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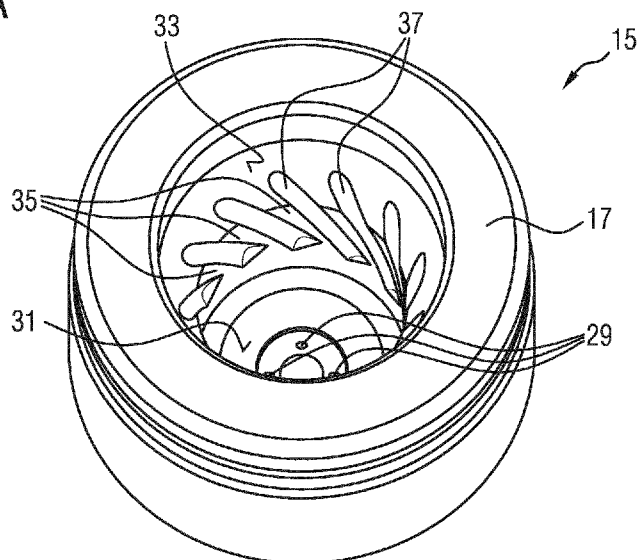
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(54) Title: SEAT BODY FOR A FLUID INJECTION VALVE AND FLUID INJECTION VALVE

FIG 1A



(57) Abstract: A seat body (15) for a fluid injection valve (1) and a fluid injection valve (1) with the seat body (15) are disclosed. The seat body (15) has a sidewall portion (17) defining a recess (21) that extends from a fluid inlet opening (23) at a first axial end (25) of the seat body (15) to a bottom portion (19) at a second axial end (27) of the seat body (15), the bottom portion (19) closing the recess (21) at the second axial end (27). The bottom portion (19) is perforated by a plurality of orifices (29) and has a seat surface (31) upstream of the orifices (29). The sidewall portion (17) has an inner circumferential surface (33) comprising guide sections (35) and a plurality of grooves (37) which alternate with the guide sections (35) for fluidly connecting the fluid inlet opening (23) with the seat surface (31). The grooves (37) are inclined with respect to the longitudinal axis (L); and the orifices (29) are radially spaced apart from and distributed circumferentially around the longitudinal axis (L).

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DESCRIPTION

Seat Body for a Fluid Injection Valve and Fluid Injection Valve

5 TECHNICAL FIELD

The present disclosure relates to a seat body for a fluid
injection valve and to a fluid injection valve. The fluid
injection valve is in particular a fuel injection valve for an
10 internal combustion engine.

BACKGROUND

Fluid injection valves usually comprise a sealing element
15 interacting with a valve seat of a seat body for controlling fluid
flow out of the seat body during operation of the injection valve
for dispensing fluid.

Part-to-part and shot-to-shot variations may occur with respect
20 to the delivery amount and the spray behavior in conventional
fluid injection valves.

It is an object of the present disclosure to specify a seat body
for a fluid injection valve and a fluid injection valve which
25 enable particular precise and reproducible dosing of the fluid.
This object is achieved by a seat body and a fluid injection valve
having the features of the independent claims. Advantageous
embodiments and developments of the seat body and the fluid
injection valve are specified in the dependent claims, in the
30 following description and in the drawings.

SUMMARY AND EMBODIMENTS

According to one aspect, a seat body for a fluid injection valve
35 is disclosed. According to a second aspect, a fluid injection
valve comprising the seat body is disclosed.

The seat body has a longitudinal axis and comprises a sidewall portion and a bottom portion. The seat body has a first axial end and a second axial end. The fluid inlet opening is located at the first axial end of the seat body. The bottom portion is located
5 at the second axial end of the seat body. The sidewall portion defines a recess. The recess extends from the fluid inlet opening at the first axial end of the seat body to the bottom portion at the second axial end of the seat body.

10 The bottom portion closes the recess at the second axial end. The bottom portion is perforated by a plurality of orifices. The orifices are configured for dispensing fluid from the seat body. The orifices are radially spaced apart from and distributed circumferentially around the longitudinal axis.

15 Further, the bottom portion has a seat surface upstream of the orifices. The seat surface is shaped and arranged for interacting with an axially displaceable sealing element of the fluid injection valve to seal and unseal the second axial end of the
20 seat body, i.e. to enable and prevent fluid flow from the fluid inlet opening through the recess and out of the orifices.

