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

(57) There is described a filling machine (1) comprising a closed tank (10), filled with the pourable product up to a given level (L) and also containing a gas above such level (L), and at least one flow control valve (15) for controlling flow of the pourable product from the tank (10) to a respective receptacle (2) to be filled; the valve (15) comprises: a vertical tubular body (16) terminating with a narrowed bottom end mouth (17), fed in use with the pourable product from the tank (10) and apt to feed the pourable product to the respective receptacle (2); a shutter (18) movable through the tubular body (16) between a closed position, in which the shutter (18) sealingly closes the end mouth (17) and interrupts flowing of the pourable product from the tank (10) to the respective receptacle (2), and an open position, in which a gap is established between the shutter (18) and the end mouth (17); and electromagnetic actuator means (19) for controlling displacement of the shutter (18) between the open and closed positions, wherein the electromagnetic actuator means (19) are arranged above the level (L) of the pourable product in the tank (10) and include a movable driving element (36) coaxially connected in series to the shutter (18).

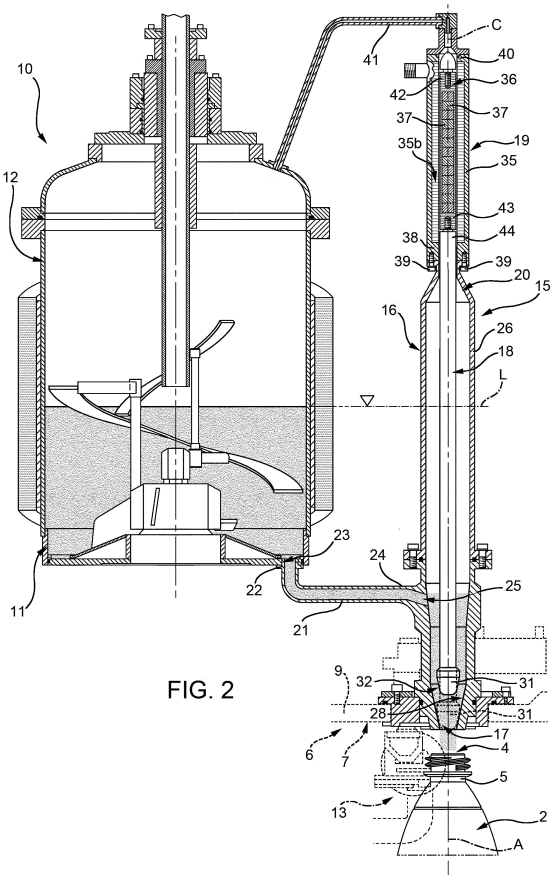


FIG. 2

EP 3 323 773 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a filling machine apt to fill receptacles with a pourable product, in particular a pourable product including solid particles suspended in a liquid phase, such as soft drinks or beverages containing fruit bits, fruit fibers and fruit sacs.

[0002] In addition, the present invention relates to a filling machine suitable for operating in aseptic or ultra clean conditions.

BACKGROUND ART

[0003] As known, there is an increasing demand from the market for soft drinks or beverages containing fruit particles or pieces, such as soft fruit bits, normally available in cubes or slices, fruit fibers, containing large portions of fruit cellulose, and fruit sacs, i.e. intact "pouch-like" structures of a citrus fruit, filled with or without liquid and having lengths up to 6-12 mm.

[0004] These kinds of beverages are normally stored in tanks before being delivered to the filling machines and then closed and sealed into receptacles for retail.

[0005] In order to prevent the deterioration and the degradation by microbial contamination of the pourable products and to prolong the maximum preservation times, it is often necessary to use filling machines which fill the receptacles in aseptic or ultra-clean conditions.

[0006] In general, such a filling machine is fed with aseptic or ultra-clean receptacles (for example receptacles which have previously been sterilised) and is adapted to provide receptacles filled with a sterilised product in aseptic or ultra-clean conditions.

[0007] A commonly-known filling machine basically comprises a carousel conveyor rotating about a rotation axis, a tank containing the product, and a plurality of filling units which are selectively connected with the tank and are supported by the carousel conveyor in a radially external position with respect to the rotation axis of the carousel conveyor itself.

