In this way, the gasket of the sleeve can abut in a fluid-tight manner against the upper edge of the receptacle to be filled.

**[0014]** In practice, the helical spring preloads the moving member with the aforesaid force and therefore push-

es the sealing sleeve, integral with the moving member, on the upper edge of the receptacle to be filled.

**[0015]** After filling has terminated, the sealing sleeve is moved again towards its release position. To carry out this movement, the filling device further comprises a cam-follower roller, integral with the moving member, rotating in use with respect to a fixed axle by means of a plurality of bushings, and configured to co-operate with a fixed cam, mounted on the peripheral portion of the carousel and extending for a given angle about the axis of this latter. In practice, the roller rolls on the cam cyclically at the aforesaid angle, at each turn of the carousel about its axis.

**[0016]** Considering the direction of rotation of the carousel, the cam has:

- a release portion, having a height increasing with respect to the axis of the carousel and thus defining an upward ramp for the roller;
- a central portion with constant height with respect to the axis of the carousel; and
- an attack portion, having decreasing height with respect to the same axis and thus defining a downward ramp for the roller.

**[0017]** In detail, the roller is configured to axially move the moving member of the actuator when it co-operates with the release or attack portions.

**[0018]** Specifically, when the roller co-operates with the release portion of the cam, the downward force exerted by the helical spring is overcome and the moving member, being integral with the roller, is moved upwards, driven by the corresponding movement of the roller along the upward ramp of the release portion. Consequently, the sealing sleeve, being integral with the moving member, is moved upwards into its own release position.

**[0019]** When the roller co-operates with the attack portion of the cam, the moving member is moved gradually downwards, following the force of the helical spring, and the sealing sleeve is consequently moved towards its fluid-tight position.

**[0020]** When the roller co-operates with the central portion of the cam, the sealing sleeve is held in the release position and the change of receptacle is carried out: the filled receptacle is sent towards the output starwheel, and a new receptacle to be filled is positioned under the filling device.

**[0021]** The operation is repeated cyclically by each filling device of the filling machine present in the carousel.

**[0022]** The applicant has observed that filling machines of the type described above present some drawbacks.

**[0023]** In particular, the cam-follower roller, in order to control the movement of the moving member of the actuator and, therefore, the movement of the sealing sleeve between the release and sealing positions, co-operates cyclically with the cam along the whole of the extension of this latter, at high speed and exerting/being subjected

to a given pressure on the/from the cam, dictated by the forces in play. Consequently, it is necessary for the roller to be formed of a tough material, with consequent increase in production costs.

**[0024]** Moreover, the friction of the bushings of the roller on the axle of the same roller causes overheating that facilitates high wear of the parts in contact; it is therefore necessary to carry out lubrication with a coolant (such as water), which could compromise the asepticity of the filling process.

**[0025]** Furthermore, the optional use of a bearing to limit wear of the roller would lead to a further increase in production costs.

**[0026]** It is therefore an object of the present invention to provide a filling machine which is designed to fulfill at least one of the above-mentioned drawbacks in a straightforward and low-cost manner.

**[0027]** This object is achieved by a filling machine as claimed in claim 1.

**[0028]** For a better understanding of the present invention, a preferred embodiment is described below purely by way of non-limiting example and with the aid of the accompanying drawings, wherein:

- Fig. 1 is schematic side view, partially sectional and with parts removed for clarity, of a filling machine provided with a plurality of filling devices produced according to the dictates of the present invention;
- Fig. 2 is a perspective view, with parts removed for clarity, of a filling device, of the filling machine of Fig. 1, shown individually;
- Fig. 3 is an axial section, in enlarged scale and with parts removed for clarity, of the filling device of Fig. 2;
- Figs. 4a, 4b and 4c illustrate the filling device according to the invention, in an axial section analogous to the section of Fig. 3, during different and subsequent operating conditions, in which it co-operates with parts of the filling machine of Fig. 1 depicted schematically;
- Fig. 5 illustrates, in a perspective view and in enlarged scale, a particular of the carousel of Fig. 1; and
- Fig. 6 illustrates a flat view, in enlarged scale and with parts removed for clarity, of a detail of the particular of Fig. 5.

**[0029]** With reference to Fig. 1, a filling machine configured to fill a plurality of receptacles 2 with a pourable product at a pressure value greater than the atmospheric pressure is indicated as a whole with the numeral 1. In particular, the receptacles 2 are made of a metal material, and the pourable product is a liquid with the addition of gas under pressure, for example a carbonated beverage.

**[0030]** The machine 1 comprises a rotary conveyor, preferably a carousel 3, configured to rotate about a vertical axis A, and a tank 5 containing the pourable product under pressure and positioned peripherally with respect to the same carousel 3.

**[0031]** Preferably, the carousel 3 receives a series of

empty receptacles 2 from an infeed starwheel (not illustrated) and directs the filled receptacles 2 towards an outfeed starwheel (also not illustrated).

**[0032]** The carousel 3 carries cantilevered at a peripheral portion 3a thereof a plurality of filling devices 4 configured to fill respective receptacles 2 to a predetermined level during the rotation of the carousel 3 about the axis A.

**[0033]** The filling devices 4 are then conveyed by the carousel 3 along a circular transfer path into respective positions spaced radially equidistant about the axis A.

**[0034]** In particular, each filling device 4 is connected fluidly to the tank 5 by means of a circuit 6 configured to convey the pourable product from the tank 5 to the same filling device 4.

**[0035]** According to a preferred embodiment of the invention, each receptacle 2 is defined by a substantially cylindrical can (Figs. 1, 3, 4a-4c) having a longitudinal axis B and advanced in vertical position by the carousel 3. In particular, each receptacle 2 is advanced by the carousel 3 with its axis B parallel to the axis A of the carousel 3 and in lower position with respect to the related filling device 4.

**[0036]** In greater detail (Figs. 3, 4a-4c), each receptacle 2 has a body 7 coaxial with the axis B and delimited above by an annular edge 9 delimiting a circular end opening 9a of the receptacle 2.

**[0037]** With reference to Figs. 3, 4a-4c, each filling device 4 further comprises a filling valve 8 that can be activated selectively to control the outflow of the pourable product towards a respective receptacle 2 to be filled. In this configuration, the edge 9 of this receptacle 2 is positioned in contact with the same filling valve 8, so as to receive therefrom the pourable product in a fluid-tight condition.

**[0038]** Therefore, each filling device 4 is configured to carry out a "contact filling operation", in which the respective receptacle 2 is supported in fluid-tight contact against the filling valve 8.

**[0039]** This filling valve 8 essentially comprises:

- a vertical tubular body 11 fixed to the peripheral portion 3a of the carousel 3, having a longitudinal axis C, parallel to the axis A of the same carousel 3, and defining a central flow channel 12 configured to feed the pourable product to the respective receptacle 2;
- a shutter 13 slidably engaging the tubular body 11 and movable inside the channel 12 so as to enable or prevent the outflow of the pourable product towards the respective receptacle 2 to be filled; and
- an actuator 30 designed to move the shutter inside the channel 12.

**[0040]** In particular, the tubular body 11 has an upper end portion 14, an intermediate portion 17 provided with a transverse infeed opening 15 configured to receive the pourable product from the tank 5 through the circuit 6, and a lower end portion 16 terminating with an axial outfeed opening 18 configured to feed the pourable product

to the respective receptacle 2.

**[0041]** With reference to the preferred embodiment illustrated in the accompanying figures, the channel 12 comprises, at the lower end portion 16 of the tubular body 11, a portion 22 with variable section, which defines the end part of the channel 12.

**[0042]** In particular, the portion 22 comprises two truncated-cone shaped stretches 23, 24; the stretch 23 is positioned upstream of the stretch 24 with respect to the direction of feed of the pourable product inside the channel 12, i.e., positioned above with respect to the stretch 24, and has a section tapered towards this latter; the stretch 24 instead has a diameter increasing from the stretch 23 to the outfeed opening 18. The two stretches 23, 24 define between them a narrow section 25.