The sidewall portion has an inner circumferential surface comprising guide sections configured to be in sliding mechanical
25 contact with the sealing element. The inner circumferential surface further comprises a plurality of grooves. The grooves alternate with the guide sections in circumferential direction, follow the guide sections in radial outward direction, and extend in axial direction along the guide sections for fluidly con-
30 necting the fluid inlet opening with the seat surface. The grooves are inclined with respect to the longitudinal axis.

By means of the combination of the inclined grooves, being arranged radially outward from the guide sections, and the
35 orifices, being spaced apart from the longitudinal axis and distributed along a circumference around that axis, a particular homogenous flow distribution in the neighbourhood of the orifices is achievable inside the recess and the shape of the fluid spray

which is dispensed from the seat body may be particularly reproducible from shot to shot and/or may have particularly stable shape during one injection event. Expediently, a swirl may be generated in the region of the inflow a purchase of the orifices
5 which distributes the fuel particularly homogeneously in circumferential direction in the region of and downstream of the seat surface.

With advantage, there may be no or little interaction between a
10 possible variation of the flow distribution through the grooves and the flow distribution into the orifices. In this way, the risk for an uncontrolled fuel delivery and spray behavior of the seat body and/or for unpredictable and uncontrollable part to part variations with respect to the spray characteristics of different
15 seat bodies is particularly small.

In one embodiment, the seat body comprises at least two orifices and at least twice as many grooves as orifices. In this way, the influence of the flow distribution in the region of the grooves
20 on the flow distribution the region of the seat surface and/or the orifices may be particularly small.

In one embodiment, the grooves are offset with respect to the orifices in radial outward direction. In this way, fluid flow from
25 the individual grooves may advantageously mix before reaching the orifices.

In one embodiment, the grooves have rounded edges at least at their inflow ends and/or their outflow ends. In another embodiment, the grooves additionally or alternatively have a curved
30 cross-sectional shape. This way, particularly little turbulences may be generated. In another embodiment, the grooves have a polygonal cross-sectional shape.

35 In one embodiment, at least one of the orifices is inclined with respect to the longitudinal axis. In an expedient development, all orifices are inclined with respect to the longitudinal axis.

Advantageous flow characteristics may be achievable in this way in combination with the swirl generated by the grooves.

5 In an expedient embodiment, the seat body is a one-pieced metal body. In this way, it can be manufactured particularly precisely.

10 In one embodiment, the fluid injection valve comprises a valve body with a cavity extending from a fluid inlet end of the valve body to a fluid outlet end of the valve body. The seat body is arranged at the fluid outlet end of the valve body. In particular, it is shifted into the fluid outlet end of the valve body.

15 In one embodiment, the fluid injection love further comprises a valve member, which can also be denoted as a "valve needle". The valve member may expediently be received in the cavity. It is axially displaceable in reciprocating fashion with respect to the valve body and the seat body.

20 The valve member comprises the sealing element. The sealing element is in sliding mechanical contact with the guide sections of the inner surface of the sidewall portion of the seat body. The grooves are arranged subsequent to the sealing element in radially outward direction and axially overlap the sealing element. In an expedient embodiment, the sealing element has a
25 spherical shape. The sealing element may in this way contribute to a homogeneous fuel distribution in circumferential direction.

BRIEF DESCRIPTION OF THE DRAWINGS

30 Further advantages, advantageous embodiments and developments of the seat body and the fluid injection valve will become apparent from the exemplary embodiments which are described below in association with schematic figures.

35 In the figures:

Figure 1A shows a perspective view of a seat body according to a first embodiment of the invention,

Figure 1B shows a longitudinal section view of the seat body according to the first embodiment,

5 Figure 1C shows a top view of the seat body according to the first embodiment,

Figure 2A shows a perspective view of a seat body according to a second embodiment,

10

Figure 2B shows a longitudinal section view of the seat body according to the second embodiment, and

Figure 3 shows a longitudinal section view of a fluid injection
15 valve with the seat body according to the first embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

In the exemplary embodiments and figures, similar, identical or
20 similarly acting elements are provided with the same reference symbols. In some figures, individual reference symbols may be omitted to improve the clarity of the figures.

