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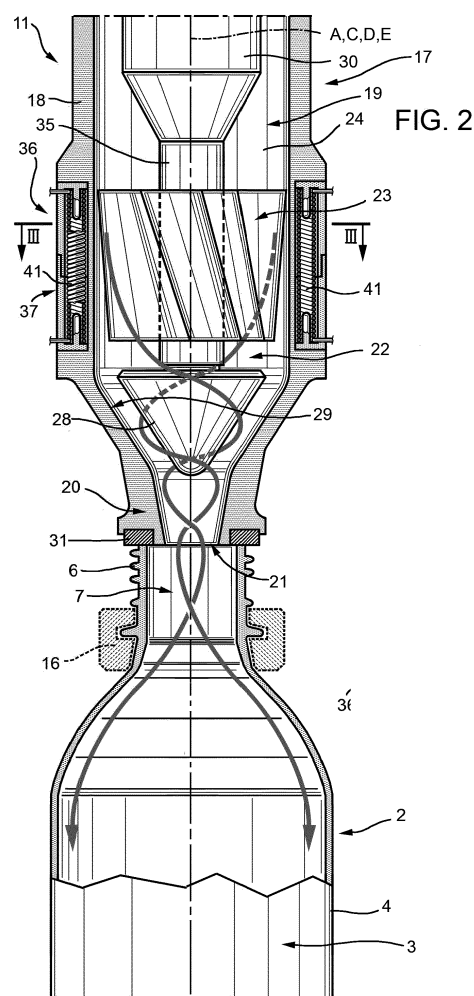
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(54) **FILLING VALVE, FILLING APPARATUS HAVING SUCH A FILLING VALVE AND METHOD OF OPERATING SUCH A FILLING VALVE**

(57) There is described a filling valve (17) for filling a receptacle (2) with a pourable product, comprising a valve body (18) having an inner flow channel (19) for the pourable product, an outlet mouth (20) arranged at one end of the flow channel (19) and through which the pourable product flows, in use, to fill a respective receptacle (2), a shutter (22) arranged within the flow channel (19) and being adapted to control the flow of the pourable product through the outlet mouth (20); and a swirl-inducing member (23) rotatably arranged inside the flow channel (19) and being adapted to induce a rotational movement of the pourable product flowing through the outlet mouth (20).



## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a filling valve for filling carbonated or non-carbonated pourable products into receptacles, such as containers or bottles made of glass, plastics, aluminum, steel or composites.

**[0002]** The present invention also relates to a filling apparatus having a plurality of such filling valves.

**[0003]** Furthermore, the present invention relates to a method of operating such a filling valve.

### BACKGROUND ART

**[0004]** Filling apparatuses for filling pourable products such as carbonated liquids (e.g. sparkling water, soft drinks and beer) or non-carbonated liquids (e.g. still water, juices, teas, sport drinks, liquid cleaners, wine, emulsions, suspensions, high viscosity liquids and beverages containing pulps) into receptacles such as bottles, containers or the like typically comprise a plurality of filling valves adapted to direct the pourable product into the receptacles.

**[0005]** Different types of filling apparatuses are known in the art. In the recent years, filling apparatuses of the rotary type have become more and more popular as providing for increased production capacities.

**[0006]** Typically, such a filling apparatus comprises a conveying carousel rotatable around a respective rotation axis and carrying a plurality of filling valves peripherally arranged on the conveying carousel. The filling apparatus receives empty receptacles at a receiving station, advances the receptacles along an arc-shaped conveying path and fills the receptacles with the pourable product. In particular, the empty receptacles are transferred to the respective filling valves at the receiving station, are advanced together with the respective filling valves to the transfer station and during advancement from the receiving station to the transfer station the receptacles are filled by the respective filling valves with the pourable product.

**[0007]** A typical filling apparatus also comprises a supply tank containing the pourable product, the supply tank being in fluidic connection with the filling valves.

**[0008]** A typical filling valve comprises a valve body having an inlet for receiving the pourable product from the supply tank, a flow channel for receiving the pourable product through the inlet and an outlet mouth through which the pourable product is directed into the receptacle for filling the latter. The filling valve also comprises a shutter for opening or closing of the outlet mouth so as to control the filling of the receptacle. During the filling of receptacles foaming is a critical issue, which, in particular, is more critical for carbonated pourable products than for non-carbonated pourable products.

**[0009]** Foaming of the pourable product during the filling process can lead to loss of pourable product filled

into the receptacles and leads to a loss in the accuracy of the amount of pourable product filled into the receptacles. Furthermore, foaming may lead to reduced filling accuracy even without loss of the pourable product.

**[0010]** The possible foaming requires that the filling speed is limited.

**[0011]** As it advantageous to have filling speeds as high as possible means have been developed direct to a reduction of foaming, so as to allow increased filling speeds.

**[0012]** A first approach consists in engaging the receptacles to the respective outlet mouths of the respective filling valves so as to obtain a sealing of the receptacle from the outside. Prior to the filling the receptacles are pressurized by the introduction of a pressurizing gas and the receptacles are depressurized during the filling of the receptacles with the pourable product.

**[0013]** A second approach, which is typically combined with the first approach, consists in placing a swirl-inducing member within the fluid channel, the swirl-inducing member being adapted to induce a rotational movement on the pourable product so that the pourable product enters the receptacle by flowing along the internal walls of the receptacle.

**[0014]** Typically, such a swirl-inducing member comprises guiding surfaces, which are inclined with respect to the longitudinal axis of the valve body so as to change the flow direction and thereby introducing the rotation of the pourable product.