**[0043]** As can be seen in Fig. 3 and in Figs. 4a-4c, the shutter 13 is mounted coaxial inside the channel 12 of the tubular body 11.

**[0044]** In particular, the shutter 13 comprises an externally cylindrical upper portion 26, a lower portion 27, having a diameter greater than the diameter of the upper portion 26 and extending axially therefrom in the direction of the outfeed opening 18, and a shaped end portion 27a, configured to co-operate with the portion of the tubular body 11 defining the portion 22 with variable section of the channel 12.

**[0045]** In particular, the end portion 27a is provided with a sealing ring 28, preferably an O-ring made of elastomeric material and configured to co-operate selectively in a fluid-tight manner with the narrow section 25 of the channel 12, so as to prevent outflow of the pourable product towards the outfeed opening 18 and, therefore, into the receptacle 2 to be filled.

**[0046]** For this purpose, the shutter 13 is movable inside the channel 12 of the tubular body 11 between:

- a lower closed position (Figs. 3, 4a and 4c), in which the shutter 13 closes the narrow section 25 of the channel 12, in a fluid-tight manner, by means of the sealing ring 28, interrupting the outflow of the pourable product towards the respective receptacle 2; and
- an upper open position (Fig. 4b), in which the shutter 13 delimits with the narrow section of the channel 12 an annular passage in fluid communication with the outfeed opening 18, so as to enable the outflow of the pourable product towards the respective receptacle 2 to be filled.

**[0047]** The movement of the shutter 13 from the closed position towards the open position is obtained by means of the actuator 30, this latter preferably being a fluid actuator, for example a pneumatic piston coupled to the shutter 13 according to known methods, not described in detail.

**[0048]** Alternatively, the movement of the shutter 13 could be obtained by means of a mechanical or electromagnetic actuator.

**[0049]** As shown in Fig. 5, each filling device 4 further comprises a support element 55 (only one of which is shown in Fig. 5) designed to receive a respective receptacle 2 and maintain it in a vertical position. In particular, this latter is held in a lower position with respect to the filling device 4 and coaxial with the axis C at least during the activation of the filling valve 8.

**[0050]** With reference to Figs. 1, 3, 4a-4c, the machine 1 further comprises:

- a pressurizing-discharge circuit 31 configured both to pressurize the respective receptacle 2 to a predetermined pressure value greater than the atmospheric pressure value before starting the actual filling, and to expel the gas present in the receptacle 2 during the filling operation; and
- a decompression circuit 32 configured to carry out a decompression phase of the respective receptacle 2 by means of the discharge of gas, after filling has terminated.

**[0051]** In particular, the pressurizing-discharge circuit 31 comprises, for each filling device 4, a duct 33 that fluidly connects the internal environment of the respective receptacle 2 to an annular chamber 34 of the pressurizing-discharge circuit 31, obtained in the carousel 3 and containing a gas under pressure, for example carbon dioxide. The duct 33 further comprises a flow control valve 35, preferably of pneumatic type, configured to enable or prevent the flow of gas under pressure from or towards the chamber 32.

**[0052]** The decompression circuit 32 comprises, for each filling device 4, a duct 36 that fluidly connects the environment inside the respective receptacle 2 with an annular chamber 37 obtained in the carousel 3; the chamber 37 is maintained at a pressure below the pressure inside of the receptacle 2 at the end of filling and is connectable in turn to the environment outside at atmospheric pressure in a known manner, not described in detail. The duct 36 further comprises a flow control valve 38, preferably of pneumatic type, configured to selectively open or close the fluid communication between the chamber 37 and the duct 36.

**[0053]** In order to ensure correct positioning of the receptacles 2 during the filling operation, each filling device 4 comprises a sealing sleeve 19 sliding axially in use through a specific annular seat 20 obtained in the end portion 16 of the tubular body 11.

**[0054]** In particular, the sleeve 19 slides axially through the seat 20 between an upper release position, in which it is at a given distance from the edge 9 of the respective receptacle 2 and is at least partially inside the seat 20, and a lower sealing position, in which it is almost totally extracted from the seat 20 and co-operates in use in a fluid-tight manner with the edge 9 of the respective receptacle 2.

**[0055]** For this purpose, the sleeve 19 comprises, at an axial end thereof facing the receptacle 2 in use, an

annular gasket 21 having a sealing surface 21a that defines in use an axial abutment for the edge 9 of the respective receptacle 2. In particular, the sealing surface 21a co-operates in use in a fluid-tight manner with the edge 9 during the filling process. In this way, the inner volume of the body 7 of the aforesaid receptacle 2 is maintained in fluid-tight conditions during this process.

**[0056]** Each filling device 4 further comprises actuator means configured to control the movement of the sleeve 19 between the release and sealing positions.

**[0057]** In particular, these actuator means comprise a fluid actuator, preferably a gas spring 56 having an elastic stiffness that can be modified selectively as a function of the diameter of the opening 9a delimited by the edge 9 of the respective receptacle 2.

**[0058]** In particular, as can be seen in Figs. 3 and 4a-4c, the gas spring 56 comprises a moving member, preferably a plunger 40, sliding axially in use inside an axial compartment 39 obtained in the upper end portion 14 of the tubular body 11.

**[0059]** More in detail, the plunger 40 delimits, on one side of the compartment 39, a sealed upper chamber 41, configured to be filled with a gas, for example air, to a pressure value P0 predetermined and modifiable as a function of the diameter of the opening 9a of the respective receptacle 2.

**[0060]** Therefore, this pressure value P0 defines the elastic stiffness of the gas spring 56.

**[0061]** The upper chamber 41 is configured to be selectively filled to different pressure values proportional to the diameter of the opening 9a of receptacles 2 of different format and/or size.

**[0062]** The plunger 40 further delimits, on the axially opposite side of the compartment 39 with respect to the side of the upper chamber 41, a sealed lower chamber 42 configured to be selectively filled with/emptied of the aforesaid gas at the same pressure value P0.

**[0063]** In practice, the plunger 40 divides, in a fluid-tight manner, the compartment 39 into the upper chamber 41 and the lower chamber 42.

**[0064]** Preferably, the gas under pressure accesses the chambers 41 and 42 by means of valve elements, in a known manner, not described in detail.

**[0065]** The plunger 40 comprises an upper surface 43, facing the upper chamber 41, and a lower surface 44, facing the lower chamber 42. The gas under pressure present, in use, in these chambers 41 and 42 interacts with the aforesaid surfaces 43 and 44, so as to push the plunger 40 and determine axial sliding thereof inside the compartment 39.

**[0066]** In practice, the gas under pressure generates a first force on the upper surface 43 that in use, pushes the plunger 40 along the axis C in the direction of the respective receptacle 2 to be filled, and a second force, opposite the first, on the lower surface 44 that in use, pushes the plunger 40 along the axis C in the opposite direction with respect to the respective receptacle 2.

**[0067]** The plunger 40 is also configured for controlling

the axial sliding of the sleeve 19 carrying the annular gasket 21 between the aforesaid sealed and release positions. For this purpose, the sleeve 19 is connected to the plunger 40 by means of two rigid axial bars 45, located externally to the tubular body 11 on diametrically opposite sides, as partially illustrated in Fig. 2. In greater detail, each bar 45 is connected, at an axial end thereof, to a stem 46 projecting axially from the plunger 40 and, at the opposite axial end, to an annular plate 47 fixed to the sleeve 19.

**[0068]** In this way, an axial movement of the plunger 40 corresponds to an axial movement of the sleeve 19 and, therefore, of the annular gasket 21 between the sealed and release positions.

**[0069]** More specifically, when the lower chamber 42 is emptied of the gas under pressure, the force acting on the lower surface 44 is progressively reduced and the plunger 40 can slide downwards inside the compartment 39, as a result of the force acting on the upper surface 43, generated by the gas under pressure constantly present in the upper chamber 41. Consequently, the sleeve 19, connected to the plunger 40 by means of the bars 45, slides inside the seat 20 towards the sealing position. The sealing surface 21a of the annular gasket 21 in this way can co-operate with the edge 9 of the respective receptacle 2.