Figures 1A, 1B and 1C show a seat body 15 of a fluid injection
25 valve 1 according to a first embodiment in a perspective view, a longitudinal section view and a top view, respectively. The fluid injection valve 1 is shown in a longitudinal section view in figure 3. The fluid injection valve in this and other embodiments is in particular a fuel injection valve, preferably for
30 injecting fuel such as gasoline directly into a combustion chamber of an internal combustion engine. The fluid injection valve 1 may be configured to operate at fluid pressures above 80 bar, preferably above 200 bar, for example between 150 bar and 500 bar.

35

The fluid injection valve 1 has a valve assembly 2 and an actuator assembly 4. The valve assembly 2 comprises a hollow valve body 3 having a cavity 5 extending along a longitudinal axis L from

a fluid inlet end 6 to a fluid outlet end 8 of the valve body 3. The fluid outlet end 3 is closed by the seat body 15 which is shifted into and fixed to the valve body 3 at the fluid outlet end 8. The valve assembly 2 further comprises a valve member 11
5 which is arranged in the cavity 5 so that it is movable in axially reciprocating fashion relative to the valve body 3.

The valve member 11 comprises a sealing element which is positioned in a recess 21 of the seat body and a shaft fixed to the
10 sealing element 13 and extending from the sealing element 13 towards the fluid inlet end 6 of the valve body 3. In an axial end region adjacent to the fluid inlet 6, a retainer element is fixed to the shaft for engaging with an armature of the actuator assembly 4.

15 The fluid injection valve 1 comprises a valve spring 7 which presses the sealing element 13 against a seat surface 31 of the seat body 15. The actuator assembly 4 comprises a solenoid 9 and a pole piece, the solenoid 9 magnetically attracting the armature
20 towards the pole piece for moving the valve member 11 away from the seat surface 31 in direction of the longitudinal axis L towards the fluid inlet end 6 of the valve body 3.

The seat body 15 in the section of figure 3 which is indicated
25 with "I" is shown in more detail in figures 1A, 1B and 1C. The seat body 15 is a one-pieced, machined metal body. It shares the longitudinal axis L with the valve body 3 and comprises a sidewall portion 17 and a bottom portion 19. The sidewall portion 17 defines the recess 21. The recess 21 extends from a fluid inlet
30 opening 23 at a first axial end 25 of the seat body 15 to a bottom portion 19 at a second axial end 27 of the seat body 15. The bottom portion 19 closes the recess 21 at the second axial end 27.

The bottom portion 19 is perforated by a plurality of orifices
35 29. The orifices 29 are configured for dispensing fluid from the seat body 15 to the outside of the seat body 15, and in particular also of the fluid injection valve 1. The orifices 29 are radially spaced apart from the longitudinal axis L. They are, in the

present embodiment, equally spaced in circumferential direction around the longitudinal axis L on a ring-shaped section of the bottom portion 19.

5 In the present embodiment, the seat body 15 has four orifices 29. However, the number of orifices 29 is not limited to four. The seat body can also have less orifices, for example two or three orifices or it can have more orifices, for example five, six, 10 seven or eight orifices. The orifices also need not be equally distributed around the longitudinal axis L. For example, some orifices 29 may be agglomerated on one side of the longitudinal axis L for defining an asymmetric fluid spray plume to be dispensed from the seat body 15.

15 The orifices 29 are inclined with respect to the longitudinal axis L in the present embodiment. For example, they include an angle of 15° or more - in another embodiment an angle of 30° or more - and/or an angle of 70° or less with the longitudinal axis L.

20 Upstream of the orifices 29, the bottom portion 19 comprises the seat surface 31 which is configured for interacting with the axially displaceable sealing element 13 of the valve member 11 of the fluid injection valve 1 in order to seal and unseal the second axial end 27 of the seat body, i.e. to enable and prevent 25 fluid flow through the recess 21 to the orifices 29.

The sidewall portion 17 has an inner circumferential surface 33. The inner circumferential surface 33 comprises guide sections 35. The guide section 35 are in sliding mechanical contact with the 30 sealing element 13 (not shown in figures 1A, 1B and 1C) for axially guiding the sealing element 13. In particular, the guide sections are surface sections of an imaginary circular cylinder extending coaxially with the longitudinal axis L.

35 The inner circumferential surface 33 further comprises grooves 37. The grooves 37 are positioned radially outward from the guide sections 35 and extend in axial direction along the guide sections 35. Grooves 37 and guide sections 35 alternate in circumferential

direction. In other words, the grooves open into surface sections of the above mentioned imaginary circular cylinder between the surface sections which represent the guide sections 35. The grooves 37 are inclined with respect to the longitudinal axis L. In particular, the grooves extend helically along the longitudinal axis L.