**[0015]** However, the use of these swirl-inducing members comes along with some drawbacks.

**[0016]** A first drawback lies in the fact that the efficiency of the swirl-inducing members used depends on the type of the pourable product, its viscosity, the details of the inner shape of the receptacle and the filling level of the pourable product within the receptacle. As the swirl-inducing members cannot adapt their performance during the filling process, during the filling the efficiency will not be optimal during all of the filling process. As well, if the type of receptacle (and therewith the inner shape) is changed or another type of pourable product is to be filled a change of the swirl-inducing member must be performed or a loss in the efficiency must be accepted. Changing the swirl-inducing member is, however, laborious and therefore increases the overall production costs.

**[0017]** A second drawback is that the swirl-inducing member needs to be removed if another kind of pourable product is to be filled for which the presence of a swirl-inducing member is inappropriate. This can e.g. be the case when the pourable product contains solid pieces.

**[0018]** A third drawback is that the swirl-inducing member needs to be removed if the filling valve is to be used in a manner to centrally fill the pourable product into the receptacles.

**[0019]** However, as mentioned above, the removal of the swirl-inducing member of the filling valve, as necessary in the latter two cases, is laborious increasing overall

production costs. In particular, one has to consider that a typical filling apparatus comprises a plurality of filling valves peripherally arranged on a conveying carousel and, thus, the removal of the swirl-inducing member has to be done for each single filling valve.

#### DISCLOSURE OF INVENTION

**[0020]** It is therefore an object of the present invention to provide a filling valve to overcome, in a straightforward and low-cost manner, at least one of the aforementioned drawbacks.

**[0021]** According to the present invention, there is provided a filling valve as claimed in claim 1.

**[0022]** Furthermore, according to the present invention, there is also provided a filling apparatus as claimed in claim 12.

**[0023]** Additionally, according to the present invention there is provided a method of operating a filling valve as claimed in claim 13.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]** A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a filling apparatus having a plurality of filling valves according to the present invention, with parts removed for clarity;

Figure 2 is a sectionized view of a filling valve according to the present invention, with parts removed for clarity; and

Figure 3 is a sectionized view along plane III-III of Figure 2, with parts removed for clarity.

#### BEST MODES FOR CARRYING OUT THE INVENTION

**[0025]** Number 1 in Figure 1 illustrates as a whole a filling apparatus for filling receptacles, such as bottles 2, containers or the like, with a pourable product such as carbonated liquids (e.g. sparkling water, soft drinks and beer) or non-carbonated liquids (e.g. still water, juices, teas, sport drinks, liquid cleaners, wine, emulsions, suspensions, high viscosity liquids and beverages containing pulps).

**[0026]** The following description will refer without any limitative scope to bottles 2 made from glass, plastics, aluminum, steel or composites.

**[0027]** As visible in Figure 2, each bottle 2 has a longitudinal axis A and comprises a hollow main body 3 bounded by sidewalls 4 substantially parallel to axis A, a bottom wall (not shown) substantially perpendicular to axis A and by a top neck 6 substantially coaxial with the axis A; neck 6 delimits a pouring/inlet opening 7 of bottle 2 opposite to the bottom wall.

**[0028]** With particular reference to Figures 1 and 2, filling apparatus 1 comprises:

- a conveying device, in particular a conveying carousel 8 rotatable around a central axis B, in particular axis B having a vertical orientation, being adapted to advance a succession of bottles 2 along a conveying path P from a receiving station 9 to a transfer station 10; and
- a plurality of filling units 11, each one having a longitudinal axis C, in particular being parallel to axis B and being adapted to retain one respective bottle 2, in particular coaxial to axis C and to fill the respective bottle 2 with the pourable product during advancement of the respective bottle 2 between stations 9 and 10.

**[0029]** Preferentially, path P is arc-shaped and bottles 2 are advanced along path P through rotation of carousel 8 around axis B.

**[0030]** Preferentially, units 11 are peripherally arranged on carousel 8, even more preferentially equally spaced angularly around axis B. In particular, units 11 advance along a conveying path Q, even more particular through rotation of carousel 8 around axis B. Preferentially, path Q is circular. Preferably, path Q and P being parallel between stations 9 and 10.

**[0031]** Apparatus 1 also comprises a storage device (not shown and known as such) for the pourable product, the storage device being adapted to be in fluid connection with units 11 for supplying the pourable product to units 11.

**[0032]** Preferentially, apparatus 1 also comprises an inlet conveyor, in particular an inlet star wheel 12 adapted to advance empty bottles 2 to station 9 and an outlet star wheel 13 adapted to receive filled bottles 2 at station 10 and to advance them to further treatment apparatuses, such as labeling apparatuses, capping apparatuses etc.

**[0033]** With particular reference to Figure 2, each unit 11 comprises:

- a retaining assembly, in particular having a gripping member 16, adapted to receive and to retain the respective bottle 2 during advancement along path P; and
- a filling valve 17 adapted to feed the pourable product into the respective bottle 2 during advancement of the respective bottle 2 along path P.

**[0034]** Preferentially, each retaining assembly, in particular the respective gripping member 16 is configured to retain the respective bottle 2 coaxial to axis C during advancement along path P.

**[0035]** Each filling valve 17 is conveniently arranged above the respective bottle 2 to be filled during advancement of the respective bottle 2 between stations 9 and 10.

**[0036]** Preferably, each filling valve 17 is adapted to be in fluid connection with the storage unit so as to direct the pourable product from the storage unit to the filling valve 17.

