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(54) **PROCESS FOR INTEGRATING A BALL VALVE IN A PUMP BODY**

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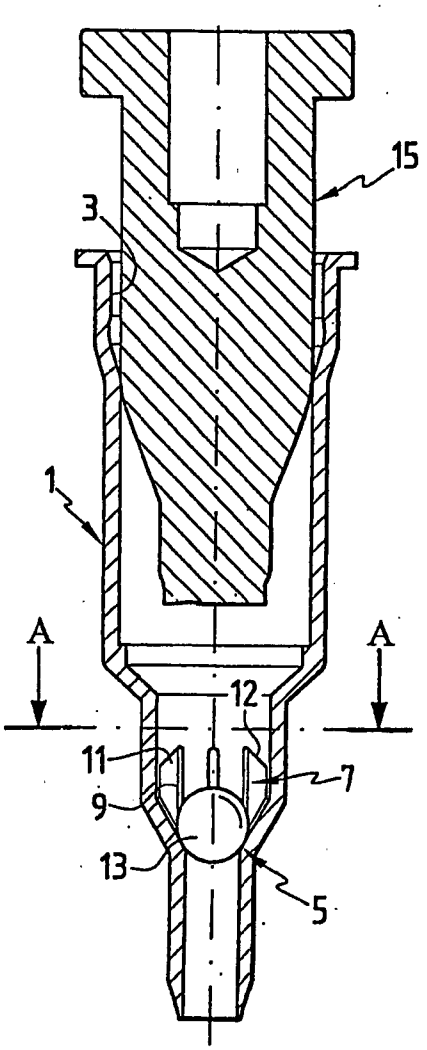
(57) **ABSTRACT**

A process for integrating a ball valve in a pump body, comprising the following stages: the pump body is moulded by arranging radial ribs on its internal surface, in the proximity of the valve seat, each of which has an end portion which can be bent towards the inside of the body, a ball is inserted inside the space enclosed by the ribs, the said end portions are bent with the help of a tool in order to imprison the ball. Application on pumps fitted with ball valves.



