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(54) **Pump assembly**

Pumpenanordnung

Ensemble de pompe

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Description

[0001] This invention relates to a pump assembly and, in particular, to a pump assembly for use in compression ignition engines.

[0002] Known fuel injection systems for supplying fuel to the cylinders of a compression ignition engine include a fuel injection pump, or pump assembly, for generating injection pressure and for delivering fuel at injection pressure to the injection nozzles of the system via high-pressure fuel lines.

[0003] In one type of fuel injection system, known as the unit injector, a pump assembly and a dedicated injection nozzle are arranged together within a common unit. The unit injector is usually driven by a camshaft run off the engine via a cam drive arrangement.

[0004] Figure 1 is an example of a known unit injector design, in which a plunger 2 reciprocates within a plunger bore 4 formed in a plunger housing or barrel 6. A pump or compression chamber 8 is defined by an end face 10 of the plunger 2 and the blind end of the plunger bore 4. A valve needle 12 of an injection nozzle 14 is responsive to the pressure of fuel supplied from the pump chamber 8 to the nozzle 14 and is biased closed against a valve needle seat 16 by means of a spring 18. In this particular unit injector the spring 18 acts on the valve needle 12 through a rocker arm 20, although other unit injector designs have the spring 18 axially aligned with the needle 12 at its pump chamber end.

[0005] First and second ports, 22 and 24 respectively, are provided in the plunger barrel 6 to provide a flow path for fuel into and out of the pump chamber 8 from a low pressure source 26 (via a storage space 28), depending on the position of the plunger 2 within its bore 4.

[0006] The plunger 2 is provided with a slot formation including two slots which are cut into its outer surface: a first longitudinal slot (not visible in Figure 1) which cuts through the end face 10 of the plunger 2 (referred to as a "stop slot"), and a second helical slot 30 which is cut at an angle to the stop slot and is arranged to communicate at one end with the stop slot.

[0007] The plunger 2 is driven by a cam drive to perform a pumping cycle during which fuel within the chamber 8 is pressurised to initiate an injection event and subsequently depressurised to terminate injection. The provision of the helical groove 30 is the means by which the quantity of fuel injected is controlled. During a forward stroke of the plunger (from bottom-dead-centre (BDC) to top-dead-centre (TDC)), pressurisation of fuel within the chamber 8 occurs when the plunger 2 has closed both ports 22, 24 and up until the point at which the edge of the helical groove 30 aligns with the second port 24 to permit fuel to escape to low pressure. As fuel within the pump chamber 8 is pressurised, the valve needle 12 is caused to lift from its seating 16 to commence injection. At the point at which the edge of the helical groove is aligned with the port 24, the pressure of fuel within the pump chamber 8 decays rapidly as fuel escapes through the helical groove 30 and the port 24 to low pressure, thereby causing the valve needle 12 to re-seat to terminate injection. The rate of pressure collapse in the pump chamber 8 at termination of injection is relatively rapid, and so the valve needle 12 is caused to seat quickly.

[0008] For some applications it is desirable for the rate of pressure collapse to be reduced or controlled carefully. In a modification of the unit injector in Figure 1, it is known to provide an additional spring-biased plate valve for this purpose. The plate valve is provided with a restricted orifice and is housed within an adapter plate located between the barrel 6 and the associated nozzle 14 (referring to Figure 1), within the high pressure connection between the pump chamber 8 and the nozzle 14. Upon termination of injection (i.e. with fuel pressure within the pump chamber decreasing), the plate valve is urged against its seating and the rate at which fuel can flow from the nozzle to low pressure is restricted by the orifice to reduce the rate of pressure collapse in the pump chamber. This is a satisfactory solution for some applications, although the requirement for additional moving parts (the plate valve and associated spring) adds cost and complexity to the unit. To some extent, the plate valve also influences initiation of injection as the closing force of the plate valve spring must be overcome before an unrestricted flow of high pressure fuel is able to flow to the nozzle.