**[0070]** On the contrary, when the lower chamber 42 is filled with the gas under pressure, the force acting on the lower surface 44 increases progressively, opposing the force acting on the upper surface 43, and the plunger 40 can slide upwards inside the compartment 39. Consequently, the sleeve 19 slides in the seat 20 towards the release position and the sealing surface 21a of the annular gasket 21 moves away from the upper edge 9 of the respective receptacle 2.

**[0071]** As shown in Figs. 4a-4c, when the sleeve 19 is in the sealing position, the edge 9 of the respective receptacle 2 delimits on the sealing surface 21a of the annular gasket 21, towards the axis B, an annular working surface 48. This working surface 48 has a radial extension proportional to the diameter of the opening 9a of the respective receptacle 2 and is lapped in use by the aforesaid gas under pressure utilized to pressurize the inner environment of the receptacle 2 during the pressurizing phase.

**[0072]** The gas thus exerts a force on the working surface 48 of the annular gasket 21 in the direction of the compartment 39, which is thus transmitted to the sleeve 19; the larger the extension of the working surface 48, and, therefore, the larger the diameter of the opening 9a of the receptacle 2 is, the higher this force is.

**[0073]** Consequently, when the diameter of the openings 9a of the receptacles 2 processed by the machine 1 varies, the sleeve 19 must oppose a different force (greater as the diameter of the openings 9a increases) to reach the sealing position and co-operate fluid-tightly with the respective edge 9 of these receptacles 2.

**[0074]** This can be obtained by filling the upper cham-

ber 41, before the filling operation, with a gas at a pressure value P1 higher than the pressure value P0, proportional to the diameter of the opening 9a of the respective receptacle 2. This will result in a force of greater intensity generated by the new gas under pressure on the upper surface 43 of the plunger 40 and transmitted, by means of the bars 45, to the sleeve 19, capable of opposing the aforesaid force generated by the pressurizing gas and applied to the working surface 48 delimited on the annular gasket 21.

**[0075]** With reference to Figs. 5 and 6, the filling machine 1 further comprises cam means 50, 51 configured to control and decelerate the movement imposed by the plunger 40 on the sleeve 19 from the release position towards the sealing position.

**[0076]** In particular, the cam means comprise a fixed cam 51 extending circumferentially on the peripheral portion 3a of the carousel 3 for a given angle about the axis A and, for each filling device 4, a cam-follower roller 50 integral with the respective plunger 40.

**[0077]** In detail, the roller 50 is mounted on the stem 46 of the plunger 40, preferably by means of a bar 49 projecting radially therefrom, and is configured to co-operate with the cam 51 in order to ensure a gradual downward movement of the plunger 40 inside the compartment 39 and, consequently, of the sleeve 19 from the release position towards the sealing position.

**[0078]** Considering the direction of rotation of the carousel 3, the cam 51 has (Figs. 5 and 6):

- a release portion 52, having a height increasing with respect to the axis A and thus defining an upward ramp for the roller 50;
- a central portion 53 at constant height with respect to the axis A; and
- an attack portion 54, having a height decreasing with respect to the same axis A and thus defining a downward ramp for the roller 50.

**[0079]** Specifically, in normal operating conditions, each roller 50 co-operates exclusively with the attack portion 54, in order to ensure a gradual descent of the respective plunger 40 when this slides axially downwards inside the respective compartment 39, after discharge of the gas under pressure from lower chamber 42. In this way, the sleeve 19 can slide gradually from the release position towards the sealing position and the annular gasket 21 can come into contact with the edge 9 of the respective receptacle 2 gently, avoiding sudden movements that could cause crushing of the body 7 of the same receptacle 2.

**[0080]** In normal operating conditions, each roller 50 does not co-operate in contact with the release portion 52 and the central portion 53 and, therefore, the upward stroke-end position of the roller 50 and the release position of the sleeve 19 are designed so that there is a given non-zero distance between the roller 50 and the release 52 and central 53 portions of the cam 51.

**[0081]** Therefore, these release 52 and central 53 portions of the cam 51 essentially perform a safety function: they are configured to move the roller 50, and thus the plunger 40 and the sleeve 19, upwards if they remain blocked in the downward position, in the event of abnormal operating conditions occurring. In this latter case, the roller 50, and therefore the plunger 40 and the sleeve 19, do not reach the respective upward stroke-end position (for example, the release position for the sleeve 19).

**[0082]** Moreover, the release portion 52 has a slight inclination and a greater length with respect to the inclination and to the length of the attack portion 54, in order to guide the roller 50 to carry out an upward movement, avoiding sudden movements that could cause impacts. The steeper inclination and the smaller length of the attack portion 54 with respect to those of the release portion 52 are justified by the need to support the receptacle 2 to be filled quickly, once it has entered the carousel 3 by means of the input star wheel.

**[0083]** Operation of the filling machine 1 according to the present invention will be described below with reference to a single filling device 4 carried by the carousel 3 and to a single receptacle 2 to be filled.

**[0084]** In particular, Figs. 4a to 4c show the operation of the filling machine 1 during three subsequent operating conditions.

**[0085]** In detail, as illustrated in Fig. 4a, the receptacle 2 to be filled is fed from the carousel 3 in a position below the filling device 4 and is positioned so as to be arranged with the edge 9 of the body 7 abutting against the annular gasket 21 of the tubular body 11. For this purpose, the plunger 40 controls, by means of discharge of the gas under pressure from the lower chamber 42, the movement of the sleeve 19 from the release position to the sealing position. This movement takes place gradually due to interaction of the roller 50 with the attack portion 54 of the cam 51. Once sealed contact between the receptacle 2 and the tubular body 11 has been ensured, the valve 35 is opened to start the pressurizing phase: the gas under pressure contained in the chamber 34 flows out along the pressurizing-discharge circuit 31, into the receptacle 2, until the pressure therein reaches the pressure value of the tank 5 of the pourable product to be introduced into the receptacle 2.

**[0086]** At the end of this phase, as shown in Fig. 4b, the shutter 13 is moved, by means of the actuator 30, from the closed position to the open position. The pourable product can then flow out into the channel 12, through the outfeed opening 18 and, therefore, into the receptacle 2. Simultaneously, the gas contained in the receptacle 2 is ejected by means of the pressurizing-discharge circuit 31.

**[0087]** At the end of filling, as shown in Fig. 4c, the shutter 13 is moved into the closed position by means of the actuator 30, and the valve 35 is closed.

**[0088]** At this point, the valve 38 is opened to start the decompression phase: the receptacle 2 is depressurized by means of outflow of the gas contained in the upper

part of the body 7 along the decompression circuit 32, towards the chamber 37.

**[0089]** At the end of the decompression phase, the plunger 40 controls, by means of filling the lower chamber 42 with the gas under pressure, the movement of the sleeve 19 from the sealing position to the release position (Fig. 3). Advantageously, filling of the lower chamber 42 takes place before the roller 50 is in the release portion 52 of the cam 51, so as to avoid, in normal operating conditions, unwanted contact of the roller 50 with the aforesaid portion 52. At this point, while the roller 50 is passing over the central portion 53, the filled receptacle 2 is sent towards the outfeed starwheel, and a new empty receptacle 2 is positioned below the filling valve 8.

**[0090]** In the event of abnormal operating conditions occurring, due to which the plunger 40 and, therefore, the sleeve 19 remain blocked in the downward position, the roller 50 would come into contact with the release portion 52, which would control an upward movement of the roller 50. Consequently, the sleeve 19 would be moved upwards until reaching an intermediate position between the release and sealing positions. At this point the roller would co-operate with the central portion 53 and the receptacle 2, separated forcibly from the annular gasket 21, would be sent towards the output star wheel, and the filling machine 1 stopped to check for any problems.