In this way, each groove 37 fluidly connects the fluid inlet opening 23 of the seat body 15 with the seat surface 31 of the bottom portion 19 of the seat body 15. In other words, the grooves 37 represent fluid channels which extend axially along the sealing element 13, the fluid channels being arranged radially outward from the sealing element 13 and interfacing with the sealing element 13 at their inner radial ends.

In the present embodiment, the seat body 15 has twelve grooves 37, which is three times the number of orifices 29. As is best visible from the top view of figure 1C, the grooves 37 are spaced in radial direction from the orifices 29 so that the seat surface 31 is arranged between the orifices 29 and the grooves 37 in top view along the longitudinal axis L. In this way, particularly homogenous swirl movement of the fluid is achievable in the gap between the seat surface 31 and the sealing element 13 when the actuator assembly 4 moves the valve member 11 away from its closing position against the bias of the valve spring 7.

In the present embodiment, the grooves 37 have rounded edges at their inflow ends and a curved cross-sectional shape. The seat body 15 according to the second embodiment shown in figures 2A and 2B in a perspective view and a longitudinal section view, respectively, has grooves 37 with a polygonal cross-sectional shape, instead. Apart from this difference, the seat body 15 according to the second embodiment corresponds to the seat body according to the first embodiment and may be used for the fluid injection valve 1 as shown in figure 3 and described above.

The invention is not limited to specific embodiments by the description on basis of these exemplary embodiments. Rather, it

comprises any combination of elements of different embodiments. Moreover, the invention comprises any combination of claims and any combination of features disclosed by the claims.

CLAIMS

1. Seat body (15) for a fluid injection valve (1) having a longitudinal axis (L) and comprising a sidewall portion (17) and a bottom portion (19), wherein
5 the sidewall portion (17) defines a recess (21) that extends from a fluid inlet opening (23) at a first axial end (25) of the seat body (15) to the bottom portion (19) at a second axial end (27) of the seat body (15), the bottom
10 portion (19) closing the recess (21) at the second axial end (27);
the bottom portion (19) is perforated by a plurality of orifices (29) configured for dispensing fluid from the seat body (15) and has a seat surface (31) upstream of the
15 orifices (29) configured for interacting with an axially displaceable sealing element (13) of the fluid injection valve (1) for sealing and unsealing the second axial end (25) of the seat body (15);
the sidewall portion (17) has an inner circumferential surface (33) comprising guide sections (35) configured to be in sliding mechanical contact with the sealing element (13) and further comprising a plurality of grooves (37);
20 the grooves (37) alternate with the guide sections (35) in circumferential direction, follow the guide sections (35) in radial outward direction, and extend in axial direction along the guide sections (35) for fluidly connecting the fluid inlet opening (23) with the seat surface (31);
25 the grooves (37) are inclined with respect to the longitudinal axis (L); and
30 the orifices (29) are radially spaced apart from and distributed circumferentially around the longitudinal axis (L).
2. Seat body (15) according to the preceding claim, comprising
35 at least two orifices (29) and at least twice as many grooves (37) as orifices (29).

3. Seat body (15) according to one of the preceding claims,
wherein the grooves (37) are offset with respect to the
orifices (29) in radial outward direction.
- 5 4. Seat body (15) according to one of the preceding claims,
wherein the grooves (37) have rounded edges at least at
their inflow ends and/or their outflow ends.
- 10 5. Seat body (15) according to one of the preceding claims,
wherein the grooves (37) have a curved cross-sectional
shape.
- 15 6. Seat body (15) according to one of the preceding claims 1
to 4, wherein the grooves (37) have a polygonal
cross-sectional shape.
- 20 7. Seat body (15) according to one of the preceding claims,
wherein at least one of the orifices (29) is inclined with
respect to the longitudinal axis (L).
- 25 8. Seat body (15) according to one of the preceding claims
which is a one-pieced metal body.
- 30 9. Fluid injection valve (1) comprising a valve body (3) with
a cavity extending from a fluid inlet end (6) of the valve
body (3) to a fluid outlet end (8) of the valve body (3)
and a seat body (15) according to one of the preceding
claims, wherein the seat body (15) is arranged at the fluid
outlet end (8) of the valve body (3).
- 35 10. Fluid injection valve (1) according to the preceding claim,
further comprising a valve member (11), which is axially
displaceable in reciprocating fashion with respect to
both, the valve body (3) and the seat body (15), and
comprises the sealing element (13), wherein
the sealing element (13) is in sliding mechanical contact
with the guide sections (35) of the inner surface (33) of
the sidewall portion (17) of the seat body (15) and

the grooves (37) are arranged subsequent to the sealing element (13) in radially outward direction and axially overlap the sealing element (13).