[0009] By way of further background, FR2564900 describes a fuel injector including an injection pump having a pumping plunger for pressurising fuel within a pump chamber. The injection pump is provided with a flow passage that is restricted by way of a valve means through which fuel is pumped from the pumping chamber to low pressure during the pumping stroke in order to vary the rate of fuel pressurisation and the timing of initiation of an injection event.

[0010] US4090819 describes a pumping plunger for a fuel pump assembly which is directed to reducing the occurrence of cavitation. The plunger is provided with an elongate pre-cut-off groove parallel to a plunger main control edge. The pre-cut-off-groove is arranged to register with a fuel spill port before the main control edge in order to depressurise the pressure space of the fuel pump by a small amount prior to the main depressurisation event.

[0011] EP0971123 discloses a pumping plunger for a fuel pump assembly. The surface of the plunger is provided with longitudinal flow channels which define formations to restrict fuel flow past the channels when injection is terminated.

[0012] It is with a view to providing improvements to the above-mentioned prior art that the following is presented.

[0013] According to a first aspect of the invention, there is provided a pump assembly for use in a compression ignition engine. The pump assembly comprises a plunger which is reciprocable within a plunger housing, in use, to cause pressurisation of fuel within a compression chamber during a pumping stroke and to cause filling of the compression chamber with fuel during a return stroke, a first flow path providing communication between the compression chamber and a low pressure circuit to permit filling of the compression chamber during the plunger return stroke, the first flow path being closed to fuel flow during a portion of the pumping stroke to initiate pressurisation of fuel within the compression chamber, and a second flow path providing communication between the compression chamber and the low pressure circuit, the second flow path being opened to fuel flow during a portion of the pumping stroke to terminate pressurisation of fuel within the compression chamber after closure of the first flow path. The second flow path is provided with flow restriction means through which fuel is permitted to flow to the low pressure circuit to retard the rate of depressurisation of the compression chamber at the end of injection, wherein the second flow path is at least partially provided in a portion of the plunger by a drilling, the flow restriction means being provided along the drilling provided in the plunger.

[0014] Where the pump assembly is of the type for supplying pressurised fuel to an injection nozzle to initiate injection, the invention provides the advantage that the rate of pressure collapse within the pump chamber to terminate injection is reduced. The valve needle of the nozzle therefore experiences a cushioning effect as it seats, reducing wear and prolonging service life. The effects of gas blow-by are also reduced. It is a particular advantage that the invention achieves these benefits without the requirement to provide additional or moving parts in known pump assembly designs, such as unit injectors or unit pumps.

[0015] A further beneficial feature of the invention is that the supply of high pressure fuel to the associated nozzle is not affected by the provision of the flow restriction means, which only influences the rate of depressurisation of the compression chamber. Thus, a passage for high pressure fuel between the compression chamber and the nozzle is provided which permits fuel flow to and from an associated injection nozzle at a substantially unrestricted rate.

[0016] Advantageously, said portion of the second flow path may include a passageway or drilling along an axis substantially parallel to a first longitudinal axis of the plunger, and said flow restriction means is provided along this passageway.

[0017] Alternatively, said portion of the second flow path may include a passageway or drilling along an axis substantially perpendicular or transverse to the longitudinal axis of the plunger, and said flow restriction means is provided along this passageway.

[0018] It is preferable that the plunger housing comprises a plunger bore within which the plunger is reciprocable, with plunger motion being guided directly by an inner wall of the plunger bore.

[0019] Advantageously, the first flow path comprises a filling port provided in the housing and opening to the plunger bore.

[0020] The second flow path may include a second port provided in the plunger housing and opening to the plunger bore, wherein the second port is provided with the flow restriction means (as mentioned above).

[0021] In one embodiment, the pump assembly is a fuel pump (for example, a unit pump) for supplying pressurised fuel to a dedicated injector remote from the pump assembly, in use.

[0022] Alternatively, the pump assembly may be a unit injector, also comprising an injector arranged within a common unit with the pump assembly.

[0023] In this context, the pump assembly unit of the invention may be incorporated into a unit pump, in which a dedicated injector is arranged remote from the pump assembly, a unit injector where the pump assembly and dedicated injector/injection nozzle are arranged in a common housing to form a single unit or any other kind of pump unit for supplying pressurised fuel to a dedicated injection nozzle/injector.