**[0037]** In more detail, each filling valve 17 comprises:

- a valve body 18 having an inner flow channel 19 for the pourable product;
- an outlet mouth 20, in particular having an outlet opening 21, being arranged at one end of flow channel 19 and through which the pourable product flows, in use, to fill a respective bottle 2;
- a shutter 22 arranged, in particular coaxially arranged, within flow channel 19 and being adapted to control the flow of the pourable product through flow channel 19, in particular to open or close outlet mouth 20, even more particular to open or close the respective outlet opening 21; and
- a swirl-inducing member 23 arranged inside flow channel 19, in particular being coaxially arranged within flow channel 19 and being adapted to induce a rotational movement of the pourable product flowing within flow channel 19 through outlet mouth 20, in particular opening 21 into the respective bottle 2.

**[0038]** In particular, each member 23 is adapted to induce a rotational movement of the pourable product flowing within flow channel 19 through outlet mouth 20 for directing the pourable product onto the inner portions of sidewalls 4 during the filling of the respective bottle 2.

**[0039]** Preferentially, each filling valve 17 also comprises an inlet portion (not shown and known as such) being arranged on the other end of flow channel 19 opposite to the end at which the respective outlet mouth 20 is arranged and through which the pourable product is fed to flow channel 19. In particular, each respective inlet portion is fluidically connected to the storage device and is adapted to establish a fluid connection between the storage device and the respective flow channel 19.

**[0040]** Preferentially, each filling valve 17, in particular the respective inlet portion, comprises at least one valve element (known as such) configured to open or close the fluid connection between the storage device and the respective flow channel 19.

**[0041]** In the preferred embodiment shown, each filling valve 17 is carried by carousel 8.

**[0042]** In more detail, each valve body 18 has a substantially cylindrical configuration and the respective flow channel 19 is defined by a cavity provided within valve body 18 itself.

**[0043]** Preferentially, each flow channel 19 has a main portion 24, in particular having a substantially cylindrical configuration. Preferentially, the respective end of each flow channel 19 at which the respective outlet mouth 20 is arranged, is tapered towards outlet mouth 20.

**[0044]** In more detail, each shutter 22 is coaxially arranged within the respective flow channel 19 and extends along a respective longitudinal axis D.

**[0045]** Preferentially, each shutter 22 is axially moveable between an open position, at which it allows the pourable product to freely flow through flow channel 19 and outlet mouth 20, in particular outlet 21 to fill the respective bottle 2; and a closed position, at which it sealingly closes outlet mouth 20, in particular outlet 21 (i.e.

in the closed configuration the pourable product is hindered from flowing through flow channel 19 and out of outlet mouth 20, in particular outlet 21).

**[0046]** In more detail, each shutter 22 comprises an interaction element 28 adapted to interact with a respective sealing zone 29 of valve body 18, in particular sealing zone 29 partially delimiting flow channel 19, so as to open or close outlet mouth 20. Preferentially, each interaction portion 28 is tapered towards the respective outlet mouth 20; in particular each interaction portion 28 has a truncated cone configuration.

**[0047]** In more detail, each shutter 22 further comprises a control portion 30 extending along the respective longitudinal axis D and being connected to interaction element 28. Preferentially, each control portion 30 extends from the end of flow channel 19 distal to the respective outlet mouth 20 (in the proximity of the respective inlet portion) towards the end of flow channel 19 being proximal to the respective outlet mouth 20.

**[0048]** Preferentially, each filling valve 17 also comprises an actuator device (not shown and known as such) adapted to actuate the axial movement of the respective shutter 22 for moving the respective shutter 22 between the open and the closed position.

**[0049]** In further detail, each outlet mouth 20 further comprises an engagement zone 31 adapted to engage with the respective neck 6 of the respective bottle 2 so as to seal the respective bottle 2 from the outer environment prior to the filling of the respective bottle 2 with the pourable product, in particular in the case of the pourable product being a carbonated pourable product.

**[0050]** In the case of the filling of a non-carbonated pourable product, the respective bottle 2, in particular the respective neck 6 can be positioned below of and in a defined distance from filling valve 17, in particular from the respective outlet mouth 20. In other words, when filling a non-carbonated pourable product, it is not required to establish contact between the respective neck 6 and the respective engagement zone 31. Preferably, each filling valve 17 also comprises pressurizing means (not shown and known as such) adapted to pressurize the respective bottle 2 prior to the filling of the respective bottle 2 with the pourable product, in particular by feeding a pressurizing gas into the bottle; and depressurizing means (not shown and known as such) apt to depressurize the respective bottle 2 during the filling with the pourable product, in particular by recovering the escaping gas.

**[0051]** With particular reference to Figures 2 and 3, advantageously, each swirl-inducing member 23 is rotatably arranged within the respective flow channel 19. In other words, member 23 is adapted to rotate around a respective rotation axis E, axis E preferentially being parallel to axis C.

**[0052]** Preferentially, each swirl-inducing member 23 comprises at least one guiding surface 32 adapted to induce the rotational movement of the pourable product during rotation of the swirl-inducing member 23. In the

example shown in Figures 2 and 3, each swirl-inducing member 23 comprises a plurality of respective guiding surfaces 32, each one protruding away, in particular protruding radially away, from the respective axis E of the respective swirl-inducing member 23.

**[0053]** In the embodiment shown, each guiding surface 32 has a continuous structure. Furthermore, in the example shown, each guiding surface 32 is inclined with respect to axis E.

**[0054]** In an alternative not shown, guiding surface 32 could extend parallel to axis E. In another alternative not shown, each guiding surface could be defined by a respective groove provided within an outer lateral surface of the respective swirl-inducing member 23. In an even further alternative not shown, each guiding surface could have a discontinuous structure.

