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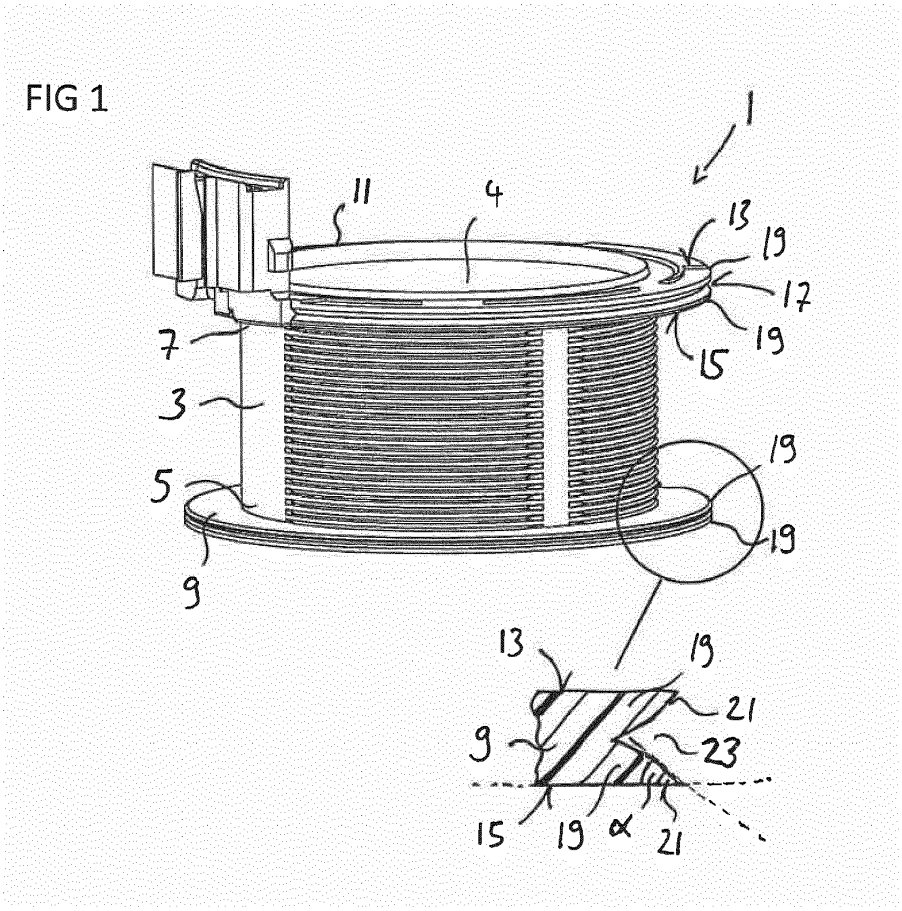
(54) **BOBBIN FOR FORMING A SOLENOID FOR AN INJECTION VALVE, POWER GROUP ASSEMBLY, INJECTION VALVE AND METHOD FOR MAKING A POWER GROUP ASSEMBLY**

(57) Bobbin for forming a solenoid for an injection valve, power group assembly, injection valve and method for making a power group assembly

Bobbin (1) for forming a solenoid for an injection valve, the bobbin (1) comprising a body (3) for receiving wire winding, a first flange (9) positioned at a first end (5) of the body (3) and a second flange (11) positioned at a second end (7) of the body (3), wherein at least two plastic ribs (19) are formed to a peripheral surface (17) of at least one of the flanges (9, 11).

FIG 1



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Description

[0001] The present invention relates to a bobbin for forming a solenoid for an injection valve, e.g. a SDI (Solenoid Direct Injection)-injection valve. Furthermore, it relates to a power group assembly comprising such a bobbin, an injection valve and a method for making such a power group assembly.

[0002] Solenoid injection valves usually comprise at least one bobbin with wire windings. The bobbin and the windings are usually enclosed in a molded plastic shell in order to seal them against moisture.

[0003] US 2008/0036564 A1 discloses a method for providing a plastic overmolding to hermetically seal electrical components of an injector solenoid.

[0004] It is an object of the present invention to further improve the sealing of the plastic shell of a fuel injector solenoid.