[0024] It will therefore be appreciated that the phrase "unit pump assembly" is intended to include reference to unit pumps and unit injectors, and the like.

[0025] The present invention is now described with reference to the accompanying figures wherein:

Figure 1 is a schematic view of a known unit injector;

Figure 2 is a sectional view of a unit injector according to a first embodiment of the invention; and

Figure 3 is a detailed view of part of the unit injector mechanism shown in Figure 2.

[0026] Referring to Figures 2 and 3, a pump assembly of one embodiment of the present invention takes the form of a unit injector having many similar features to the prior art unit injector described previously. Where possible, similar parts to those shown in Figure 1 will be referred to with like reference numerals.

[0027] The plunger 2 is reciprocal within a plunger bore 4 provided in a plunger housing or barrel 6, with the plunger end face 10 defining the pump or compression chamber 8 at the blind end of the bore 4. The associated injection nozzle 14 includes a valve needle 12 provided with thrust surfaces (not identified), which are exposed to fuel pressure within a delivery chamber 32 defined within a nozzle bore 34. The delivery chamber 32 communicates with the pump chamber 8 of the pump assembly through channels which are not visible in the sections shown in Figures 2 and 3. The nozzle 14 is provided with nozzle spray holes (not shown) through which pressurised fuel is delivered to an associated engine cylinder when the valve needle 12 is caused to lift from its seating. The injection nozzle 14 and a lower end of the plunger housing 6 are retained between first and second housings 36, 38 respectively in a conventional manner.

[0028] First and second ports 22, 24 respectively are provided in the plunger housing 6 to open to the plunger bore 4, as described previously. A low pressure circuit including a storage space 28 and a supply rail 26 (typically at a pressure of 4 bar) is able to communicate with the pump chamber 8 through one or both of the first and second ports 22, 24 when they are open. Whether the ports 22, 24 are open or closed depends on the position of the plunger 2 within the bore 4.

[0029] Both the first and second ports 22, 24 provide a flow path by which the pump chamber 8 is filled during the pumping cycle. Notably, the unit injector shown in Figures 2 and 3 and the prior are unit injector in Figure 1 differ in the means by which the pump chamber 8 is brought into communication with the low pressure circuit 26, 28 at the end of an injection event. The distinctive feature of Figures 2 and 3, and that which distinguishes the invention from prior art assemblies, is shown in the highlighted portion X of Figure 2 and is reproduced in greater detail in Figure 3.

[0030] Referring in particular to Figure 3, the plunger 2 is provided with two additional drillings or passageways 40, 42 forming flow paths within the plunger 2. The drillings 40, 42 are provided instead of the stop slot in the pump assembly of Figure 1. A first longitudinal drilling 40 cuts through the plunger end face 10, preferably along the longitudinal axis of the plunger 2 for ease of manufacture, and meets with a second transverse drilling 42, perpendicular to the plunger axis, through a restriction 44. Much in the same way as in Figure 1, a helical groove or slot 30 is also provided in the plunger surface, only a portion of which is visible in Figure 3. The transverse drilling 42 is able to communicate with the second port 24 through the helical groove 30. The longitudinal drilling 40, the restriction 44, the transverse drilling 42 and the helical groove 30 together define a fuel flow path, having restricted flow means 44, by which the pump chamber 8 is able to communicate with the storage space 28 and the low pressure fuel rail 26. Typically, for example, the restriction is of the order of 1.0-1.5 mm diameter.

[0031] As an aside, it is preferable (although inessential) to provide the plunger 2 with a circumferential leakage groove 46, which serves to collect leakage fuel down the plunger bore 4 from the pump chamber 8. A further port 48 in the plunger housing 6 enables fuel collected within the leakage groove 46 to flow into the storage space 28 and to the low pressure rail 26. Other means for providing leakage collection are also envisaged, for example the plunger bore 4 may be provided with a leakage groove instead.