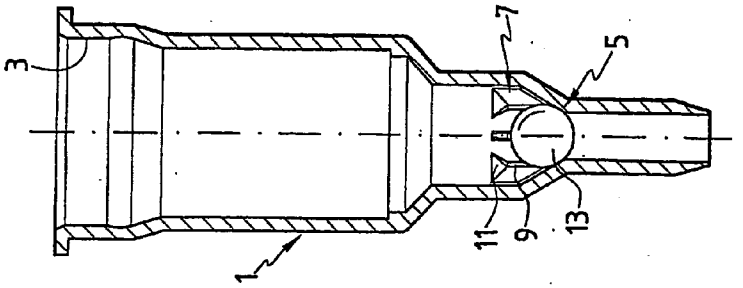


FIG.4

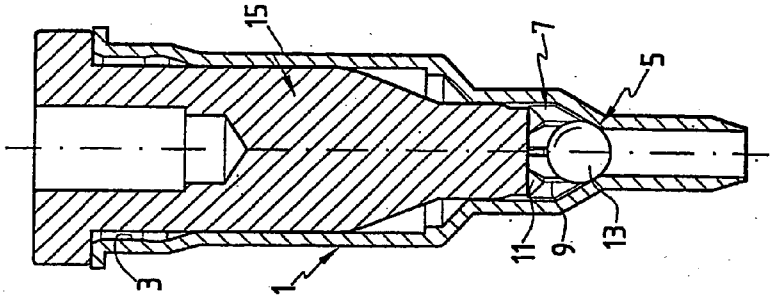


FIG.3

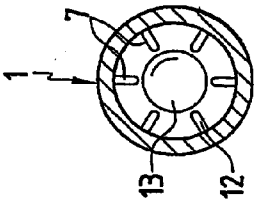


FIG.2B

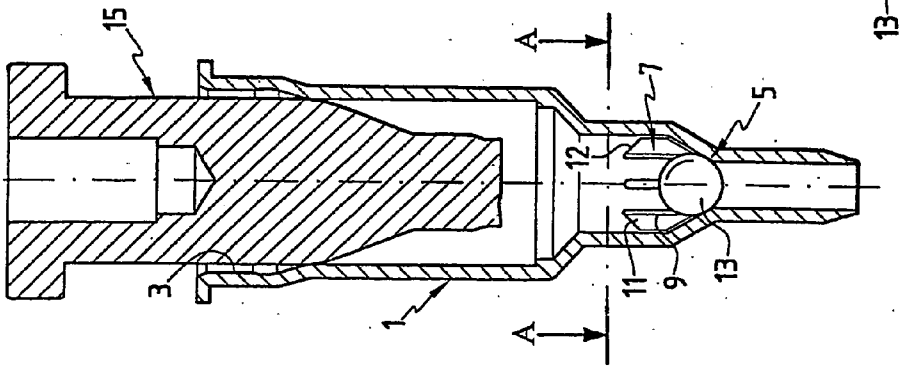


FIG.2A

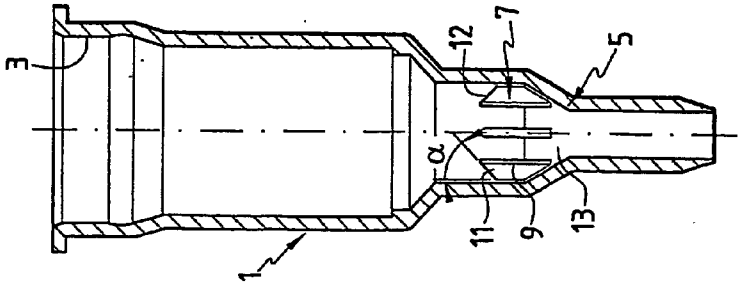


FIG.1

PROCESS FOR INTEGRATING A BALL VALVE IN A PUMP BODY

[0001] This application is a continuation of pending International Patent Application No. PCT/EP2003/014321 filed Dec. 16, 2003, which designates the United States and claims priority of French Patent Application No. 0216703, filed Dec. 26, 2002.

FIELD OF THE INVENTION

[0002] The object of the present invention is to integrate a ball valve in a pump body.

[0003] This type of valve includes a ball that works together with a seat, which is generally conical in shape, arranged in the bottom of the pump body. In order to completely fulfil its check valve function, the ball must be able to rapidly block the seat after pumping the product, and it must consequently have a restricted range of movement between an initial position, in which the valve is open, and a second position, in which the valve is blocked.

[0004] A known solution consists of enclosing the ball in a space arranged inside the pump body. It is common to form undercuts on the body of the pump, above the ball, which define a substantially circular opening with a diameter that is smaller than that of the ball in order to prevent the ball from coming out of this space. The movement of the ball is therefore restricted on one side by the seat of the valve and on the other by the said undercuts.

[0005] The larger the undercuts, the smaller the diameter of the opening that they define and the better the retention of the ball. And yet, the moulding procedures generally used to make pump bodies, such as injection moulding, forbid the direct creation of excessively large undercuts on the said bodies. Indeed, the latter are revealed to be considerably cumbersome during the stripping stage.

[0006] Thus, to avoid creating low-relief undercuts that poorly retain the ball, or undercuts that are too large and therefore hamper stripping, it is common to resort to using an additional part.

[0007] This part, placed above the ball, replaces the undercuts by sealing the cavity in which the ball is mobile, but imprisoned. However, manufacturing such a part requires an additional production cost and inserting it in the bottom of the pump body could turn out to be delicate.

[0008] The present invention proposes to resolve the inconveniences of the current procedures and has the object of integrating a ball valve in a pump body, characterised in that:

[0009] a) the pump body is moulded by arranging radial ribs on its internal surface, in the proximity of a valve seat, each of which has a longitudinal edge and an end portion detached from the internal surface, where the longitudinal edges define between them a space for inserting the ball, in the proximity of the said seat;

[0010] b) a ball is inserted inside the space defined by the said ribs; and

[0011] c) the end portions of the said ribs are plastically deformed towards the inside of the pump body, leaving the ball imprisoned inside the said space.

[0012] Such a procedure makes it possible easily to carry out moulding and stripping of the pump body. The pump body shall preferably be moulded by injection. In addition, it is no longer necessary to have to resort to using an additional part, which makes it easier to assemble the valve and reduces production costs.

[0013] Advantageously, the longitudinal edges of the said radial ribs make up a cylindrical surface with a circular base that has a diameter which is slightly larger than that of the ball. The range of radial movement of the ball inside the defined revolution cylinder is thus restricted in order to favour the axial movement of the ball, and therefore to optimise the operation of the valve.

[0014] According to a preferred embodiment of the invention, a tool is inserted axially in the inside of the pump body for stage c) of the process. This tool may have a flat tip, since this simple shape makes it possible to easily bend the end portions of the ribs. Moreover, a heating tool can be used, in which case the heat emitted would favour the bending of the said portions.

[0015] A second object of the invention is a moulded pump body, mainly during application of the procedure defined above.

[0016] Such a pump body has radial ribs on its internal surface, made in the bottom of the body, each of which has a longitudinal edge and an end portion that is detached from the internal surface.

[0017] Preferably, the said end portion has an upper edge which is separated from the said internal surface forming an acute angle with it. The aforementioned angle is measured between the internal surface of the pump body and the middle plane of the upper edge of the end portions.

[0018] Advantageously, each end portion forms a square corner between its longitudinal edge and its upper edge.

[0019] Such a shape is used during the stage in which the end portions are bent c), described above. Indeed, due to the inclination of the upper edge, when a tool inserted axially in the pump body comes into contact with the said edge, the pressure exerted by the tool contributes to bending the said end portions towards the inside of the pump body.