[0008] Each filling unit comprises a filling valve selectively connecting the tank with the receptacle to be filled. Dosage of the pourable product may be done on the basis of the time during which the filling valve is maintained open or through a batcher valve, interposed between the tank and the filling valve.

[0009] Each filling valve basically comprises:

- a tubular body defining a flowing channel for the pourable product and terminating with at least one narrowed end mouth; and
- a shutter movably sliding within the flowing channel between a closed position, in which the shutter sealingly closes the narrowed end mouth and interrupts the flow of the pourable product, and an open position, in which a gap is established between the shutter and the narrowed end mouth so as to allow free flow of the pourable product through such narrowed end mouth.

[0010] In order to avoid any risk of external contamination, the movements of the shutter within the flowing channel are magnetically controlled. In practice, the shutter is magnetically coupled to a driving actuator arranged completely external to the tubular body. More specifically, the driving actuator is provided with one or more permanent magnets and is mounted onto the outer surface of the tubular body in a sliding manner; in a completely equivalent manner, the shutter is provided with one or more permanent magnets facing the respective permanent magnets of the driving actuator and magnetically attracted by the latter through the lateral wall of the tubular body. In this way, any axial displacement of the driving actuator produces a corresponding axial movement of the shutter.

[0011] This type of solution is disclosed for instance in WO 2013/057695 in the name of the same applicant.

[0012] In this case, the shutter comprises a substantially cylindrical main portion, sliding within the tubular body, and a closing head adapted to sealingly engage the narrowed end mouth of the tubular body in the closed position of the shutter itself.

[0013] More specifically, the main portion of the shutter integrally comprises a central cylindrical body, provided with the permanent magnets and housed with a radial gap within the tubular body, and a plurality of protrusions, projecting radially from the cylindrical body at different axial heights thereof and sliding in use along the inner surface of the tubular body itself.

[0014] In practice, the annular space between the cylindrical body of the shutter and the tubular body defines the passage for the pourable product with the solid particles; the radial projections of the shutter are so shaped and positioned to not hamper the flow of the particles.

[0015] This recently-proposed solution still leaves room for improvements, especially as to further ease flowing of the pourable product from the tank to the respective receptacle, even in presence of large-sized solid particles suspended in the pourable product and which may produce clogging issues.

DISCLOSURE OF INVENTION

[0016] It is therefore an object of the present invention to provide a filling machine, which is designed to meet the above need, and which is cheap and easy to implement.

[0017] According to the present invention, there is provided a filling machine as claimed in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A preferred embodiment is hereinafter disclosed for a better understanding of the present inven-

tion, by mere way of non-limitative example and with reference to the accompanying drawings, in which:

Figure 1 shows a front view, with parts removed for clarity, of a filling machine provided with a plurality of filling units according to the present invention;
Figure 2 shows a larger-scale, axial section of one filling unit of the Figure 1 filling machine along with a product tank of such machine; and
Figure 3 shows a larger-scale detail of Figure 2.

BEST MODE FOR CARRYING OUT THE INVENTION

[0019] Number 1 in Figure 1 indicates as a whole a filling machine to fill receptacles, in particular bottles 2, in aseptic or ultra-clean conditions (known per se and not shown) with a pourable food product, in particular a liquid product with solid particles, i.e. solid parts immersed or suspended in the liquid product; typical examples of this type of pourable food product are soft drinks or beverages containing fruit particles, such as soft fruit bits, fruit fibers and fruit sacs having average lengths up to 6-12 mm.

[0020] Machine 1 is clearly also adapted to fill bottles 2 with other types of pourable food products, such as milk, still water, carbonated water, fruit juices, beer, soft drinks and beverages in general as well as high viscosity liquids. Machine 1 is also adapted to fill bottles 2 with emulsions and suspensions.

[0021] As visible in Figures 1 and 2, each bottle 2 has a longitudinal axis A and comprises:

- a bottom wall 3 substantially perpendicular to axis A;
- a mouth 4, opposite to bottom wall 3, to allow the filling of the bottle 2 by machine 1 and the following pouring of the pourable product from the bottle 2 itself; and
- a neck 5 arranged immediately below mouth 4.

[0022] In the example shown, bottles 2 are made of plastics; however, machine 1 may be also used for other types of containers, such as containers made of aluminum, steel, glass and composites.