**[0091]** It is clear that the above applies in the same manner to each filling device 4 and to each receptacle 2 to be filled.

**[0092]** The advantages of filling machine 1 according to the present invention will be clear from the foregoing description.

**[0093]** In particular, the roller 50 of each filling device 4 co-operates exclusively with the attack portion 54, which has a much smaller extension than that of the whole cam 51. In this way, overheating and the resulting wear of the parts in contact are greatly reduced.

**[0094]** Moreover, the use of coolants can be avoided, so as not to compromise the asepticity of the filling operation.

**[0095]** Finally, the roller 50 can be made using a less expensive material.

**[0096]** It is clear that modifications and variants can be made to the filling machine 1 described and illustrated without departing from the scope of protection defined by the claims.

**[0097]** In particular, the opening 9a of the receptacle 2 could have a non-circular, for example elliptical, shape and, therefore, the elastic stiffness of the gas spring 56 could be modified selectively as a function of the dimensions of the same opening 9a.

## Claims

1. A filling machine (1) configured for filling receptacles (2) with a pourable product under pressure; said fill-

ing machine (1) comprising at least one filling device (4) having a longitudinal axis (C) and including: a filling valve (8) selectively operable to feed said pourable product to a respective receptacle (2) through an opening (9a) of this latter, a sealing member (21) having a sealing surface (21a) configured to co-operate in use in a fluid-tight manner with an edge (9) of said opening (9a), and a support member (55) configured to maintain said opening (9a) coaxial with said sealing member (21) at least during the activation of said filling valve (8); wherein at least one of said sealing (21) and support (55) members is movable in use between:

- a sealing position, in which it determines the fluid-tight contact between said edge (9) of said opening (9a) and said sealing surface (21a); and
- a release position, in which it maintains a certain distance between said edge (9) of said opening (9a) and said sealing surface (21a);

said filling device (4) further comprising actuator means (56) configured to control the movement of said one of said sealing (21) and support (55) members between the said release and sealing positions; **characterized in that** said actuator means comprise a fluid actuator (56); and **in that** they further comprising cam means (50, 51) configured to control and slow down the movement imposed by said fluid actuator (56) to said one of said sealing (21) and support (55) members from said release position to said sealing position.

2. The machine according to claim 1, wherein said fluid actuator (56) comprises a compartment (39) and a moving member (40) movable in use in a fluid-tight manner inside said compartment (39) and configured to control said movement of said one of said sealing (21) and support (55) members between said release and sealing positions; said moving member (40) dividing said compartment into a first sealed chamber (41), fillable in use with a gas at a predetermined pressure value (P0), and into a second sealed chamber (42), which in use can be selectively filled with/emptied of a gas at a predetermined pressure value, so as to determine the movement of said moving member (40) inside said compartment (39).
3. The machine according to claim 2, wherein said cam means comprise a cam-follower element (50), connected to said moving member (40), and a fixed cam (51); said cam-follower element (50) being integral with said one of said sealing (21) and support (55) members and being movable in use away from or towards said cam (51).
4. The machine according to claim 3, wherein said cam (51) comprises a central portion (53) orthogonal to

said axis (C), a release portion (52) defining a ramp inclined with respect to said central portion (53) and to said axis (C), and an attack portion (54) defining a ramp inclined with respect to said central portion (53) and to said axis (C) and with opposite inclination to that of said release portion (52); said cam-follower element (50) co-operating exclusively with said attack portion (54) to gradually control said movement of said one of said sealing (21) and support (55) members from said release position towards said sealing position; said cam-follower element (50) co-operating with said release (52) and central (53) portions in the case in which said one of said sealing (21) and support (55) members remains blocked in said sealing position.

5. The machine according to claim 4, wherein said release portion (52) has an inclination that is different with respect to the inclination of said attack portion (54) and with respect to said central portion (53).
6. The machine according to claim 4 or 5, wherein said cam-follower element (50) is connected substantially rigidly to said moving member (40), so that a movement of said moving member (40) inside said compartment (39) corresponds to a movement of said cam-follower element (50); said moving member (40) being connected to said one of said sealing (21) and support (55) members by means of at least one rigid element (45), so that said movement of said moving member (40) inside said compartment (39) corresponds to a movement of said one of said sealing (21) and support (55) members.
7. The machine according to claim 6, wherein said cam-follower element (50) is maintained by said moving member (40), in normal operating conditions, at a non-zero distance from said release (53) and central (53) portions of said cam (51).
8. The machine according to any one of the preceding claims, wherein said filling valve (8) comprises a hollow body (11) coaxial with said axis (C), defining a flow channel (12) for said pourable product and terminating at an end (16) thereof with an output opening (18) configured to feed said pourable product to said receptacle (2); and wherein said sealing member (21) is movable with respect to said hollow body (11) between said sealed and release positions.
9. The machine according to claim 8, wherein said sealing member (21) is carried by a sleeve (19) sliding axially with respect to said hollow body (11).
10. The machine according to any one of claims 2 to 8, wherein said pressure value (P0) is modifiable as a function of the dimensions of said opening (9a) of



said receptacle (2) .