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FIG 1A

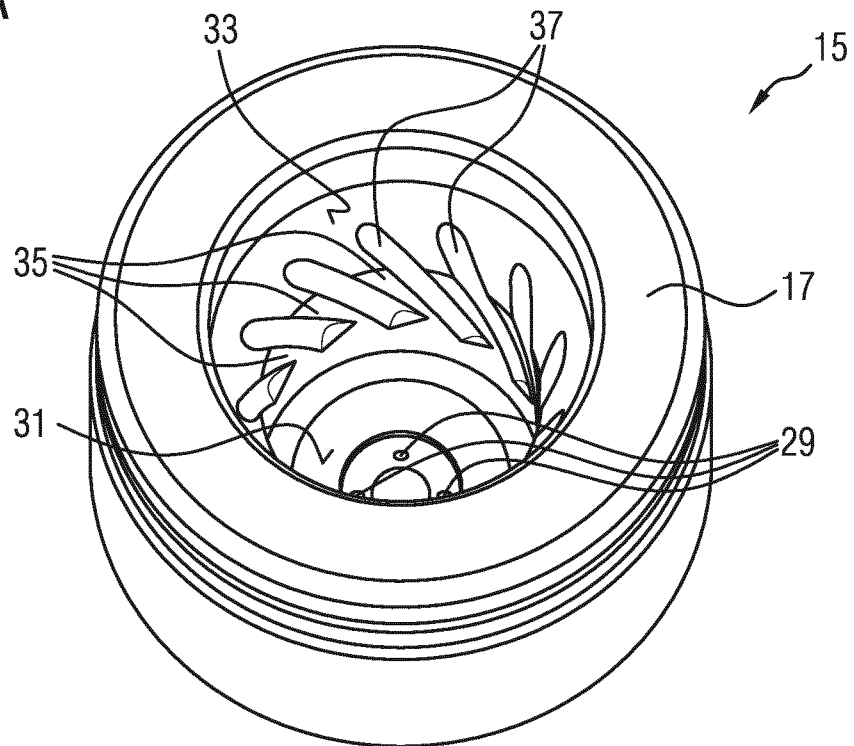