[0020] Once the ball is inserted in the body of the pump and once the said end portions have been bent, the grooves define a kind of cage in which the ball is mobile yet imprisoned. A unit made up of a pump body and a ball valve is thus obtained, in which the pump body includes radial ribs on its internal surface in the proximity of the valve seat, each of which has a longitudinal edge and an end portion detached from the internal surface, bent towards the inside of the pump body, where the said longitudinal edges define a space for inserting the ball between them in the proximity of the said seat; preferably, this space should be substantially cylindrical with a circular base with a diameter that is slightly larger than that of the ball.

[0021] Yet another object of the invention is a pump comprising a pump body as defined previously after moulding and after plastic deformation.

BRIEF DESCRIPTION OF DRAWINGS

[0022] The invention and its advantages will be better understood from a reading of the detailed description of a

preferred embodiment of the invention. The description which follows refers to the accompanying drawings in which:

[0023] **FIG. 1** is a transverse section of a moulded pump body according to the invention;

[0024] **FIG. 2A** is a transverse section of the pump body in **FIG. 1** in which a ball has been placed and in which a flat-tipped tool is inserted;

[0025] **FIG. 2B** is a cross-section along plane A-A of **FIG. 2***a*.

[0026] **FIG. 3** is a transverse section of the same pump body after plastic deformation of the end portions of the said groove; and

[0027] **FIG. 4** is a transverse section of a unit made up of a moulded pump body and a ball valve.

DETAILED DESCRIPTION OF DRAWINGS

[0028] The moulded pump body **1** as depicted in **FIG. 1** includes radial ribs **7** on its internal surface **3** and above the seat of the valve **5** intended to be blocked by the ball.

[0029] Each of these ribs **7** has a longitudinal edge **9** and an end portion **11** which is detached from the internal surface **3**, with the flat upper edge **12** of the end portion **11** separated from the internal surface **3** forming an acute angle α with it.

[0030] In addition, on the opposite side of the internal surface **3**, the said end portion **11** has a square corner. This angle is defined by its longitudinal edge **9** and its upper edge **12**. In the depicted example, the aforementioned square corner is complementary to the angle α.

[0031] As regards **FIG. 2A**, a ball **13** is inserted inside the pump body **1**. This ball **13** is therefore housed inside the insertion space defined by the longitudinal edges **9** of the ribs **11** in the proximity of the valve seat. These edges preferably make up a cylindrical surface with a circular base that has a diameter which is slightly larger than that of the ball **13**, such as depicted in **FIG. 2B**. A flat-tipped tool **15** is then inserted axially inside the pump body **1**.

[0032] As regards **FIG. 3**, the flat-tipped tool **15** comes into contact with the end portions **11** detached from the internal surface **3** and exerts a pressure on them that forces them to bend towards the inside of the pump body **1**. The end portions **11** are bent in this way due to the inclination of their upper edges **12**, on which the pressure of the tool **15** is exerted.

[0033] Once plastically deformed, the end portions enclose the ball **13** inside the space defined by the longitudinal edges **9** of the ribs **7**. **FIG. 4** depicts the obtained unit, made up of the pump body with the thus-formed ball valve integrated.

1. A process for integrating a ball valve into a pump body characterised in that:

a) the pump body is moulded by arranging radial ribs on its internal surface, in the proximity of the valve seat, each of which has a longitudinal edge and an end portion detached from the internal surface, where the longitudinal edges define between them a space for inserting the ball, in the proximity of the said seat;

b) a ball is inserted inside the space defined by the said ribs; and

c) the end portions of the said ribs are plastically deformed towards the inside of the pump body, leaving the ball imprisoned inside the said space.

2. A process according to claim 1, characterised in that each longitudinal edge is part of a cylindrical surface with a circular base that has diameter which is slightly larger than that of the ball.

3. A process according to claim 1, characterised in that the said pump body is moulded by injection.

4. A process according to claim 1, characterised in that the said end portion is deformed using a flat-tipped tool inserted axially inside the pump body.

5. A process according to claim 1**4**, characterised in that the said end portion is deformed using a heating tool inserted axially inside the pump body.

6. A moulded pump body, characterised in that it includes radial ribs on its internal surface, made in the bottom of the body, each of which has a longitudinal edge and an end portion detached from the internal surface.

7. A moulded pump body according to claim 6, characterised in that each end portion has an upper edge which is separated from the said internal surface forming an acute angle (α) with it.

8. A pump body according to claim 6, characterised in that each end portion has a square corner.

9. A unit made up of a pump body and a ball valve, characterised in that the pump body has radial ribs on its internal surface in the proximity of the valve seat, each of which has a longitudinal edge and an end portion detached from the internal surface plastically deformed towards the inside of the pump body, where the longitudinal edges define a space where the ball is inserted between them, in the proximity of the said seat.

10. A unit according to claim 9, characterised in that the said longitudinal edges make up a cylindrical surface with a diameter that is slightly larger than that of the ball.

11. A pump characterised, in that it includes a pump body according to claim 9.

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