**[0055]** Preferentially, each shutter 22 rotatably carries the respective swirl-inducing member 23. Preferably, each shutter 22 carries the respective member 23 in such a manner that the axial movement of shutter 22 (i.e. for moving shutter 22 into the closed or open position) also leads to an axial movement of the respective member 23. In particular, each swirl-inducing member 23 is coupled to the respective shutter 22, preferentially by means of a bearing member, in particular an annular bearing member (e.g. a bush bearing; not shown and known as such).

**[0056]** Preferentially, each swirl-inducing member 23 has an annular structure and comprises a respective through-hole. Preferably, each swirl-inducing member 23 surrounds a section 35 of the respective shutter 22, in particular of the respective control portion 30; i.e. the respective shutter 22, in particular the respective control portion 30 extend through the respective through-hole.

**[0057]** Preferentially, each section 35 has a cross-sectional diameter smaller than the main cross-sectional diameter of the respective control portion 30.

**[0058]** Preferentially, each filling valve 17 comprises a control unit 36 adapted to control the respective swirl-inducing member 23 into:

- an operative configuration, at which the swirl-inducing member is configured to induce the rotational movement of the pourable product flowing through the flow channel 19 and the respective outlet mouth 20, in particular for directing, in use, the flow of the pourable product along the inner portions of sidewalls 4 of the respective bottle 2 to be filled; and
- a rest configuration, at which the respective swirl-inducing member 23 is configured not to direct, in use, the flow of the pourable product along the inner portions of sidewalls 4 of the respective bottle 2 to be filled.

**[0059]** Thus, with the respective swirl-inducing member 23 being controlled into the rest configuration, the pourable product is directed centrally out of outlet mouth 20.

**[0060]** In other words, in the rest configuration each swirl-inducing member 23 substantially leaves the flow of the pourable product through the respective flow channel 19 and through the respective outlet mouth 20 unhindered. Or in even other words, in the rest configuration each swirl-inducing member 23 does not induce a significant rotational movement of the pourable product, which would result in directing, in use, the flow of the pourable product onto the inner portions of sidewalls 4 of the respective bottle 2 to be filled.

**[0061]** In particular, it is preferable to control each swirl-inducing member 23 into the respective rest configuration, when filling the respective bottle 2 with a non-carbonated pourable product. Preferably, when filling the respective bottle 2 with a non-carbonated pourable product, the respective bottle 2 is typically, in use, positioned below of and at a defined distance from the respective filling valve 17.

**[0062]** In particular, each unit 36 is configured to control the respective swirl-member 23 into the operative or rest configuration by actuating or disabling/suspending/suppressing rotation of the respective swirl-inducing member 23 around the respective rotation axis E. Even more particular, each unit 36 is configured to control the respective swirl-member 23 into the operative configuration by actuating, in use, rotation of the respective member 23 around the respective axis E; and to control the respective member 23 into the rest configuration by disabling/suspending/suppressing, in use, rotation of the respective member 23 around the respective axis E.

**[0063]** In particular, each swirl-inducing member 23 is adapted to induce the rotational movement of the pourable product as a consequence of the rotation of the swirl-inducing member 23 itself and the interaction of the respective guiding surface or guiding surfaces 32 with the flow of the pourable product.

**[0064]** Preferentially, each control unit 36 is also adapted to control the respective shutter 22 between the relative open and the closed position. Even more preferentially, each control unit 36 is adapted to control the respective member 23 into the operative configuration or the rest configuration when controlling the respective shutter 22 into the open position.

**[0065]** Preferentially, each control unit 36 is configured to control the rotational speed of the respective swirl-inducing member 23 as a function of the type of pourable product and/or the viscosity of the pourable product and/or the inner shape of the respective bottle 2 and/or the filling level of the pourable product within the bottle 2 during the filling of the respective bottle 2, in particular for optimizing the filling process. It should be noted that the characteristics of the rotational movement of the pourable product are directly related to the rotational speed of members 23. Thus, by controlling the rotation speed of members 23 it is possible to control the optimal working condition of members 23.

**[0066]** Preferentially, each control unit 36 comprises an actuation assembly 37 adapted to generate a mag-

netic field interacting with the respective swirl-inducing member 23. In particular, each actuation assembly 37 is adapted to generate a rotating magnetic field, even more particular each actuation assembly 37 is configured to control the rotational speed of the respective member 23 by controlling the angular speed of the rotating magnetic field. Preferentially, each actuation assembly 37 is also adapted to generate a fixed magnetic field.

**[0067]** In particular, each actuation assembly 37 is configured to generate a rotating magnetic field for setting the respective member 23 into the operative configuration (i.e. to actuate, in use, rotation of the respective swirl-inducing member 23 around the respective axis E). Preferentially, each actuation assembly 37 is configured to generate a fixed magnetic field for setting the respective member 23 into the rest configuration (i.e. in the case the pourable product shall not be directed onto the inner portion of sidewalls 4 of the respective bottle 2 to be filled, a possible angular movement of member 23 due to the flow of the pourable product is suspended by exerting a stabilizing force through the application of the fixed magnetic field; in other words, the flow of pourable product cannot set the respective member 23 into rotation). Preferentially, each actuation assembly 37 is at least partially arranged within the respective valve body 18.

**[0068]** Favorably, each actuation assembly 37 at least partially surrounds the respective flow channel 19.

**[0069]** In particular, each actuation assembly 37 is substantially positioned on the level (at the same elevation) of the respective member 23.

**[0070]** In the preferred embodiment shown in Figures 2 and 3, each actuation assembly 37 comprises a plurality of coil elements 41 configured to generate a magnetic field, in particular a rotating magnetic field; and a power source 42 for generating an electrical current within the coil elements.