FIG 1B

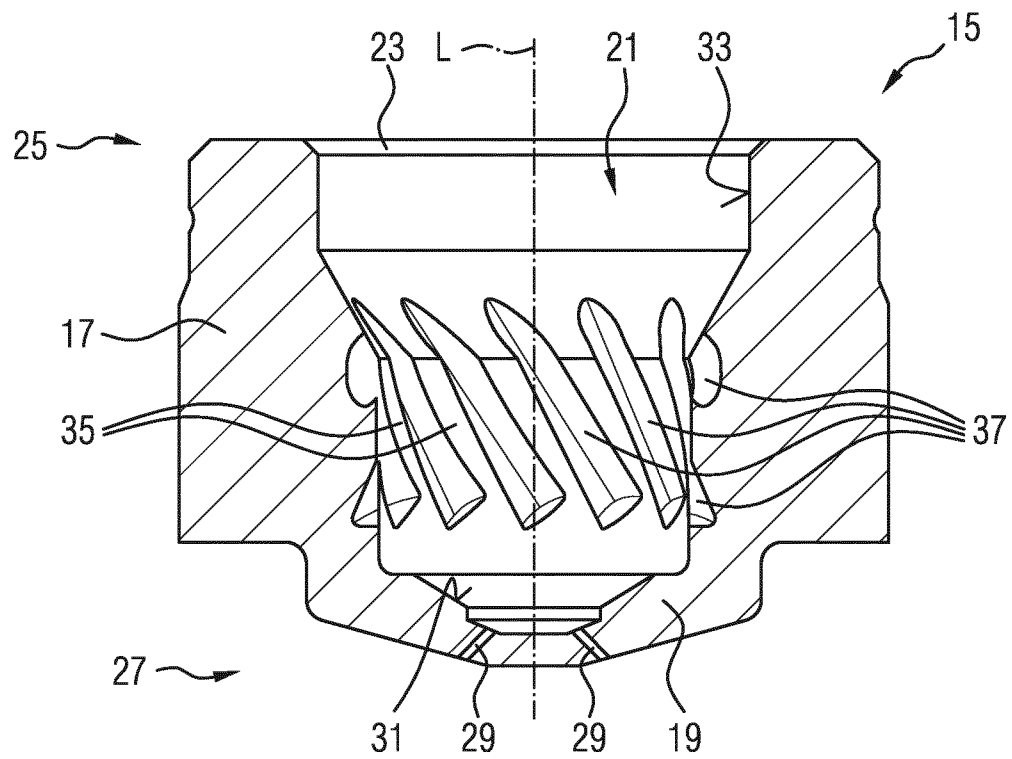
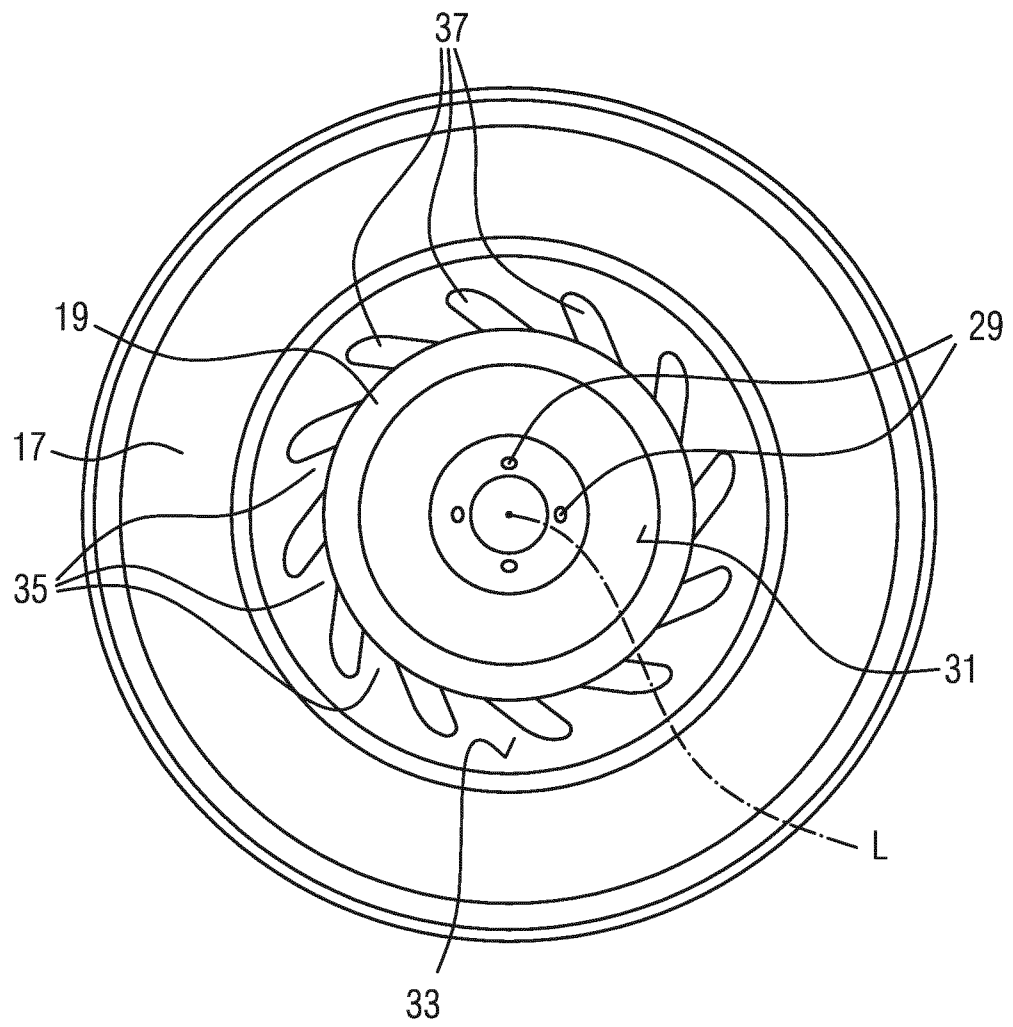