[0032] The pump assembly in Figures 2 and 3 has a similar pumping cycle to that described previously for the prior art, but its operation will now be described in detail to emphasise the functional advantages it provides.

[0033] In use, the plunger 2 is driven by the engine-driven cam to perform a pumping cycle having two extreme positions of motion. At top dead centre (TDC) the plunger 2 is at the innermost position within the bore 4 and at bottom dead centre (BDC) the plunger 2 is at the outermost position within the bore 4. From a starting position of TDC, the pumping chamber 8 is at its minimum volume and the end of the helical groove 30 is at least partially aligned with the second port 24. As the plunger 2 begins to travel towards BDC (referred to as the plunger return stroke), the pump chamber volume is expanding and a point will be reached at which the plunger end face 10 passes the edge of the first port 22 causing a substantially unrestricted flow of fuel to be drawn into the pump chamber 8 from the low pressure rail 26. As the plunger 2 continues to move towards BDC, the plunger end face 10 clears the lowermost edge of the second port 24 also so that further fuel is admitted into the pump chamber 8 through the second port 24.

[0034] Once the plunger 2 reaches BDC, the pump chamber 8 is at its maximum volume and filled with fuel. As the plunger 2 starts to move towards TDC (referred to as the plunger forward stroke), the volume of the pump chamber 8 starts to decrease and, initially, fuel is dispelled from the pump chamber 8 to the low pressure circuit 26, 28 through the uncovered ports 22, 24. As the plunger 2 moves further through the forward stroke, the end face 10 clears, initially, the lowermost edge of the second port 24 and subsequently the lowermost edge of the first port 22. Fuel remaining in the pump chamber 8, with the first and second ports 22, 24 closed by the plunger 2, will undergo pressurisation as the plunger 2 moves further through the forward stroke. It will be appreciated that pressurisation of fuel within the pump chamber 8 is only initiated when the first port 22 is also closed to break all communication routes between the pump chamber 8 and the low pressure rail 26.

[0035] Pressurised fuel within the pump chamber 8 is delivered to the delivery chamber 32 of the nozzle 14 through channels and passages of the pump and nozzle assembly (not shown) and a point will be reached at which the force due to the shut-off spring 18 is overcome and the needle 12 lifts from its seating 16. Under such circumstances fuel flows out of the nozzle holes into the engine cylinder to commence injection. It will be appreciated that this flow of high pressure fuel to the nozzle 14 is not restricted, and in particular the provision of the restricted drilling 44 has no bearing on this flow of fuel.

[0036] As the plunger 2 moves further through the forward stoke, a point will be reached at which the lowermost edge of the helical groove 30 passes the uppermost edge of the second port 24. As the plunger 2 moves further through the forward stroke, fuel within the pump chamber 8 is therefore able to flow through the longitudinal drilling 40, into the restriction 44, through the transverse drilling 42, into the helical groove 30 and into the second port 24 to low pressure. Fuel pressure within the pump chamber 8 is therefore reduced, or collapses, at a rate determined by the size of the restriction 44. The longitudinal drilling 40, the restriction 44, the transverse drilling 42 and the second port 24 therefore form part of a restricted flow passage for fuel between the pump chamber 8 and the low pressure circuit 26, 28.

[0037] As the pressure of fuel being supplied to the delivery chamber 32 of the nozzle 14 is reduced, a point will be reached at which the force due to the spring 18 is sufficient to re-seat the valve needle 12, thereby terminating injection through the nozzle holes. For the remainder of the plunger forward stroke, the plunger 2 moves to fully align the helical groove 30 with the second port 24, and may move beyond this point although at all times ensuring the flow passage to low pressure through the drillings 40, 44, 42, the groove 30 and the second port 24 is maintained.

[0038] During the subsequent plunger return stroke the plunger 2 moves outwardly from the bore 4, expanding the volume of the pump chamber 8 and filling the pump chamber 8 through the first and second ports 22, 24 ready for the next forward stroke, as described previously.