**[0071]** Preferably, each coil element 41 is arranged within a respective housing cavity provided within the respective valve body 28. In particular, the respective housing cavities are provided within the respective sidewall of the respective valve body 28.

**[0072]** Alternatively, each actuation assembly 37 could comprise a plurality of permanent magnets and being adapted to rotate around axis C so as to generate a rotating magnetic field.

**[0073]** In another alternative, actuation assembly 37 may also comprise one or more fixed magnets for generating the fixed magnetic field for setting the respective swirl-inducing member 23 into the rest configuration. In such an alternative, the application of a rotating magnetic field by coil elements 41 would also need to overcome the static force exerted by the fixed magnets.

**[0074]** Preferentially, each swirl-inducing member 23 comprises a plurality of magnetic or ferromagnetic interaction elements 43 adapted to interact with the magnetic field generated by the respective actuation assembly 37. In particular, interaction elements 43 being equally spaced angularly around axis E.

**[0075]** Preferentially, each swirl-inducing member 23 is of a plastics material. In particular, interaction elements 43 are incorporated into the respective swirl-inducing member 23. Even more particular, interaction elements 43 are fully encapsulated within the respective swirl-inducing member 23. Preferably, interaction elements 43 are incorporated within guiding surfaces 32.

**[0076]** Alternatively, each swirl-inducing member 23 can be made of a material having ferromagnetic properties, in particular stainless steel, even more particular ferritic stainless steel. In this case, no further interaction elements are required. The application of a magnetic field by the respective actuation assembly 37 allows to magnetize swirl-inducing member 23 and to actuate or to disable/suspend/suppress rotation of swirl-inducing member 23.

**[0077]** In use, a succession of empty bottles 2 is advanced by star wheel 12 to station 9. At station 9 each empty bottle 2 of the succession of bottles 2 is transferred to a respective filling unit 11 and is further advanced by rotation of carousel 8 through axis B from station 9 to station 10. During advancement along path P, each bottle 2 is filled by the respective filling unit 11 with the pourable product. Then, each filled bottle 2 is transferred to star wheel 13 at station 10 and is further advanced, in particular to further treatment apparatuses.

**[0078]** In more detail, each bottle 2 is transferred at station 9 to one respective filling unit 11, in particular each bottle 2 is received by the respective retaining assembly, in particular the respective gripping member 16.

**[0079]** Each retaining assembly, in particular the respective gripping member 16 retains the respective bottle 2 during advancement of the respective bottle 2 along path P from station 9 to station 10.

**[0080]** During advancement of each bottle 2, in particular the bottle 2 being retained by the respective retaining assembly, along path P, each bottle 2 is filled by the respective filling valve 17.

**[0081]** In further detail, the filling process by the respective filling valve 17 comprises the steps of:

- arranging the respective bottle 2 below outlet mouth 20 of the respective filling valve 17; and
- directing/feeding the pourable product from the respective flow channel 19 through the respective outlet mouth 20 into the respective bottle 2.

**[0082]** In particular, when filling carbonated pourable products, the filling process also comprises the step of establishing a sealing contact between the respective bottle 2 and the respective outlet mouth 20, in particular neck 6 of the respective bottle 2 sealingly engages with engagement zone 31 of the respective outlet mouth 20.

**[0083]** Preferentially, the step of establishing a sealing contact is done prior to directing/feeding the pourable product into the respective bottle 2.

**[0084]** In particular, when filling non-carbonated pourable products, it is sufficient, to position the respective

bottle 2, in particular the respective neck 6 below of and at a defined distance from the respective filling valve 17, in particular the respective outlet mouth 20. Still, also in the case of filling a non-carbonated pourable product, it is possible to provide for the step of establishing a sealing contact prior to directing/feeding the pourable product into the respective bottle 2.

**[0085]** In further detail, the step of directing/feeding the pourable product into the respective bottle 2 comprises the phase of moving the respective shutter 22 from the closed position to the open position. At the end of the step of directing/feeding the pourable product into the respective bottle 2, the respective shutter 22 is moved from the open position to the closed position.

**[0086]** In particular, when filling carbonated pourable products, prior to moving the respective shutter 22 from the closed to the open position, the respective bottle 2 is pressurized by the respective pressurizing means, in particular by feeding a pressuring gas into the respective bottle 2. During the feeding of the pourable product, the respective bottle 2 is depressurized by the respective depressurizing means, in particular by recovering the escaping gas.

**[0087]** Advantageously, the respective control unit 36 controls the respective member 23 into the rest or operative configuration. In particular, the respective control unit 36 controls the respective member 23 into the operative configuration by the respective actuation assembly 37 generating a rotating magnetic field; the rotating magnetic field interacting with the respective member 23, in particular interacting with the respective interaction elements 43 and thereby inducing the rotation of the respective member 23.

**[0088]** Preferably, the respective control unit 36 controls the respective member 23 into the rest configuration by the respective actuation assembly 37 generating a fixed magnetic field.

**[0089]** Preferentially, the respective control unit 36 controls the respective member 23 into the operative configuration for inducing a rotary movement on the pourable product flowing through the respective flow channel 19 towards the respective outlet mouth 20 into the respective bottle 2. In other words, control unit 36 controls the respective member 23 into the operative configuration for directing the pourable product flowing through the respective flow channel 19 and through the respective outlet mouth 20 into the respective bottle 2 onto the respective inner portions of sidewalls 4 of the respective bottle 2.

**[0090]** Preferentially, each control unit 36 controls the rotational speed of the respective member 23 as a function of the type of pourable product and/or the viscosity of the pourable product and/or the inner shape of the receptacle and/or the filling level of the pourable product within the respective bottle 2 during the filling of the receptacle, when having controlled the respective member 23 into the operative configuration.