[0005] This object is achieved by means of a bobbin for forming a solenoid for an injection valve, by means of a power group assembly comprising a bobbin, by means of a fluid injection valve and by means of a method for making a power group assembly according to the independent claims.

[0006] Advantageous embodiments and developments are disclosed in the dependent claims, the drawings and the following description.

[0007] According to one aspect of the invention, a bobbin for forming a solenoid for an injection valve is provided, the bobbin comprising a body for receiving wire winding, a first flange positioned at a first end of the body and a second flange positioned at a second end of the body. At least two plastic ribs are formed to a peripheral surface of at least one of the flanges.

[0008] The first and second flanges are in particular portions of the bobbin which are preferably in one piece with the body for receiving the wire windings. The expression "in one piece" means in the present context that the flanges and the body are not a plurality of separate parts which are connected to one another during the manufacturing process of the bobbin. Rather, the body and the flanges are a single workpiece or made from a single workpiece. In particular, the bobbin is a one-pieced, integrally formed part.

[0009] Preferably, the body has a circumferential wall extending around a longitudinal axis, the circumferential wall being provided for being covered with the wire windings. The first and second ends of the body are in particular opposite axial ends of the body.

[0010] The first and second flanges project in particular in radial outward direction from the circumferential wall, in particular for limiting axial displacement of the wire windings. The flanges preferably extend completely circumferentially around the longitudinal axis. The "peripheral surface" of the respective flange is in particular its circumferential surface which faces away from the longitudinal axis.

[0011] The plastic ribs are in particular configured to melt at least partially during the process of forming a plastic shell for the solenoid. In particular, the plastic ribs are configured and arranged to form an interface of the respective flange with the plastic shell. The process of forming the plastic shell in particular comprises overmolding the bobbin with a molten plastic material for forming the plastic shell. This process is the so-called "second overmold". The plastic ribs are in particular configured to melt due to contact with the molten plastic material.

[0012] Providing at least two plastic ribs has the advantage that a tight seal between the bobbin and the shell will be formed at least at two places, thereby doubling the water tightness provided by one plastic rib. Furthermore, the coupling surface between the bobbin and the plastic shell is increased considerably, so that adhesion between the bobbin and the shell is increased. Thus, a tight seal can be provided only by modifying the shape of the bobbin. No additional steps need to be taken.

[0013] According to an embodiment of the invention, the bobbin is formed of a thermoplastic material, e.g. nylon. Such a material is advantageous for melting of the plastic ribs during the second overmold and the subsequent solidification. In this way, a particularly tight seal is achievable.

[0014] In order to make sure the plastic ribs melt at least partially during the second overmold, the material and temperature during the second overmold are selected such that the temperature reaches at least the melting point of the plastic ribs.

[0015] According to an embodiment of the invention, the plastic ribs are acute-angled with an opening angle of less than 50°. The opening angle may even be less than 30°.

[0016] By the plastic ribs being acute-angled it is understood that the plastic ribs have acute-angled tips. In other words, the plastic ribs taper in radial outward direction. This has the advantage, that melting occurs more easily in the region of the tips. Thus, the acute-angled tips ensure that the plastic ribs melt at least partially during the second overmold.

[0017] According to an embodiment of the invention, at least two plastic ribs are formed to the peripheral surface of both flanges. This has the advantage, that a tight seal is formed at both ends of the bobbin.

[0018] According to a further aspect of the invention, a power group assembly is provided comprising the described bobbin and further comprising a wire winding on the bobbin - the wire being in particular wound around the body -, a plastic shell and with wire terminals. Preferably the bobbin and/or the plastic shell have a central axial opening, in particular for receiving a valve body of a fluid injection valve.

[0019] The power group assembly may be produced and handled separately and be assembled with a valve assembly of the injection valve after the second overmold, thereby receiving the valve body of the valve assembly in the central axial opening. The power group assembly has the advantage that its housing is tightly sealed

against moisture.

[0020] According to an embodiment of the invention, the plastic ribs in the power group assembly are at least partially melted and solidified again, in particular for forming an interface of the respective flange(s) with the plastic shell, thereby forming a hermetic seal of the solenoid. To put it differently, material of the plastic ribs and the plastic shell may be mixed in an interface region of the respective flange with the plastic shell. In this case, the power group assembly comprises a plastic shell formed during a second overmold process, in which the plastic ribs melt at least partially.