[0039] It is an important feature of the present invention that the rate of pressure collapse at the end of injection is controlled, or reduced, due to the provision of the restriction 44 in the plunger 2. By reducing the rate of pressure collapse at the end of injection, fuel suck-back through the nozzle holes, nozzle passageways and the pump chamber 8 is slowed, resulting in fuel remaining in the region of the valve needle seating 16 for a slightly longer period so as to cushion the valve needle 12 during the seating process. It is a benefit of this that valve needle and needle seat wear is reduced.

[0040] The provision of the restriction 44 within the plunger 2 itself is easy to accommodate and requires no additional parts to those in existing units. The jet of high pressure fuel expelled from the restriction 44 also impinges an internal surface of the plunger 2, which being made from a hard wearing material does not wear significantly as a result.

[0041] It is a further benefit of the invention that the detrimental effects of gas blow-by are minimised. Gas blow-by is known to occur in injection nozzles generally, due to combustion gasses being sucked from the combustion cylinder up into the nozzle, and can result in blocked flow passageways and contamination of the fuel system. Reducing the rate of pressure collapse in the pump chamber 8 at the end of injection minimises these effects.

[0042] As is known in unit injectors generally of the aforementioned type, the plunger 2 is movable angularly about its longitudinal axis so that the point in the forward stroke at which the edge of the helical groove 30 is brought into communication with the second port 24 may be adjusted. Hence, the quantity of fuel that is injected during each pumping cycle can be controlled by adjusting the angular position of the plunger 2.

[0043] It is noted that the helical groove 30 necessarily does not cut through to the plunger end face 10, otherwise depressurising fuel would flow through the helical slot, bypassing the longitudinal drilling 40 and through the restriction 44. Were this to happen the benefits of the restriction 44 in controlling fuel pressure collapse would not be realised.

[0044] Although the embodiment described shows a restriction 44 between two drillings 40, 42, it is to be noted that the invention does not preclude location of the restriction along other positions in the fuel depressurisation circuit to achieve the same benefits as those described above. As an example, an alternative location for the restriction would be in the transverse drilling 42, although this embodiment may be less preferable as the depressurising fuel jet may impinge on other parts of the pump assembly, and not on internal surfaces of the plunger 2.

[0045] Another embodiment provides one of the ports 22, 24 with a restriction whilst the other is unrestricted. The ports must be positioned so that pump chamber filling can occur through the unrestricted port, whilst depressurisation of the pump chamber 8 occurs through the restricted port. In this embodiment the plunger housing 6 of existing units therefore requires modification, and the plunger 2 also requires the provision of the drillings 40, 42 (with no stop slot).

Claims

1. A pump assembly for use in a compression ignition engine, the pump assembly comprising:

    a plunger (2) that is reciprocable within a plunger housing (6) to cause pressurisation of fuel in a compression chamber (8) during a pumping stroke and to cause filling of the compression chamber (8) with fuel during a return stroke,
    a first flow path (22) providing communication between the compression chamber (8) and a low pressure circuit (26, 28) to permit filling of the compression chamber (8) during the return stroke, the first flow path (22) being closed to fuel flow during a portion of the pumping stroke to initiate pressurisation of fuel within the compression chamber (8),
    a second flow path (40, 42, 24) providing communication between the compression chamber (8) and the low pressure circuit (26, 28), and being opened to fuel flow during a portion of the pumping stroke to terminate pressurisation of fuel within the compression chamber after said closure of the first flow path (22);

    wherein the second flow path (40, 42, 24) is provided with flow restriction means (44) through which fuel flows to the low pressure circuit to retard the rate of depressurisation of the compression chamber (8) at the end of injection, **characterised in that** the second flow path (40, 42, 24) is at least partially provided through a portion of the plunger (2), the second flow path comprising a drilling (40, 42) in the plunger, said flow restriction means (44) being provided along the drilling (40, 42).

2. A pump assembly according to Claim 1, said drilling (40) being provided along an axis parallel with a longitudinal axis of the plunger (2).

3. A pump assembly according to Claim 1, said drilling (42) being provided along an axis transverse to a longitudinal axis of the plunger (2).

4. A pump assembly according to any one of the preceding claims, further **characterised in that** the plunger housing (6) is provided with a plunger bore (4), which serves to guide reciprocal motion of the plunger (2) within the plunger housing (6).