**[0091]** Preferably, each control unit 36 controls the respective member 23 into the rest configuration for allow-

ing for the flow of the pourable product through the respective flow channel 19 without being directed towards the inner portions of the respective sidewalls 4 of the respective bottle 2. The flow of the pourable product is left undisturbed. In other words, no rotational movement is induced onto the flow of the pourable product. In even other words, the pourable product is centrally filled into the respective receptacle 2.

**[0092]** The advantages of filling valves 17 according to the present invention will be clear from the foregoing description.

**[0093]** In particular, filling valves 17 having a swirl-inducing member 23 being rotatable around axis E provide for an overall improved filling process of bottles 2 with a pourable product. Filling valves 17 also allow for an increased flexibility.

**[0094]** Furthermore, filling valves 17 can be used both for inducing a rotational movement into the flow of the pourable product through flow channels 19 and out of outlet mouths 20 and for allowing for a normal, undisturbed flow of the pourable product. Thus, filling valves 17 can be used for different kinds of pourable products and/or different methods of filling without the need of any laborious variations of the filling valve 17.

**[0095]** Additionally, the speed of rotation of swirl-inducing members 23 is easily controlled by the rotating magnetic field. This allows to control the speed of rotation of swirl-inducing members 23 not only based on the type of pourable product, its viscosity and/or the shape of the bottle, but also during the filling process itself so as to adapted the operation of swirl-inducing members 23 on the level of the pourable product already filled into bottles 2.

**[0096]** Clearly, changes may be made to filling valve 17 as described herein, without, however, departing from the scope of protection as defined in the accompanying claims.

**[0097]** In one alternative embodiment not shown, each swirl-inducing member is fixedly connected to the respective shutter and the respective shutter being configured to be rotatable around the respective longitudinal axis. In this alternative embodiment, member 23 is rotatable because of the fixed connection with shutter 22. Furthermore, in this alternative embodiment interaction elements can be associated to the respective swirl-inducing member or they could be arranged in other zones of the respective shutter.

**[0098]** In an even further embodiment not shown, the swirl-inducing members are retained in position within the respective flow channel by means of a magnetic field induced by the respective actuation assembly 37. In other words, each swirl-inducing member 23 is not coupled to the respective shutter 22, but the shutter 22 solely extends through the respective through-hole of the member 23. Thus, the swirl-inducing members do not move together with the respective shutters, when the shutters move between the open and closed position.

## Claims

1. Filling valve (17) for filling a receptacle (2) with a pourable product, comprising:

- a valve body (18) having an inner flow channel (19) for the pourable product;  
 - an outlet mouth (20) arranged at one end of the flow channel (19) and through which the pourable product flows, in use, to fill a respective receptacle (2);  
 - a shutter (22) arranged within the flow channel (19) and being adapted to control the flow of the pourable product through the outlet mouth (20); and  
 - a swirl-inducing member (23) arranged inside the flow channel (19) and being adapted to induce a rotational movement of the pourable product flowing through the outlet mouth (20);

**characterized in that** the swirl-inducing member (23) is adapted to rotate around a respective rotation axis (E).

2. The filling valve according to claim 1 further comprising a control unit (36) adapted to control the swirl-inducing member (23) into:

- an operative configuration at which the swirl-inducing member (23) is configured to induce the rotational movement of the pourable product for directing, in use, the pourable product towards the inner portions of the sidewalls (4) of the receptacle (2) to be filled; and  
 - a rest configuration at which the swirl-inducing member (23) is configured to not direct, in use, the pourable product towards the inner portions of the sidewalls (4) of the receptacle (2) to be filled;

wherein the control unit (36) is configured to control the swirl-inducing member (23) into the operative configuration or the rest configuration by actuating or disabling/suspending/suppressing rotation of the swirl-inducing member (23) around the rotation axis (E).

3. The filling valve according to claim 2, wherein the control unit (36) is configured to control the rotational speed of the swirl-inducing member (23) as a function of the type of pourable product and/or the viscosity of the pourable product and/or the inner shape of the receptacle (2) and/or the filling level of the pourable product within the respective receptacle (2) during the filling of the receptacle (2).  
 4. The filling valve according to claim 2 or 3, wherein the control unit (36) comprises an actuation assembly (37) adapted to generate a magnetic field; and wherein the swirl-inducing member (23) is of a material having ferromagnetic properties or comprises a plurality of magnetic or ferromagnetic interaction elements (43) configured to interact with the magnetic field generated by the actuation assembly (37).

5. The filling valve according to claim 4, wherein the actuation assembly (37) is at least partially arranged within the valve body (18).

6. The filling valve according to claims 4 or 5, wherein the actuation assembly (37) at least partially surrounds the flow channel (19).

7. The filling valve according to any one of claims 4 to 6 extending along a longitudinal axis (C); and wherein the actuation assembly comprises a plurality of permanent magnets and is adapted to rotate around the longitudinal axis (C) for generating a rotating magnetic field for setting the swirl-inducing member into rotation around the rotational axis.

8. The filling valve according to any one of claims 4 to 7, wherein the actuation assembly (37) comprises a plurality of coil elements (41) configured to generate a rotating magnetic field for setting the swirl-inducing member (23) into rotation around the rotational axis (E).

9. The filling valve according to any one of the preceding claims wherein the shutter (22) rotatably carries the swirl-inducing member (23).

10. The filling valve according to any one of claims 1 to 8, wherein the shutter fixedly carries the swirl-inducing member and the shutter is adapted to rotate for rotating the swirl-inducing member around the rotation axis.