[0023] Machine 1 comprises a conveying device 6 (Figure 1) that serves to fill bottles 2 while they are conveyed along a transfer path P.

[0024] In the preferred embodiment as illustrated in Figure 1, conveying device 6 comprises a carousel 7, which is mounted to rotate continuously (anticlockwise in Figure 1) about a vertical axis B.

[0025] Carousel 7 receives a succession of sterilized empty bottles 2 from an input star wheel (known per se and not shown), and releases a succession of filled bottles 2 to an output star wheel (also known per se and not shown); both input and output star wheels rotate continuously about respective longitudinal axes parallel to axis B.

[0026] Machine 1 further comprises a plurality of filling units 8 for filling respective bottles 2 while they are advanced by carousel 7. Filling units 8 are equally spaced angularly about axis B and are mounted along a peripheral portion 9 of carousel 7. Filling units 8 have respective axes C parallel to axis B and are moved by carousel 7 along path P; in the present case, path P has a circular configuration about axis B.

[0027] Machine 1 also includes a closed or sealed tank 10 (Figure 2) common to all filling units 8 and which is filled with the pourable product up to a given level L as well as at a given pressure value; tank 10 also contains a gas, typically air, above level L of the pourable product. In practice, in use a lower portion 11 of tank 10 contains the pourable product up to level L and an upper portion 12 of the tank 10 itself is filled with gas.

[0028] Tank 10 is normally maintained in overpressure with respect to the ambient pressure.

[0029] Tank 10 conveniently houses internally an agitator 10a, known per se and not further described.

[0030] Tank 10 is normally arranged centrally on carousel 7. As a possible alternative not shown, tank 10 may be also arranged externally with respect to carousel 7.

[0031] As filling units 8 are identical to one another, only one will be described hereafter for the sake of simplicity; it is however clear that the following description will apply to any filling unit 8.

[0032] As shown in particular in Figure 2, filling unit 8 comprises a support device 13 (known per se and only schematically shown), adapted to receive and retain one bottle 2 in a vertical position, in which such bottle 2 has its axis A coaxial with axis C and parallel to axis B of carousel 7; filling unit 8 also comprises a flow control valve 15 for selectively controlling flow of the pourable product from tank 10 to a respective bottle 2 to be filled as the support device 13 travels along path P.

[0033] Filling unit 8 is conveniently arranged above the bottle 2 to be filled.

[0034] With particular reference to Figure 2, valve 15 basically comprises:

- a vertical tubular body 16 of axis A, terminating at the bottom with a narrowed end mouth 17, which is fed in use with the pourable product from tank 10 and is apt to feed the pourable product to the respective bottle 2 to be filled;
- a shutter 18 housed within tubular body 16 and movable along axis A to allow or prevent flow of the pourable product from tank 10 to end mouth 17 and to the respective bottle 2; and
- an electromagnetic actuator 19 for controlling displacement of shutter 18 along axis C.

[0035] In particular, tubular body 16 has another narrowed end mouth 20, opposite to end mouth 17 and which is coaxially engaged by shutter 18 in a sliding manner.

[0036] End mouth 17 is arranged below level L of the pourable product within tank 10 and is connected to the latter through a conduit 21 (Figure 2); more specifically,

conduit 21 has one end 22, connected to a bottom opening 23 of tank 10, and one opposite end 24, connected to a radial through opening 25 formed in an intermediate portion of tubular body 16. Preferably, conduit 21 extends below tank 10 and laterally with respect to tubular body 16.

[0037] Tubular body 16 has a substantially cylindrical main portion 26 connecting end mouths 17 and 20 and having an approximately constant inner diameter with respect to axis C.

[0038] End mouth 17 is directly fitted to a respective opening formed through peripheral portion 9 of carousel 7.

[0039] End mouth 20 interiorly has a conical configuration tapering from main portion 26.

[0040] Shutter 18 is coaxially housed within tubular body 16 and comprises a cylindrical main portion 30, engaging end mouth 20 in a sliding manner and extending towards end mouth 17, and a closing head 31, axially protruding from main portion 30 and configured to cooperate in a fluid-tight manner with end mouth 17.