5. A pump assembly according to any one of the preceding claims, wherein the first flow path comprises a filling port (22) provided in the plunger housing (6) and opening to the plunger bore (4).

6. A pump assembly according to any one of the preceding claims, in the form of a fuel pump for supplying pressurised fuel to a dedicated injector remote from the pump assembly, in use.

7. A pump assembly according to any one of claims 1 to 5, in the form of a unit injector, which also comprises an injection nozzle (14) arranged within a common unit with the pump assembly (2, 6).

8. A pump assembly as claimed in claim 7, including a passage for high pressure fuel between the compression chamber (8) and the nozzle (14), which permits fuel flow to and from the injection nozzle (14) at a substantially unrestricted rate.

Patentansprüche

1. Pumpenanordnung zur Verwendung in einem Verbrennungsmotor, wobei die Pumpenanordnung umfasst:

    einen Kolben (2), der innerhalb eines Kolbengehäuses (6) hin und her bewegt werden kann, um während eines Pumpenhubs die Beaufschlagung von Kraftstoff in einer Druckkammer (8) mit Druck zu bewirken und zu bewirken, dass die Druckkammer (8) während eines Rückhubs mit Kraftstoff befüllt wird,
    einen ersten Strömungsweg (22), der zwischen der Druckkammer (8) und einem Niederdruckkreislauf (26,28) eine Strömungsverbindung ermöglicht, damit die Druckkammer (8) während des Rückhubs befüllt werden kann, wobei der erste Strömungsweg (22) während eines Teils des Pumpenhubs für den Durchfluss von Kraftstoff geschlossen wird, um die Beaufschlagung des Kraftstoffs innerhalb der Druckkammer (8) mit Druck in Gang zu setzen,
    einen zweiten Strömungsweg (40,42,24), der zwischen der Druckkammer (8) und
    dem Niederdruckkreislauf (26,28) eine Strömungsverbindung ermöglicht und
    während eines Teils des Pumpenhubs für den Durchfluss von Kraftstoff geöffnet wird, um das Beaufschlagen von Kraftstoff innerhalb der Druckkammer mit Druck nach dem Verschließen des ersten Strömungswegs (22) zu beenden;

worin der zweite Strömungsweg (40,42,24) mit einem Strömungsbegrenzer (44) ausgestattet ist, durch welchen Kraftstoff zu dem Niederdruckkreislauf strömt, um das Ausmaß der Druckentlastung der Druckkammer (8) am Ende der Einspritzung zu verlangsamen, **dadurch gekennzeichnet, dass** der zweite
Strömungsweg (40,42,24) mindestens teilweise durch einen Teil des Kolbens (2) hindurchgehend ausgebildet ist, wobei der zweite Strömungsweg eine
Drillbohrung (40,42) in dem Kolben umfasst, wobei der Strömungsbegrenzer (44) entlang der Drillbohrung (40,42) ausgebildet ist.

2. Pumpenanordnung gemäß Anspruch 1, wobei die Drillbohrung (40) entlang einer Achse ausgebildet ist, die parallel zu einer Längsachse des Kolbens (2) verläuft.

3. Pumpenanordnung gemäß Anspruch 1, wobei die Drillbohrung (42) entlang einer Achse ausgebildet ist, die quer zu einer Längsachse des Kolbens (2) verläuft.

4. Pumpenanordnung gemäß einem der voranstehenden Ansprüche, weiterhin **dadurch gekennzeichnet, dass** das Kolbengehäuse (6) mit einer Kolbenbohrung (4) ausgestattet ist, die dazu dient, die Hin- und Herbewegung des Kolbens (2) innerhalb des Kolbengehäuses (6) zu führen.

5. Pumpenanordnung gemäß einem der voranstehenden Ansprüche, worin der erste Strömungsweg eine Füllöffnung (22) aufweist, die in dem Kolbengehäuse (6) ausgebildet ist und sich zu der Kolbenbohrung (4) hin öffnet.