11. The filling valve according to any one of the preceding claims, wherein the swirl-inducing member (23) comprises at least one guiding surface (32) for inducing the rotary movement on the flow of the pourable product.

12. Filling apparatus (1) comprising a plurality of filling valves (17) according to any one of the preceding claims.

13. Method for filling receptacles (2) with a pourable product by a filling valve (17) according to any one of claims 1 to 11, the method comprising the steps of:

- arranging the receptacle (2) below the outlet mouth (20) of the filling valve (17);  
 - directing the pourable product from the flow channel (19) to the outlet mouth (20) and into



the receptacle (2); and

- controlling the rotation of the swirl-inducing member (23) around the rotation axis (E) for inducing a rotary movement on the pourable product flowing from the flow channel (19) to the outlet mouth (20). 5

**14.** The method according to claim 13 further comprising the step of establishing a sealing contact between the receptacle (2) and the outlet mouth (20) prior to directing the pourable product from the flow channel (19) to the outlet mouth (20) and into the receptacle (2). 10

**15.** The method according to claim 14, wherein the method comprises the step of controlling the rotational speed of the swirl-inducing member (23) as a function of the type of pourable product and/or the viscosity of the pourable product and/or the inner shape of the receptacle and/or the filling level of the pourable product within the respective receptacle (2) during the filling of the receptacle (2). 15 20

**16.** The method according to claim 14 or 15, wherein the rotation of the swirl-inducing member (23) is controlled by the application of a rotating magnetic field. 25

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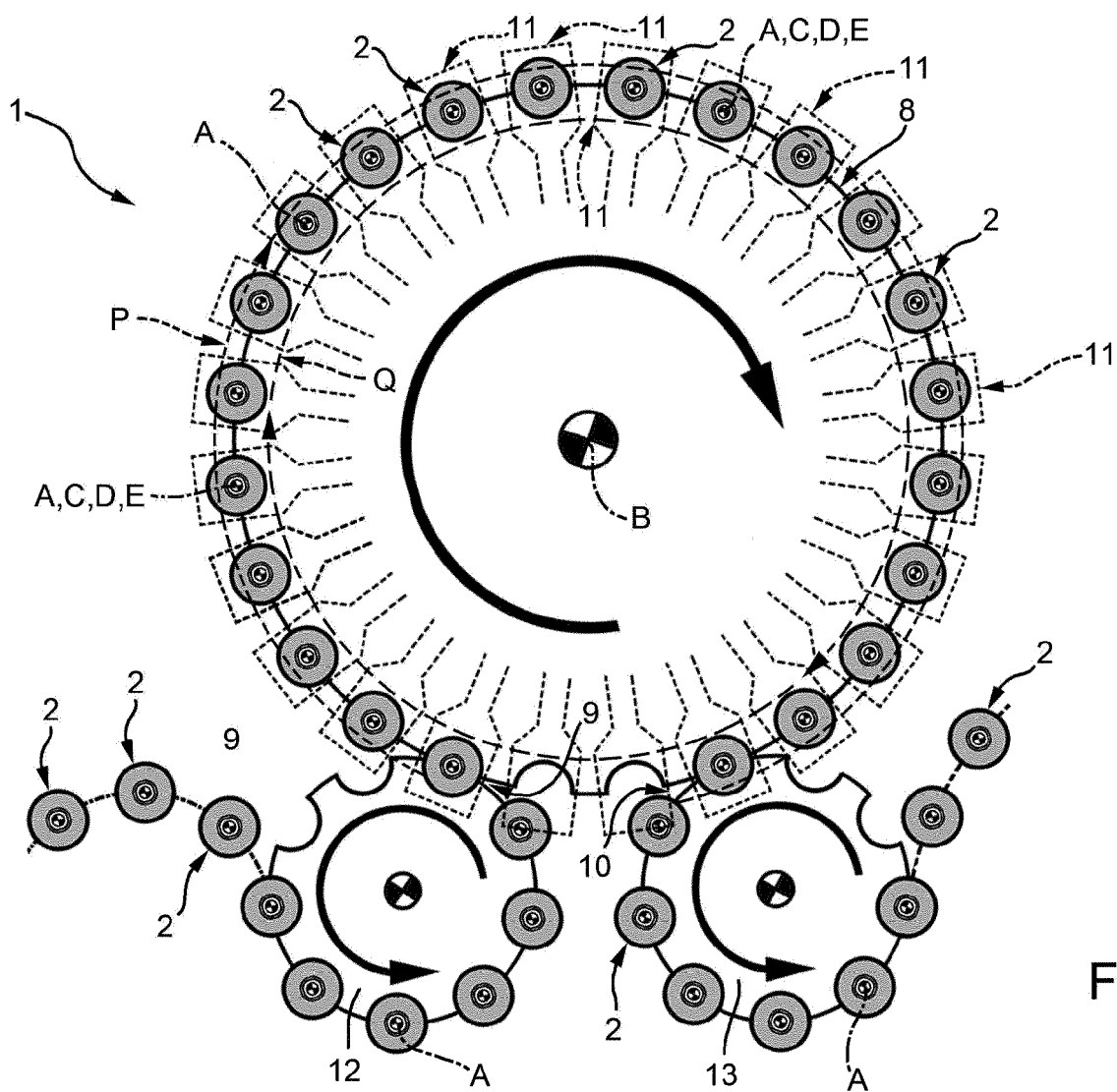