[0041] In particular, closing head 31 terminates with a conical surface 32, which is complementary to the surface of tubular body 16 interiorly delimiting end mouth 17 and is configured to cooperate in use with this latter surface to sealingly close fluidic connection of valve 15 with tank 10.

[0042] Shutter 18 is selectively moved by electromagnetic actuator 19 within tubular body 16 between a closed position (Figure 2, dotted lines), in which the closing head 31 of shutter 18 sealingly closes end mouth 17 and interrupts flowing of the pourable product from tank 10 and conduit 21 to the respective bottle 2, and an open position (Figure 2, solid lines), in which a gap is established between the closing head 31 of shutter 18 and end mouth 17 so as to allow free flowing of the pourable product through the end mouth 17 itself.

[0043] With particular reference to Figures 2 and 3, electromagnetic actuator 19 is advantageously arranged above the level L of the pourable product in tank 10 and includes:

- a vertical tubular stator 35, axially fitted in series to tubular body 16 of valve 15, arranged above the tubular body 16 itself and provided with electrically-powered coils 35b (known per se and only schematically shown); and
- a driving element 36, which is axially movable through a chamber 35a defined by stator 35, is provided with a plurality of permanent magnets 37 and is coaxially connected in series to shutter 18.

[0044] In particular, stator 35 has a bottom end portion 38 coaxially connected to end mouth 20 of tubular body 16, e.g. by screws 39, and a top end portion 40 connected to upper portion 12 of tank 10 by a conduit 41, so as to put into communication the internal environment of stator 35 and tubular body 16 with the internal environment of tank 10 and to ensure that such environments are always maintained at the same pressure value.

[0045] Driving element 36 is defined by a vertical plunger 42 coaxially engaging stator 35, internally housing the plurality of magnets 37 and directly coupled, at its bottom end 43, to a top end 44 of shutter 18, opposite to closing head 31.

[0046] By controlling excitation of coils 35b of stator 35, driving element 36 can be displaced into a first axial position (not shown), in which it maintains shutter 18 in the closed position on end mouth 17 of tubular body 16, and in a second axial position (Figures 2 and 3), in which it maintains closing head 31 of shutter 18 detached from end mouth 17 of a given amount so allowing the pourable product to flow through the end mouth 17 itself.

[0047] Both first and second axial position of driving element 36 are stable positions, i.e. they can be maintained independently of powering stator 35. This can be achieved for instance by providing respective ring-shaped, magnetic attraction elements (known per se and not shown) substantially at bottom and top end portions 38, 40 of stator 35; such magnetic attraction elements may exert an attraction force on driving element 36, as engaged by the latter, to maintain the driving element 36 itself in the first and second axial position, respectively. The magnetic attraction elements may be made of a ferromagnetic material, may include a permanent magnet or even may be a combination thereof, depending on the required attraction force.

[0048] As a possible alternative not shown, electromagnetic actuator 19 may be also defined by any type of linear motor, such as such as a voice coil, or a linear magnetic actuator as described in EP-B-2881636, whose content relative to the linear magnetic actuator itself is incorporated in the present specification.

[0049] Operation of machine 1 will now be described with reference to the filling of one bottle 2, and therefore to one filling unit 8, and as of the instant in which such bottle 2 is received by support device 13 of filling unit 8 from the input star wheel in order to be filled with the pourable product.

[0050] In particular, bottle 2 is centered in known manner with respect to filling unit 8 and driving element 36 of electromagnetic actuator 19 is in the first axial position and maintains shutter 18 in the closed position on end mouth 17 of tubular body 16 so as to prevent the pourable product from flowing into the bottle 2.

[0051] Starting from this condition and during the rotation of carousel 7 about axis B, upon excitation of coils 35b of stator 35, driving element 36 of electromagnetic actuator 19 is moved to the second axial position so displacing shutter 18, coupled thereto, into the open position (Figure 2). As a result, the pourable product flows from tank 10 and conduit 21 to end mouth 17 under the gravity action and/or under the effect of overpressure of tank 10 with respect to the ambient pressure and/or under the mechanical action of agitator 10a housed within the tank 10 itself. Hence, the pourable product starts to fill the

bottle 2.