6. Pumpenanordnung gemäß einem der voranstehenden Ansprüche in Gestalt einer Kraftstoffpumpe, die unter Druck stehenden Kraftstoff während des Betriebs einem dafür vorgesehen Einspritzventil zuführen soll, das separat von der Pumpenanordnung angeordnet ist.

7. Pumpenanordnung gemäß einem der Ansprüche 1

bis 5 in Gestalt einer Einspritzventil-Einheit, die außerdem eine Einspritzdüse (14) aufweist, die innerhalb einer Einheit angeordnet ist, die sie mit der Pumpenanordnung (2,6) teilt.

8. Pumpenanordnung wie in Anspruch 7 beansprucht, umfassend einen Kanal für unter hohem Druck stehenden Kraftstoff zwischen der Druckkammer (8) und der Düse (14), der es ermöglicht, dass Kraftstoff im Wesentlichen ungehindert oder unbeschränkt zu der Einspritzdüse (14) und von ihr weg fließen kann.

Revendications

1. Assemblage de pompe pour un moteur à allumage par compression, l'assemblage de pompe comprenant :

un plongeur (2) qui est à va-et-vient à l'intérieur d'un logement du plongeur (6) pour entraîner la pressurisation de combustible dans une chambre de compression (8) au cours d'une course de pompe et pour entraîner le remplissage de la chambre de compression (8) avec le combustible au cours d'une course de retour,
un premier parcours d'écoulement (22) créant une communication entre la chambre de compression (8) et un circuit basse pression (26, 28) pour entraîner le remplissage de la chambre de compression (8) au cours de la course de retour, le premier parcours d'écoulement (22) étant fermé de manière à alimenter l'écoulement au cours d'une portion de la course de la pompe pour initier la pressurisation du combustible à l'intérieur de la chambre de compression (8),
un second parcours d'écoulement (40, 42, 24) créant une communication entre la chambre de compression (8) et le circuit basse pression (26, 28) et étant ouvert de manière à alimenter l'écoulement au cours d'une portion de la course de la pompe pour terminer la pressurisation du combustible à l'intérieur de la chambre de compression après ladite fermeture du premier parcours d'écoulement (22) ;

dans lequel le second parcours d'écoulement (40, 42, 24) est doté de moyens de restriction de l'écoulement (44) à travers lesquels le combustible s'écoule vers le circuit basse pression pour ralentir le taux de dépressurisation de la chambre de compression (8) à la fin de l'injection,
caractérisé en ce que le second parcours d'écoulement (40, 42, 24) se situe au moins partiellement dans une portion du plongeur (2), le second parcours d'écoulement comprenant un perçage (40, 42) dans le plongeur, lesdits moyens de restriction d'écoulement (44) étant disposés le long du perçage (40, 42).

2. Assemblage de pompe selon la revendication 1, ledit perçage (40) étant disposé le long d'un axe parallèle à un axe longitudinal du plongeur (2).

3. Assemblage de pompe selon la revendication 1, ledit perçage (42) étant disposé le long d'un axe transversal à un axe longitudinal du plongeur (2).

4. Assemblage de pompe selon l'une quelconque des revendications précédentes, **caractérisé en outre en ce que** le logement du plongeur (6) est doté d'un alésage du plongeur (4), qui sert à guider le mouvement de va-et-vient du plongeur (2) à l'intérieur du logement du plongeur (6).

5. Assemblage de pompe selon l'une quelconque des revendications précédentes, dans lequel le premier parcours d'écoulement comprend un orifice de remplissage (22) disposé dans le logement du plongeur (6) et s'ouvrant vers l'alésage du plongeur (4).

6. Assemblage de pompe selon l'une quelconque des revendications précédentes, sous la forme d'une pompe à combustible pour fournir le combustible pressurisé à un injecteur spécialisé éloigné de l'assemblage de pompe, lors de l'utilisation.

7. Assemblage de pompe selon l'une quelconque des revendications 1 à 5, sous la forme d'un injecteur-pompe, qui comprend également une buse d'injection (14) disposée à l'intérieur d'une unité commune avec l'assemblage de pompe (2, 6).