FIG 1C



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FIG 2A

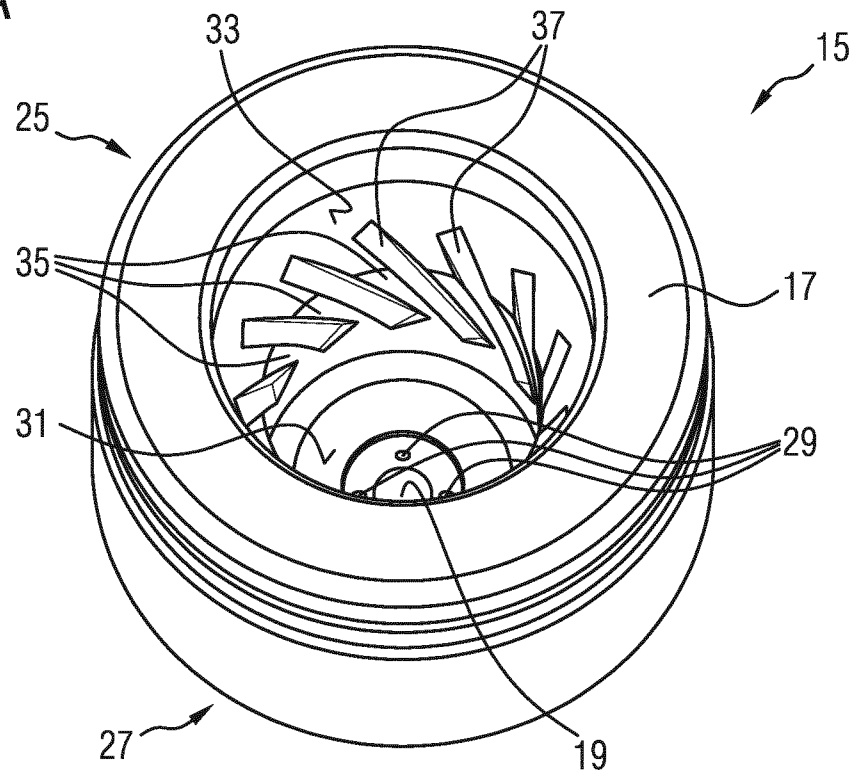
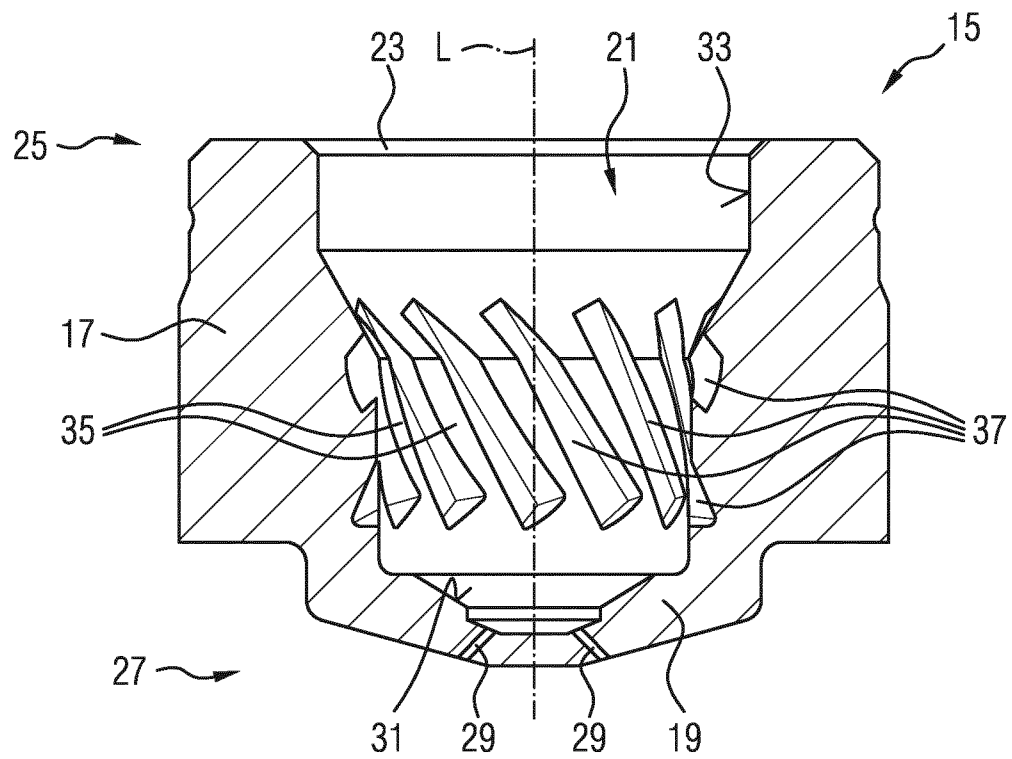
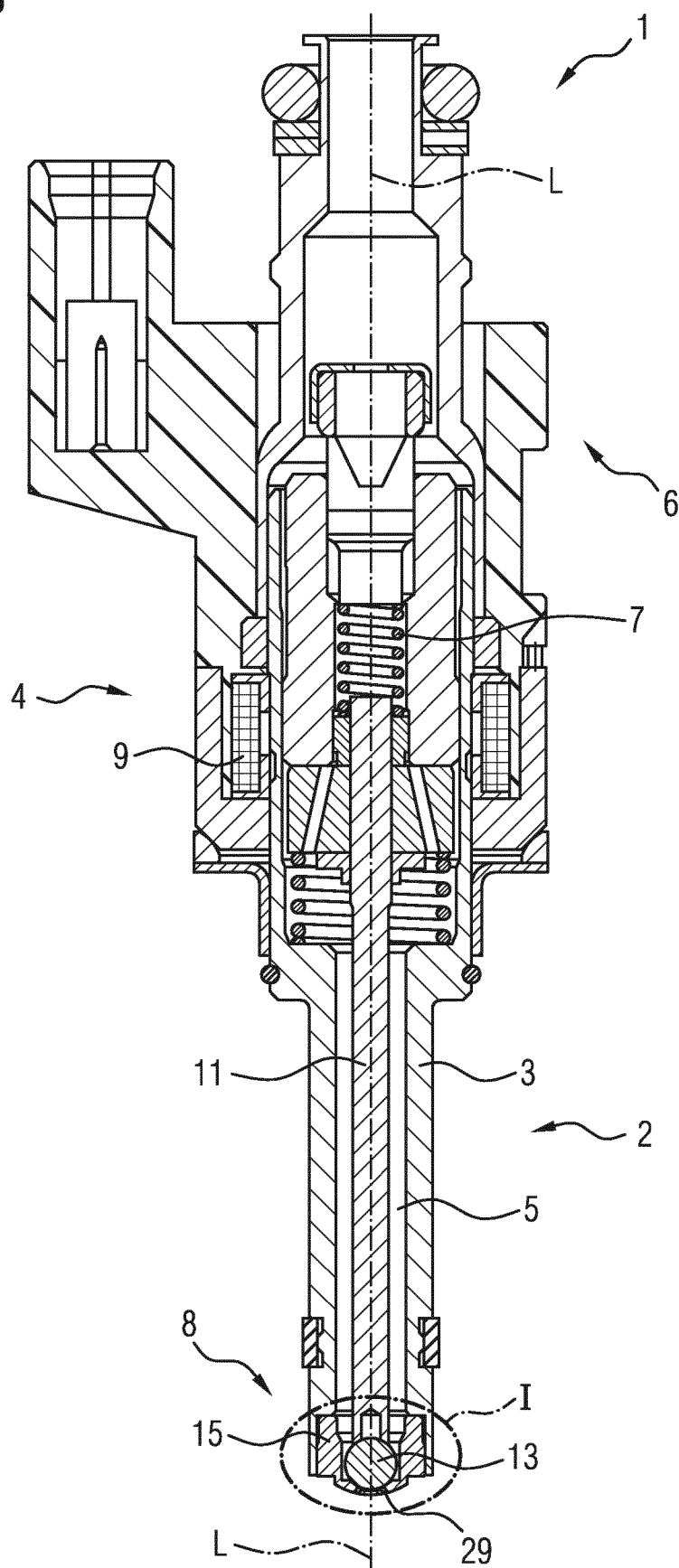


FIG 2B



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FIG 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/069376

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02M61/18 F02M61/16 F02M61/12
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	WO 02/25101 A1 (BOSCH GMBH ROBERT [DE]; DANTES GUENTER [DE]) 28 March 2002 (2002-03-28) page 4, line 7 - page 7, line 6; figures 2,3a,3b,3c	1-10
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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26/09/2018

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/069376

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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