[0052] Electromagnetic actuator 19 may be also activated to position the shutter in a modulating condition, e.g. according to a desired slow movement from the open position towards the closed position, or to remain in a position that reduces the flow (this is possible with some products containing small particles or a low concentration of particles).

[0053] After a given time necessary to complete filling of the bottle 2 with the pourable product, excitation of coils 35b of stator 35 produces the displacement of driving element 36 of electromagnetic actuator 19 into the first axial position so carrying closing head 31 of shutter 18 again in the closed position on end mouth 17. During production, all these steps are continuously repeated to fill a plurality of bottles 2.

[0054] In addition to the described example of excitation of the coils after a predetermined time, this can also be done after achieving some other measurable parameter, such as reaching a given weight or volume or level in the bottle 2.

[0055] The advantages of filling machine 1 according to the present invention will be clear from the foregoing description.

[0056] In particular, thanks to the fact that, in each filling unit 8, the electromagnetic actuator 19 is arranged above the level L of the pourable product in the tank 10 and includes a movable driving element 36 coaxially connected in series to the shutter 18 of the valve 15, there is no possibility or need that the pourable product with solid particles passes between the magnetic interacting elements (in the present case, the driving element 36 and the stator 35) with possible clogging issues (since the magnetically interacting elements should be maintained as close as possible to one another for correctly operating).

[0057] In addition, since there is no need to maintain shutter 18 near to the wall of tubular body 16 (no magnetic interaction involves the shutter 18), the passage between the shutter 18 itself and the tubular body 16 can be designed as large as desired so as to avoid any possible clogging issue with relatively large particles.

[0058] Last but not least, the fact that the first and second axial position of the driving element 36 are stable positions allows a relevant saving in electric energy.

[0059] In view of the above, the filling machine 1 according to the present invention allows to increase the control on particles integrity and to considerably reduce the occurrence of obstructions, even partial ones, thus limiting accordingly the need for maintenance intervention and, as a consequence, down times.

[0060] Clearly, changes may be made to filling machine 1 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0061] In particular, the filling machine 1 may also comprise only one single filling unit 8 cyclically fed with a bottle 2 to be filled.

Claims

1. A filling machine (1) for filling receptacles (2) with a pourable product, in particular with a pourable product including solid particles in a liquid phase, said machine (1) comprising:

   - a closed tank (10) filled with the pourable product up to a given level (L) and also containing a gas above said level (L); and
   - at least one flow control valve (15) for controlling flow of the pourable product from said tank (10) to a respective receptacle (2) to be filled;
   wherein said valve (15) is in use placed above the receptacle (2) to be filled and comprises:

      - a vertical tubular body (16) terminating with at least one narrowed bottom end mouth (17), fed in use with the pourable product from said tank (10) and apt to feed the pourable product to the respective receptacle (2) to be filled;
      - a shutter (18) movable through said tubular body (16) between a closed position, in which the shutter (18) sealingly closes said end mouth (17) and interrupts flowing of the pourable product from the tank (10) to the respective receptacle (2), and an open position, in which a gap is established between the shutter (18) and said end mouth (17) so as to allow free flowing of the pourable product through said end mouth (17); and
      - electromagnetic actuator means (19) for controlling displacement of the shutter (18) between said open and closed positions;
      characterized in that said electromagnetic actuator means (19) are arranged above the level (L) of the pourable product in the tank (10) and include a movable driving element (36) coaxially connected in series to said shutter (18).

2. The machine as claimed in claim 1, wherein said end mouth (17) of the tubular body (16) is arranged below the level (L) of the pourable product in the tank (10).

3. The machine as claimed in claim 1 or 2, wherein said end mouth (17) of the tubular body (16) is arranged below said tank (10).

4. The machine as claimed in any one of the foregoing claims, wherein said shutter (18) has a closing head (31), adapted to sealingly close said end mouth (17) in said closed position, and an opposite end portion (44) connected to said driving element (36).

5. The machine as claimed in any one of the foregoing claims, wherein said tank (10) has a lower portion

(11), containing the pourable product up to said level (L), and an upper portion (12) containing gas.

6. The machine as claimed in claim 5, wherein said driving element (36) is movable through a chamber (35a) of the electromagnetic actuator means (19); and wherein said chamber (35a) is connected to the inside of said tubular body (16) and to the inside of the upper portion (12) of said tank (10).