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FIG. 1

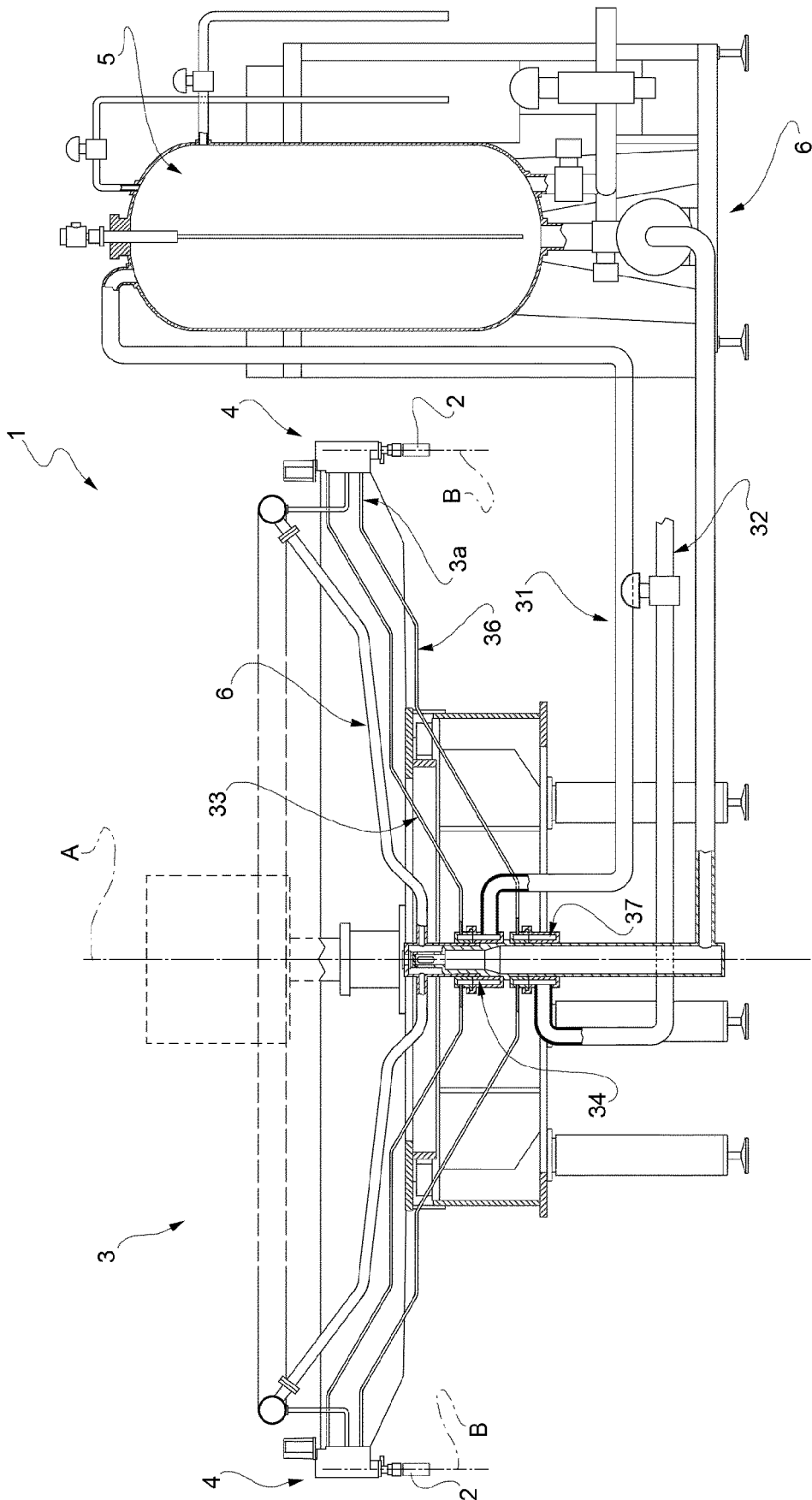


FIG. 2

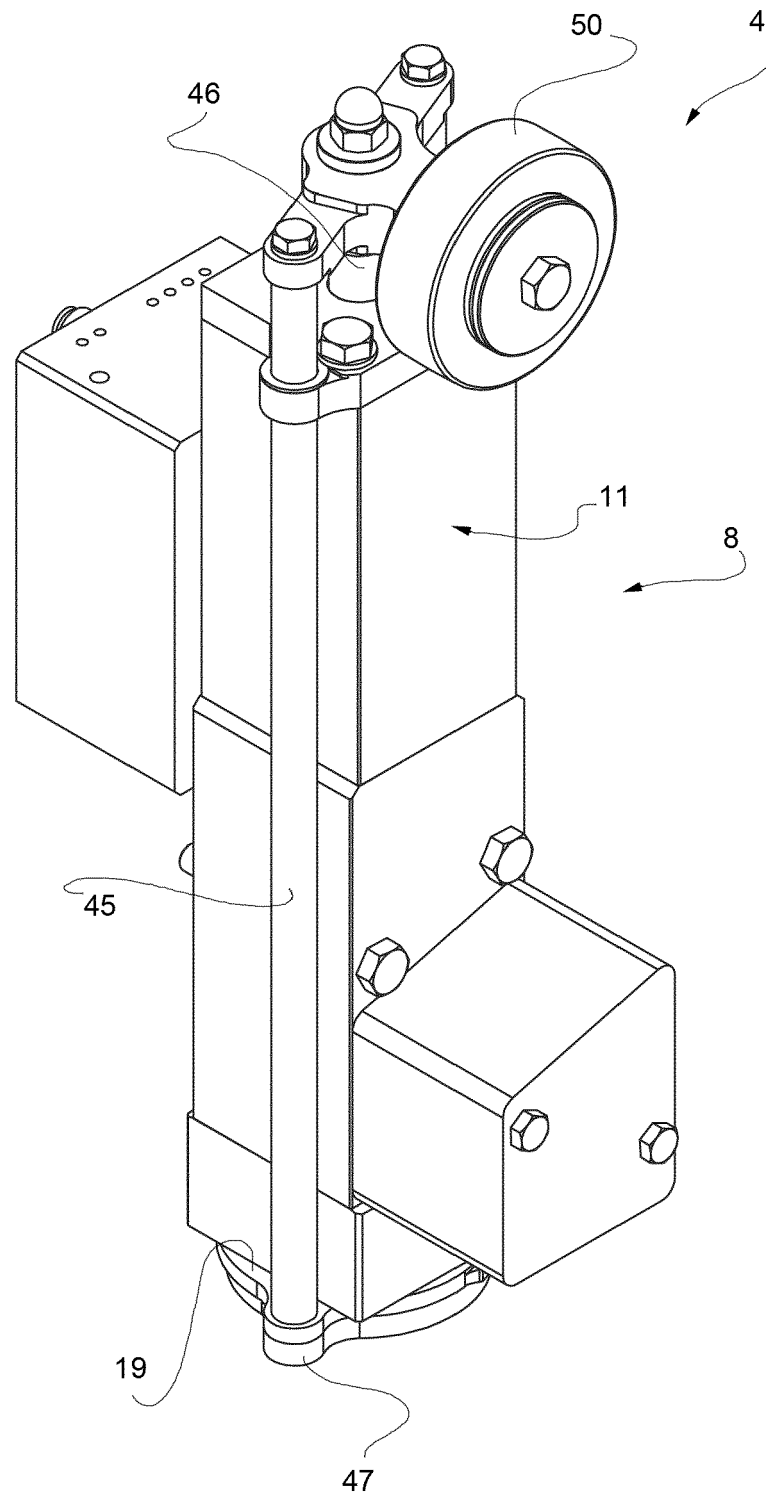


FIG. 3

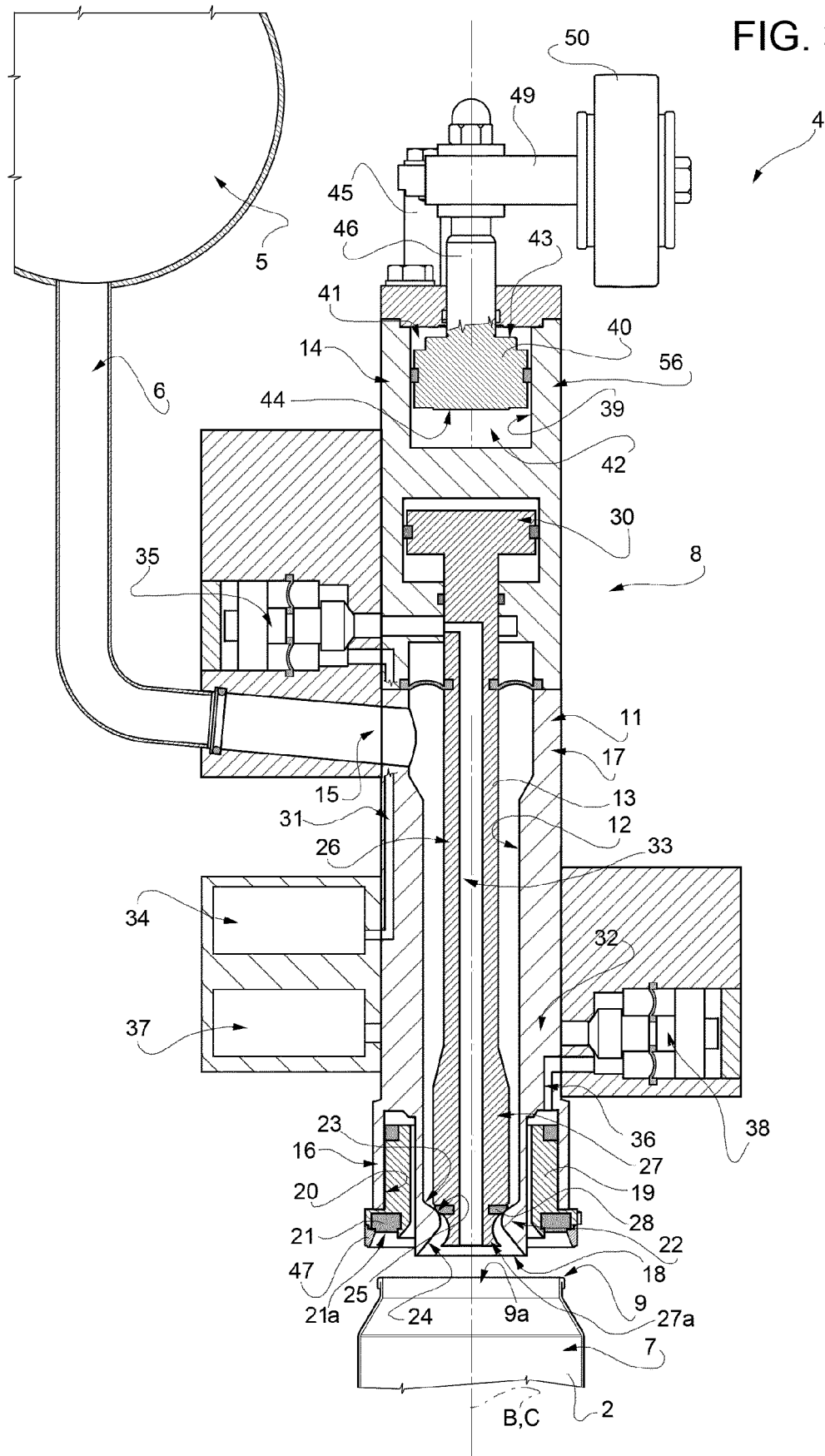


FIG. 4a

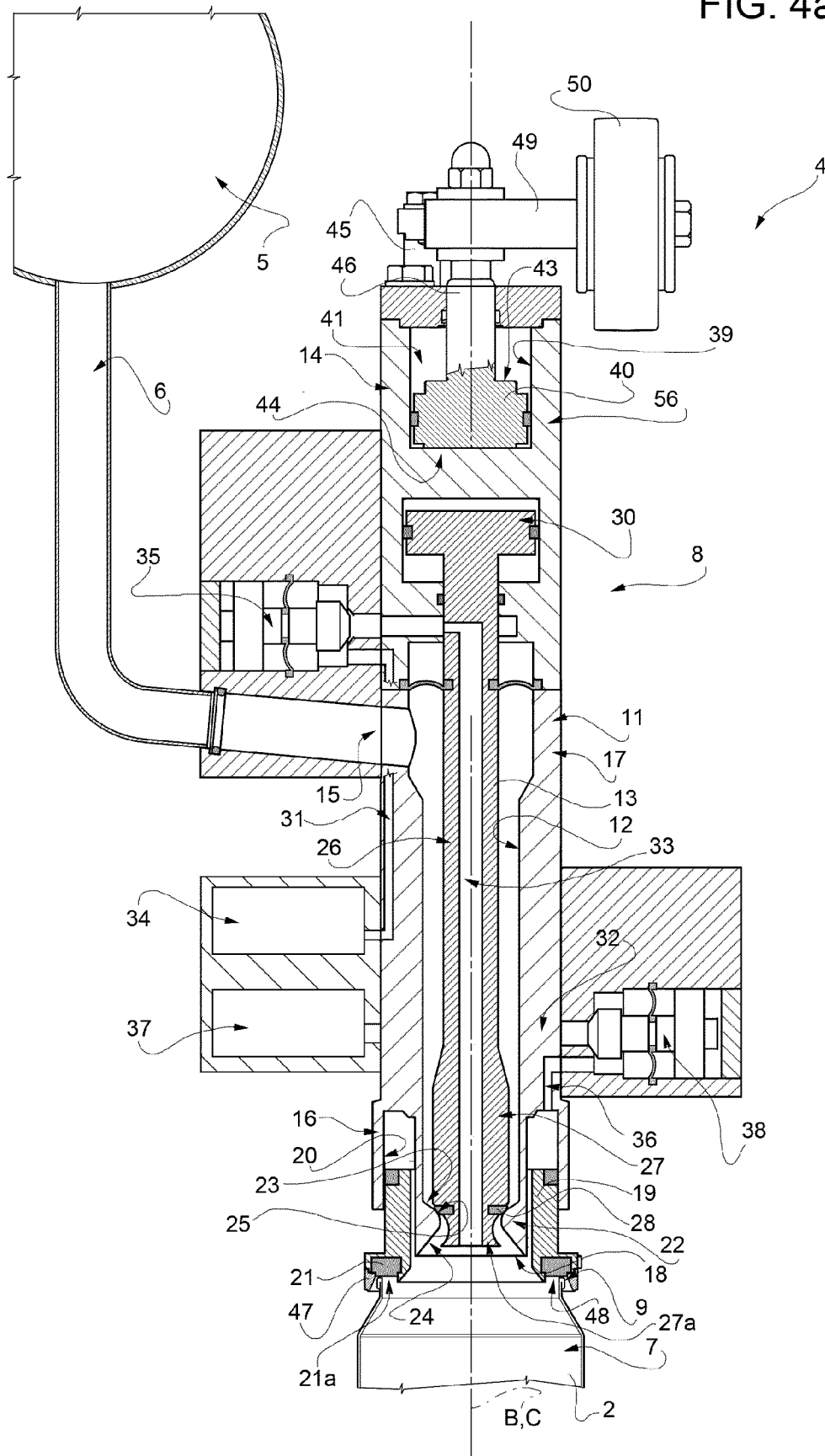


FIG. 4b

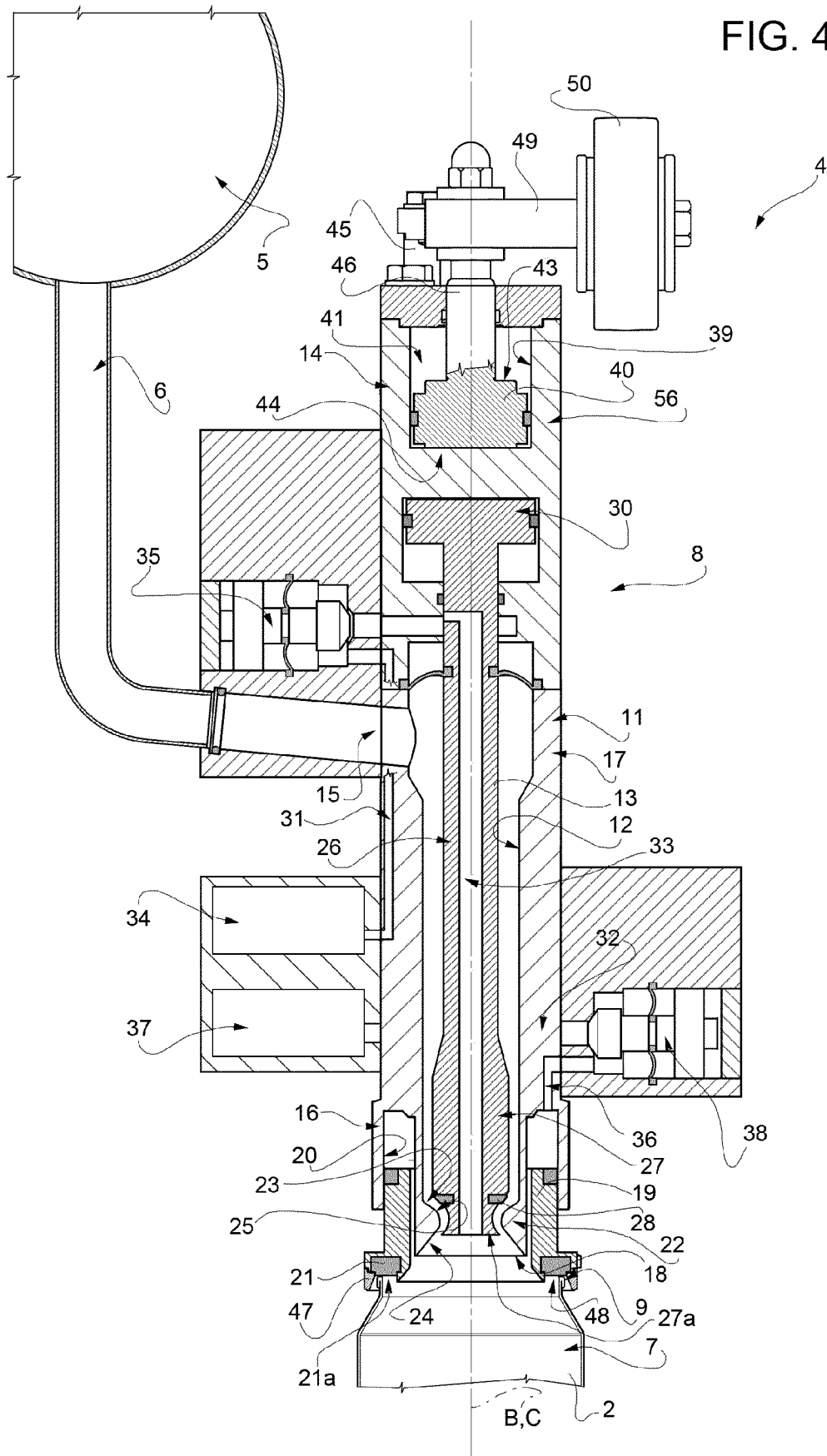


FIG. 4c

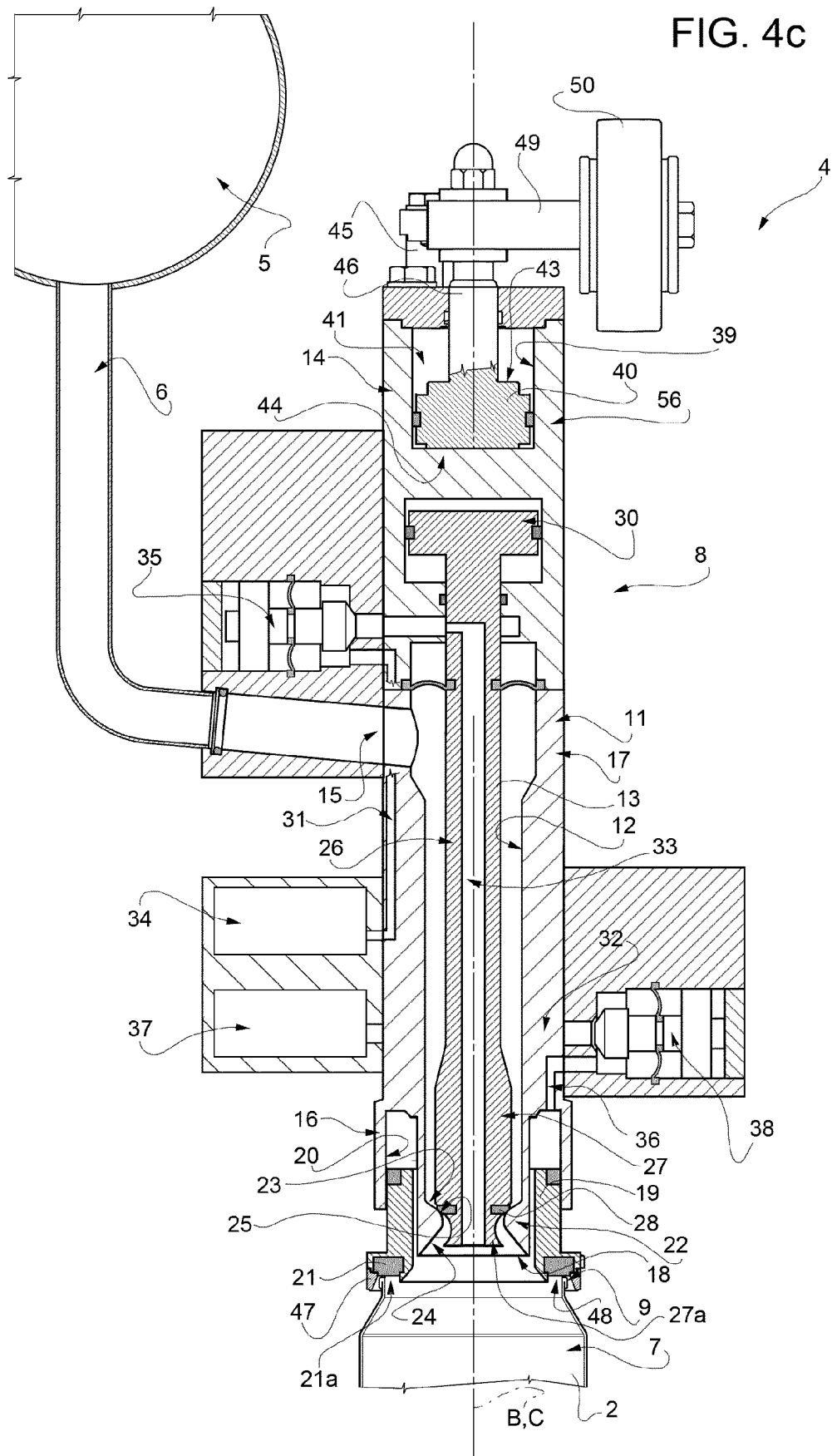


FIG. 5

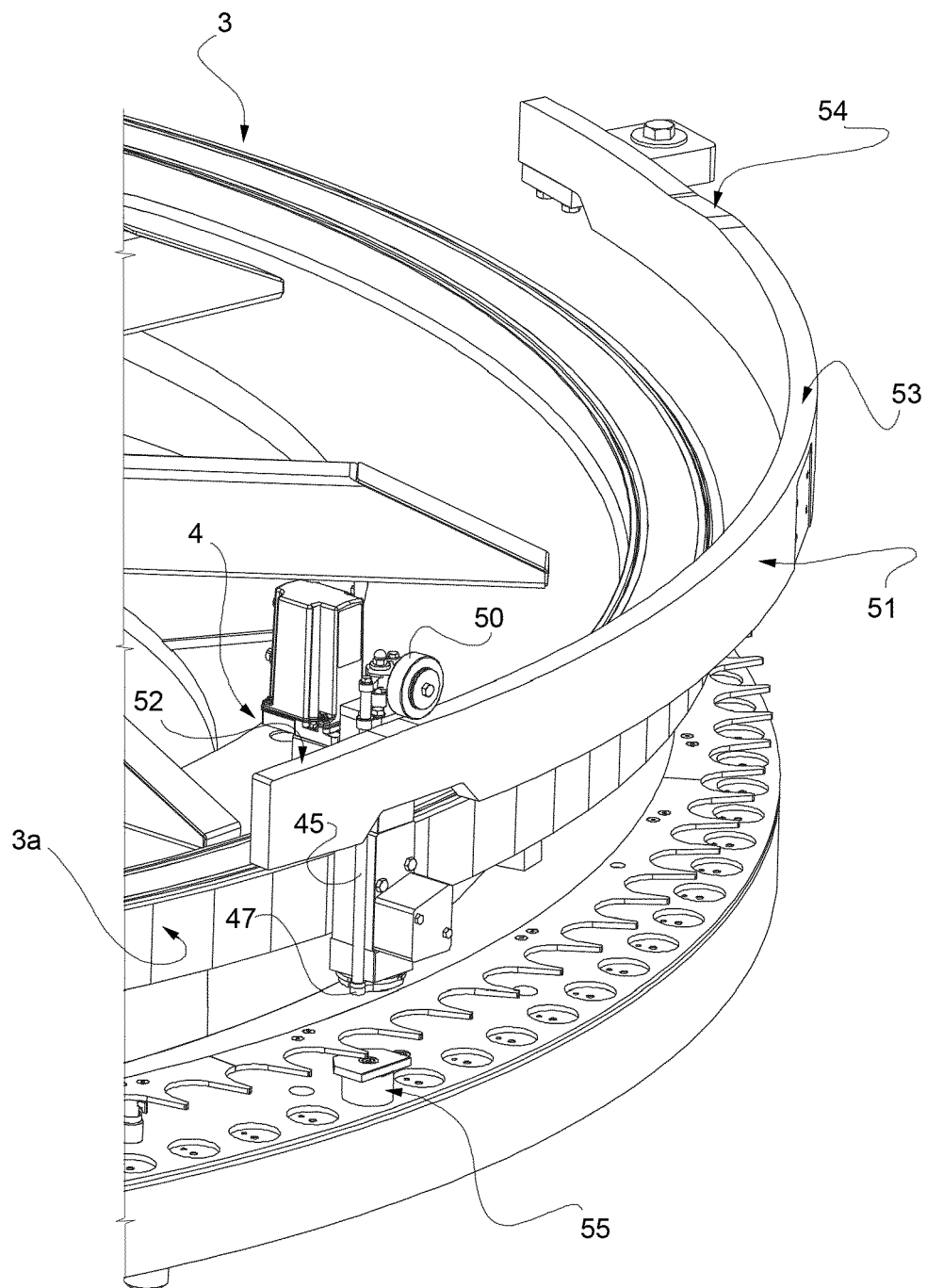
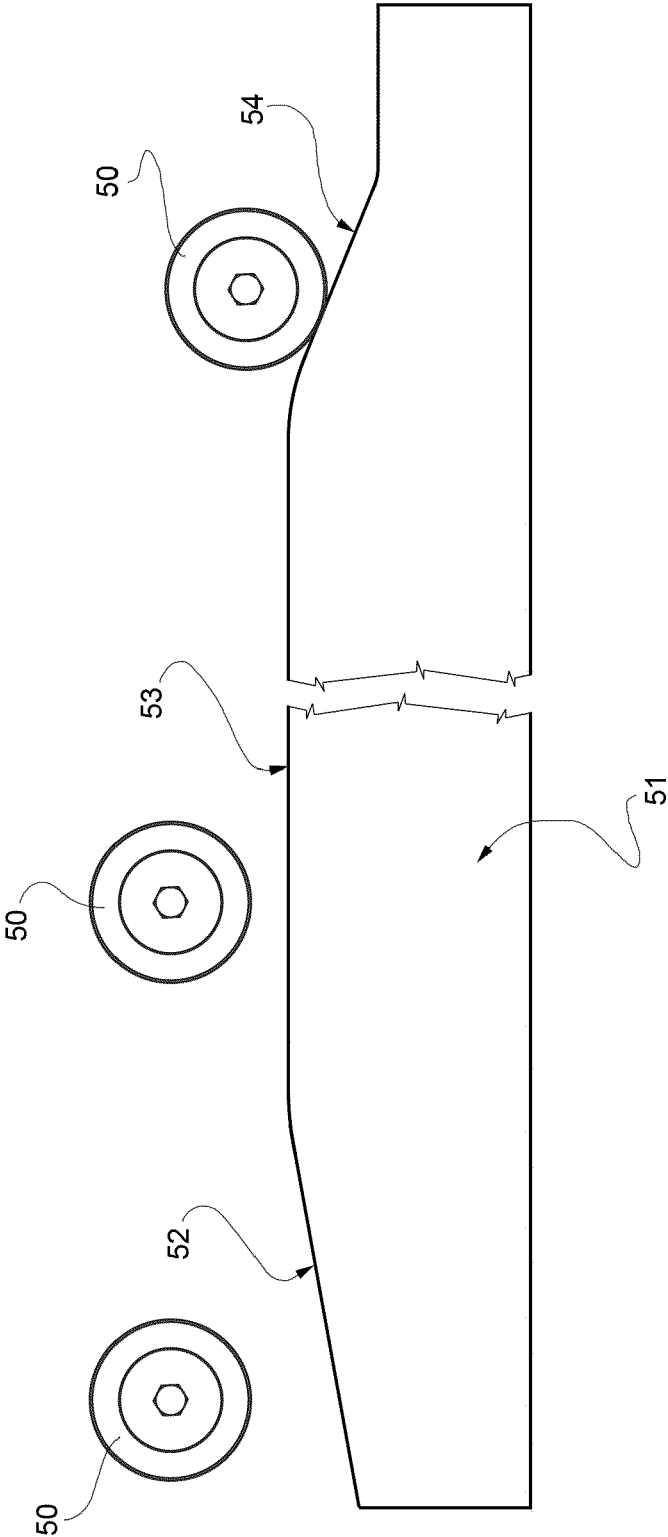




FIG. 6





## EUROPEAN SEARCH REPORT

Application Number  
EP 18 20 7851

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                  |                                                 |                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                    | Relevant to claim                               | CLASSIFICATION OF THE APPLICATION (IPC)    |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 0 634 357 A2 (METTE MANFRED [DE])<br>18 January 1995 (1995-01-18)<br>* column 5, line 29 - column 6, line 2;<br>figure *                      | 1-10                                            | INV.<br>B67C3/26<br>B67C3/06<br>B67C3/24   |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 0 080 774 A2 (CROWN CORK & SEAL CO [US]) 8 June 1983 (1983-06-08)<br>* page 5, line 7 - line 9 *<br>* page 6, line 8 - line 21; figures 1-4 * | 