[0021] According to a further aspect of the invention, a fluid injection valve with the described power group assembly is provided.

[0022] According to a further aspect of the invention, a method for making a power group assembly for a solenoid valve injector is described. The method comprises providing the described bobbin, providing wire windings on the body and overmolding the bobbin with a plastic material to form a plastic shell, thereby melting the at least two plastic ribs at least partially - in particular for forming an interface of the respective flange(s) with the plastic shell -, thereby creating a hermetically sealed shell.

[0023] Further advantages, advantageous embodiments and developments of the bobbin for an injection valve, the power group assembly, the injection valve and the method for making such a power group assembly will become apparent from the exemplary embodiments which are described below in association with the schematic figures.

Figure 1 shows a perspective view of a bobbin according to an embodiment of the invention and

Figure 2 shows a perspective view of a power group assembly according to an embodiment of the invention with a partial cross section to show internal parts.

[0024] The bobbin 1 of figure 1 has a substantially cylindrical body 3 with a central axial opening 4. In other words, the body 3 has a generally cylindrical wall extending around a longitudinal axis and defining the central axial opening 4.

[0025] The body 3 receives the wire windings, which are not shown in figure 1. For positioning the wire, the cylindrical wall has a multitude of partial circumferential grooves at its peripheral surface.

[0026] The body 3 has a first end 5 and an axially opposing second end 7. At the first end 5, there is a first flange 9 arranged, extending radially outward from the body 3. At the second end 7, there is a second flange 11 arranged, also extending radially from the body 3. The flanges 9, 11 confine the wire windings to the body 3, i. e. they limit axial displacability of the wire with respect to the body 3. The flanges 9, 11 are integrally formed and in one piece with the body 3.

[0027] Both flanges 9, 11 have a first main surface 13, an opposing second main surface 15 and a peripheral surface 17. The main surfaces 13, 15 face in oppoxite axial directions. The peripheral surface 17 faces in radial outward direction and extends in axial direction from the first main surface 13 to the second main surface 15.

[0028] Formed to the peripheral surface 17 are two plastic ribs 19, which project in radial outward direction and extend at least partially circumferentially around the longitudinal axis. In other words: The outer rim of the flanges 9, 11 is formed by two plastic ribs 19.

[0029] The plastic ribs 19 have tips 21, which are acute-angled with an opening angle α of less than 50°. In the embodiment shown in figure 1, α is about 30°. The two plastic ribs 19 are divided by an interspace 23.

[0030] The bobbin 1 shown in figure 1 is formed of a thermoplastic material, e.g. nylon, in a first mold or overmold process. The bobbin 1 is then provided with wire windings and subjected to a second overmold process in which a plastic shell is formed, enclosing the bobbin 1 and the wire windings.

[0031] Figure 2 shows the modular power group assembly 25 as a result of the second overmold process. The power group assembly 25 comprises the bobbin 1 with wire windings (not visible in figure 2), the plastic shell 27 formed in the second overmold process, terminals 31 for the wire windings 35 and the metal housing 33.

[0032] The power group assembly 25 has a central axial opening 29 extending through the bobbin 1 and the plastic shell 27 to receive a valve body of an injection valve during the assembly of the injection valve.

[0033] During the second overmold process, the plastic ribs 19 melt at least partially due to the prevailing temperature of e.g. 300°C. After having re-solidified, the plastic ribs 19 form a tight, waterproof seal for the bobbin 1. Furthermore, during the second overmold process, plastic material enters the interspace 23 between the plastic ribs 19. After solidification, the plastic shell and the plastic ribs interlock tightly.

Claims

1. Bobbin (1) for forming a solenoid for an injection valve, the bobbin (1) comprising a body (3) for receiving wire winding, a first flange (9) positioned at a first end (5) of the body (3) and a second flange (11) positioned at a second end (7) of the body (3), wherein at least two plastic ribs (19) are formed to a peripheral surface (17) of at least one of the flanges (9, 11).

2. Bobbin (1) according to the preceding claim, wherein the body (3), the flanges (9, 11) and the plastic ribs (19) are in one piece.