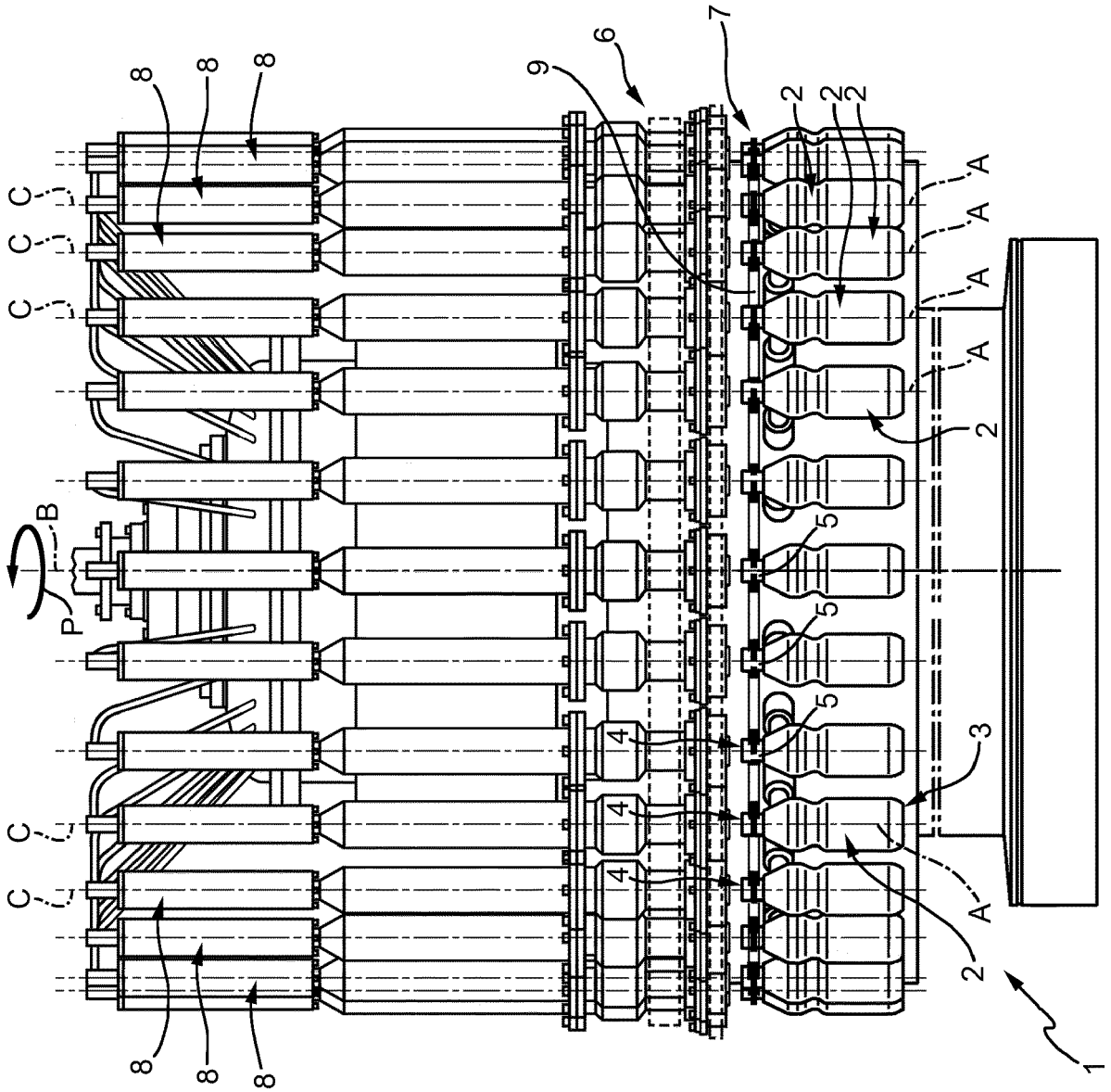
7. The machine as claimed in claim 6, wherein said chamber (35a) of said electromagnetic actuator means (19) is connected to said upper portion (12) of said tank (10) by a first conduit (41).