1-10                                            |                                            |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 10 2008 011109 A1 (KHS AG [DE])<br>3 September 2009 (2009-09-03)<br>* paragraphs [0003], [0004], [0024],<br>[0027]; figures 1-6 *             | 1-10                                            |                                            |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 94/10079 A1 (SIMONAZZI SPA [IT];<br>CONFORTI LUCIO [IT])<br>11 May 1994 (1994-05-11)<br>* page 9, line 17 - page 10, line 5;<br>figures 1,6 * | 1-10                                            |                                            |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 0 488 215 A1 (MITSUBISHI HEAVY IND LTD [JP]) 3 June 1992 (1992-06-03)<br>* column 8, line 8 - line 26; figures 1-16 *                         | 1-10                                            | TECHNICAL FIELDS<br>SEARCHED (IPC)<br>B67C |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | JP 2012 025435 A (MITSUBISHI HEAVY IND<br>FOOD & PACKAGING MACHINERY CO LTD)<br>9 February 2012 (2012-02-09)<br>* abstract; figures 1-7 *        | 1-10                                            |                                            |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                  |                                                 |                                            |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                  | Date of completion of the search<br>10 May 2019 | Examiner<br>Wartenhorst, Frank             |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                  |                                                 |                                            |

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 20 7851

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                                                          | Publication<br>date                                                                                          |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| EP 0634357 A2                             | 18-01-1995          | DE 4323746 A1<br>EP 0634357 A2                                                                                                      | 19-01-1995<br>18-01-1995                                                                                     |
| EP 0080774 A2                             | 08-06-1983          | AU 557696 B2<br>BR 8207010 A<br>CA 1194845 A<br>DE 3278812 D1<br>EP 0080774 A2<br>US 4442873 A                                      | 08-01-1987<br>11-10-1983<br>08-10-1985<br>01-09-1988<br>08-06-1983<br>17-04-1984                             |