3. Bobbin (1) according to any one of the preceding claims, wherein the bobbin (1) is formed of a thermoplastic material.

4. Bobbin (1) according to the preceding claim, wherein the bobbin (1) is made from nylon.

5. Bobbin (1) according to any one of the preceding claims, wherein the plastic ribs (19) are acute-angled with an opening angle of less than 50°.

6. Bobbin (1) according to the preceding claim, wherein the opening angle is less than 30°.

7. Bobbin (1) according to any one of the preceding claims, wherein at least two plastic ribs (19) are formed to the peripheral surface (17) of both flanges (9, 11).

8. Power group assembly (25) comprising a bobbin (1) according to any one of the preceding claims, further comprising a wire winding (35) on the body (3), a plastic shell (27), wire terminals (31) and a metal housing (33).

9. Power group assembly (25) according to the preceding claim, wherein the plastic ribs (19) are at least partially melted and solidified for forming an interface of the flange (s) (9, 11) with the plastic shell (27), thereby forming a hermetic seal of the solenoid.

10. Fluid injection valve (1) with a power group assembly (25) according to any one of claims 8 and 9.

11. Method for making a power group assembly (25) for a solenoid valve injector, the method comprising

- providing a bobbin (1) according to any one of claims 1 to 7,
- wrapping wire windings on the body (3),
- overmolding the bobbin (1) and the wire windings with a plastic material to form a plastic shell (27), thereby melting the at least two plastic ribs (19) at least partially, thereby forming an interface of the flange (s) (9, 11) with the plastic shell and creating a hermetically sealed shell (27).