FIG. 1

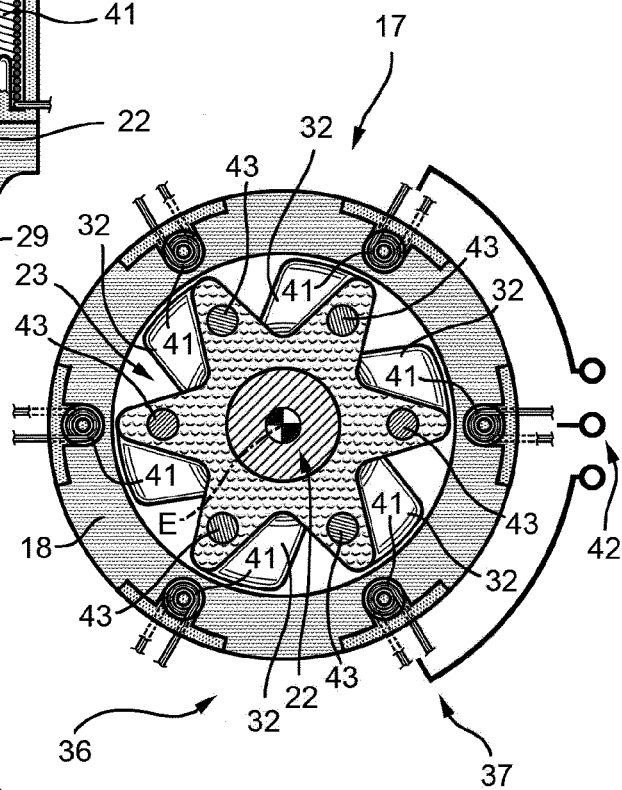
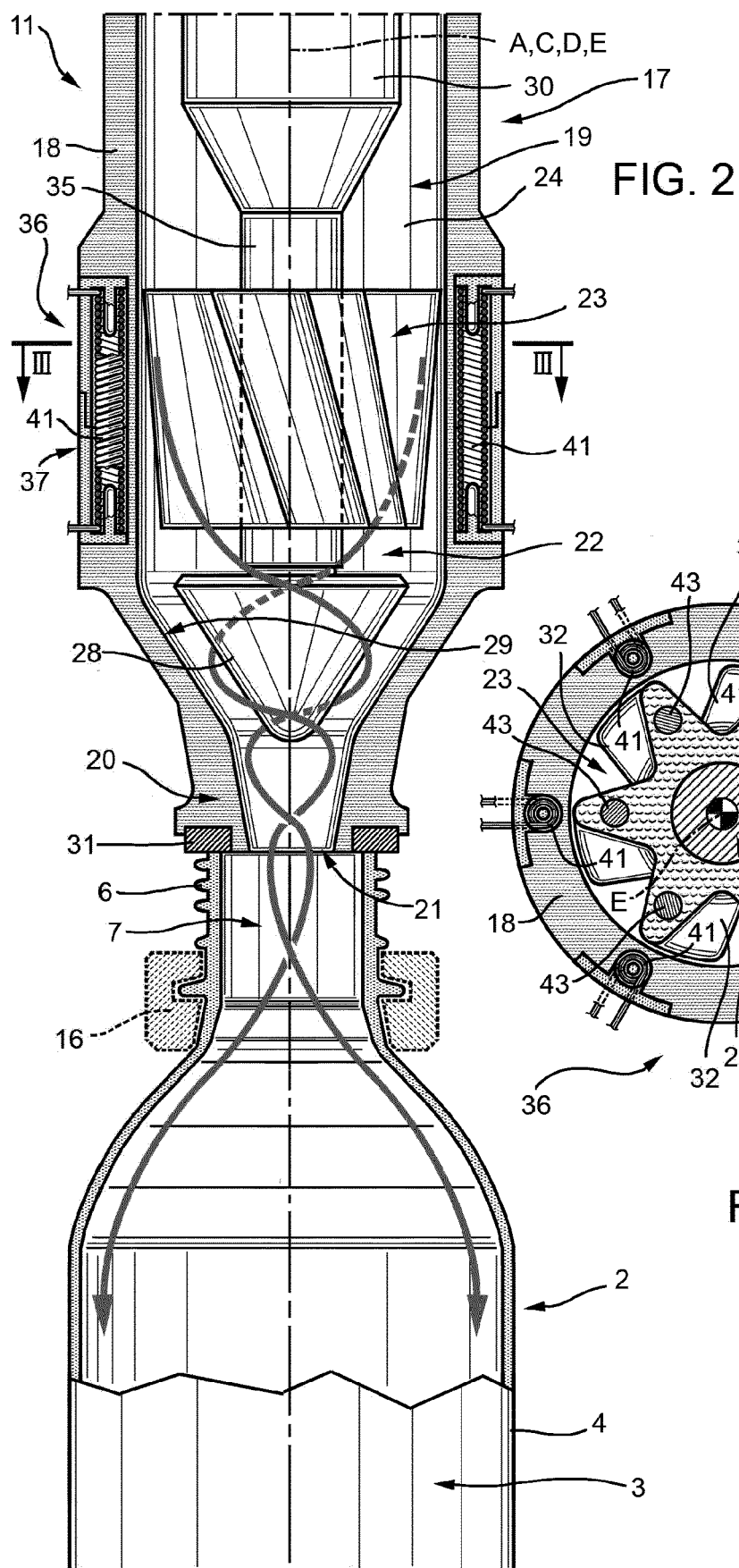


FIG. 3



## EUROPEAN SEARCH REPORT

Application Number  
EP 17 30 5141

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			TECHNICAL FIELDS SEARCHED (IPC)
			B67C
The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>16 August 2017</b>	Examiner <b>Wartenhorst, Frank</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

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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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16-08-2017

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