| DE 102008011109 A1                        | 03-09-2009          | BR PI0905877 A2<br>DE 102008011109 A1<br>EP 2244967 A1<br>SI 2244967 T1<br>US 2011030843 A1<br>WO 2009106215 A1                     | 30-06-2015<br>03-09-2009<br>03-11-2010<br>29-01-2016<br>10-02-2011<br>03-09-2009                             |
| WO 9410079 A1                             | 11-05-1994          | AU 670609 B2<br>BR 9307350 A<br>DE 69302826 D1<br>DE 69302826 T2<br>EP 0665811 A1<br>US 5749403 A<br>WO 9410079 A1                  | 25-07-1996<br>01-06-1999<br>27-06-1996<br>02-01-1997<br>09-08-1995<br>12-05-1998<br>11-05-1994               |
| EP 0488215 A1                             | 03-06-1992          | AU 629136 B2<br>CN 1062116 A<br>DE 69101368 D1<br>DE 69101368 T2<br>EP 0488215 A1<br>KR 950004766 B1<br>NZ 240739 A<br>US 5282500 A | 24-09-1992<br>24-06-1992<br>14-04-1994<br>01-09-1994<br>03-06-1992<br>10-05-1995<br>27-09-1993<br>01-02-1994 |
| JP 2012025435 A                           | 09-02-2012          | JP 5345591 B2<br>JP 2012025435 A                                                                                                    | 20-11-2013<br>09-02-2012                                                                                     |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82