8. The machine as claimed in claim 6 or 7, wherein said electromagnetic actuator means (19) include a tubular stator (35), which is coaxially connected in series to said tubular body (16) at an end (20) of the latter opposite said end mouth (17), is provided with electrically-powered coils (35b) and defines said chamber (35a), and wherein said driving element (36) is provided with one or more permanent magnets (37).

9. The machine as claimed in any one of claims 5 to 8, wherein said end mouth (17) is connected to said lower portion (11) of said tank (10) by a second conduit (21), laterally arranged with respect to said tubular body (16).

10. The machine as claimed in any one of the foregoing claims, wherein said driving element (36) is movable between a first axial position, in which it maintains said shutter (18) in the closed position on said end mouth (17), and a second axial position, in which it maintains said shutter (18) in said open position; and wherein said first and second axial position are stable positions not needing electrical powering of the electromagnetic actuator means (19).

FIG. 1



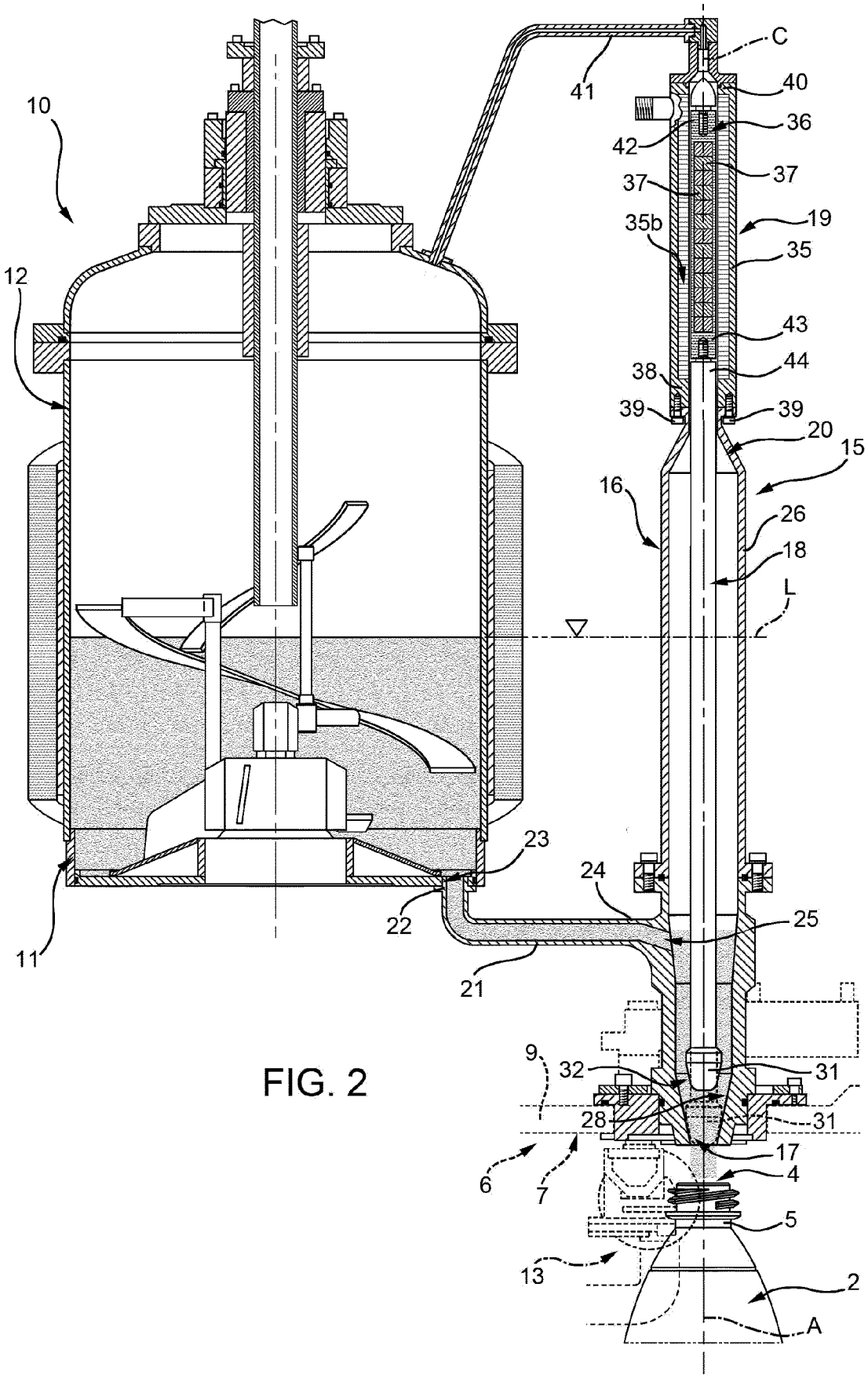

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FIG. 2

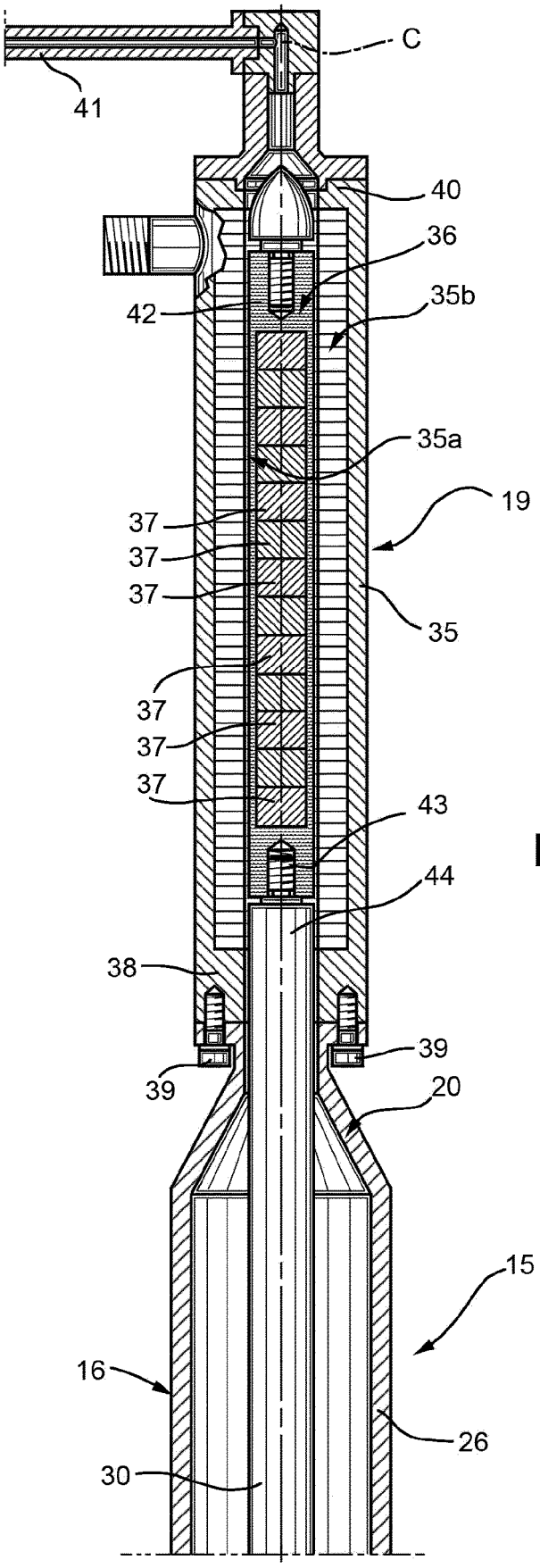

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FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 16 30 6519

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 2 921 451 A1 (SIDEL SPA CON SOCIO UNICO [IT]) 23 September 2015 (2015-09-23) * figures 1-7 * * paragraphs [0015] - [0058] *	1-10	INV. B67C3/28
X	DE 10 2007 035872 A1 (KRONES AG [DE]) 5 February 2009 (2009-02-05) * figure 1 * * paragraphs [0007], [0021] - [0026] *	1-8	
X	DE 10 2005 003222 A1 (KRONES AG [DE]) 27 July 2006 (2006-07-27) * figures 1-3 * * paragraphs [0018] - [0021] *	1-7	

TECHNICAL FIELDS SEARCHED (IPC)

B67C
F16K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 April 2017	Pardo Torre, Ignacio

CATEGORY OF CITED DOCUMENTS

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