FIG 1

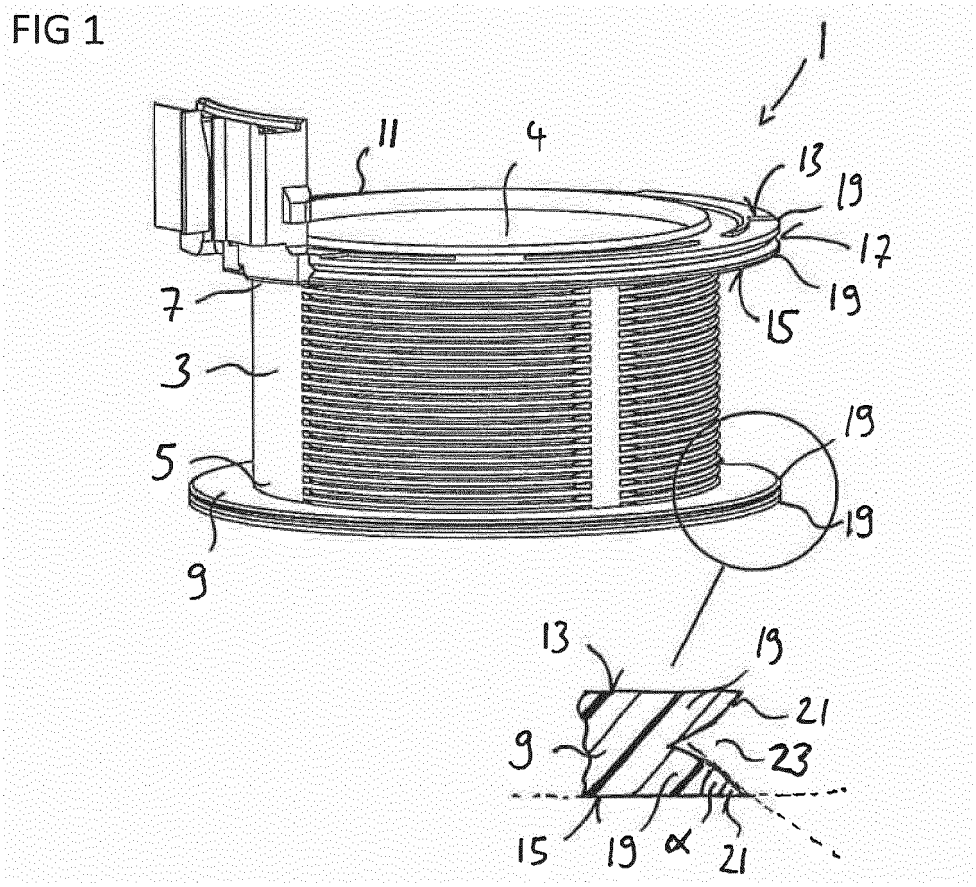
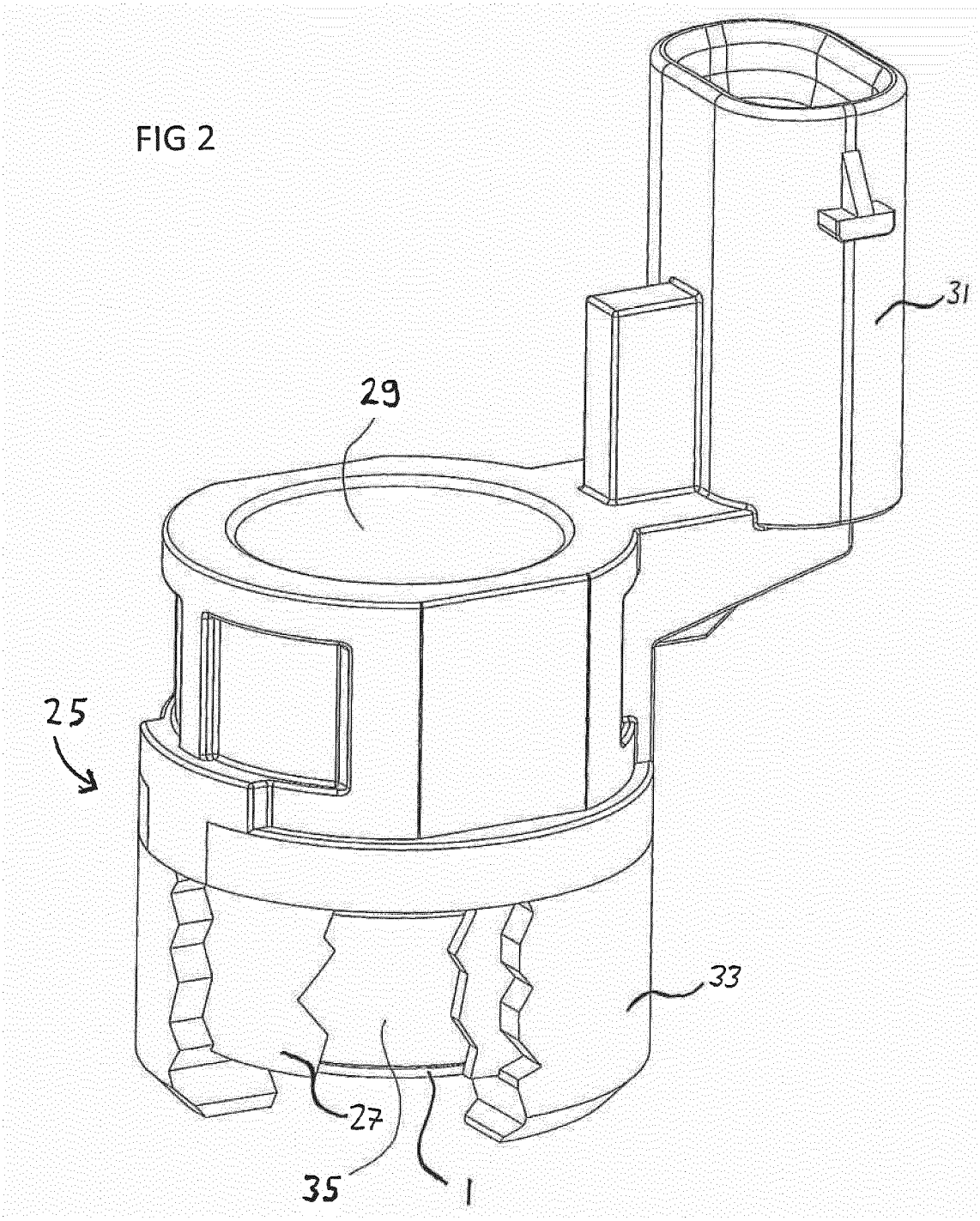


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 1406

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 March 2017	Van den Berg, G

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X : particularly relevant if taken alone
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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 1406

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

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