8. Assemblage de pompe selon la revendication 7, comprenant un passage pour combustible haute pression entre la chambre de compression (8) et la buse (14), qui permet l'écoulement du combustible vers et de la buse d'injection (14) à un taux essentiellement libre.

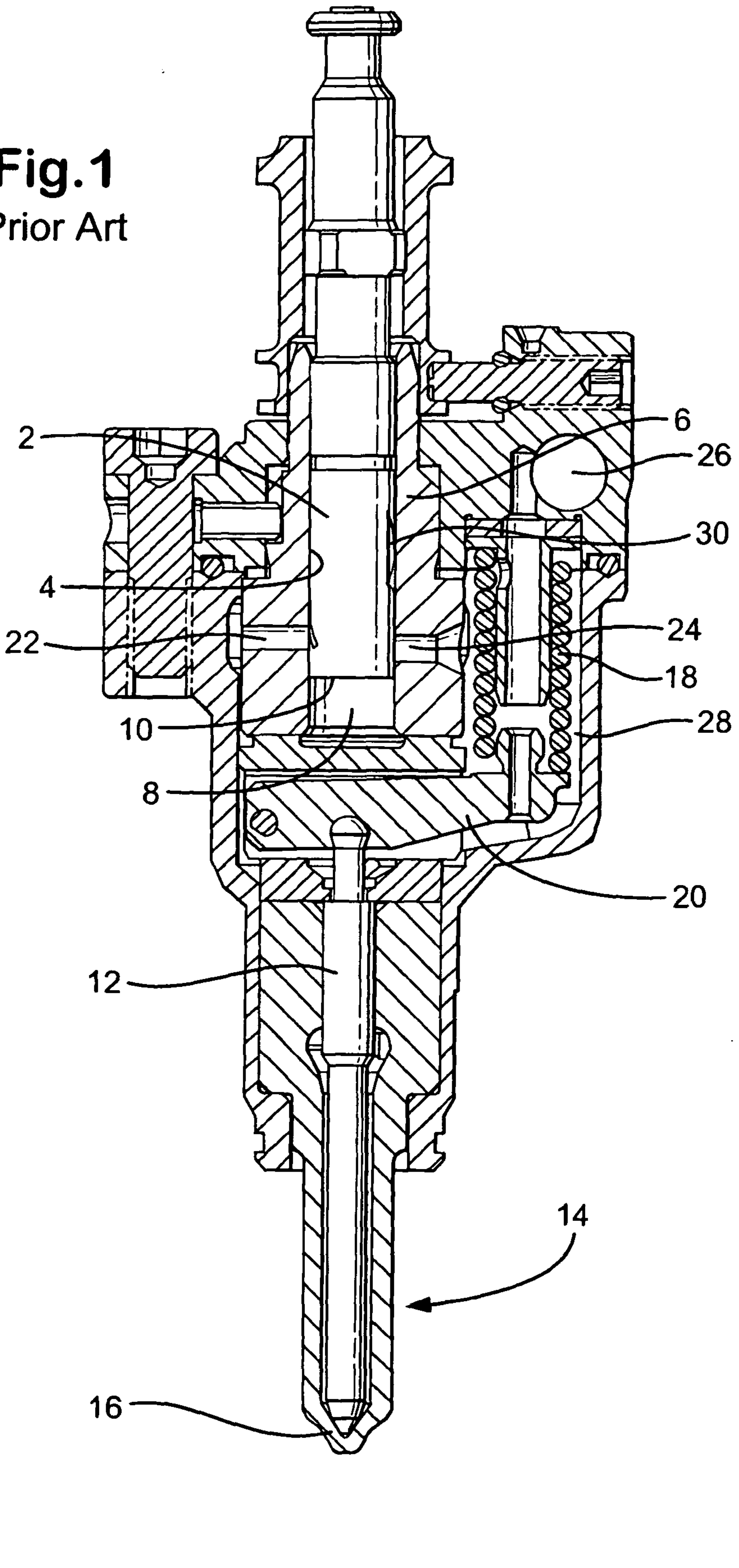

Fig.1
Prior Art

Fig.2

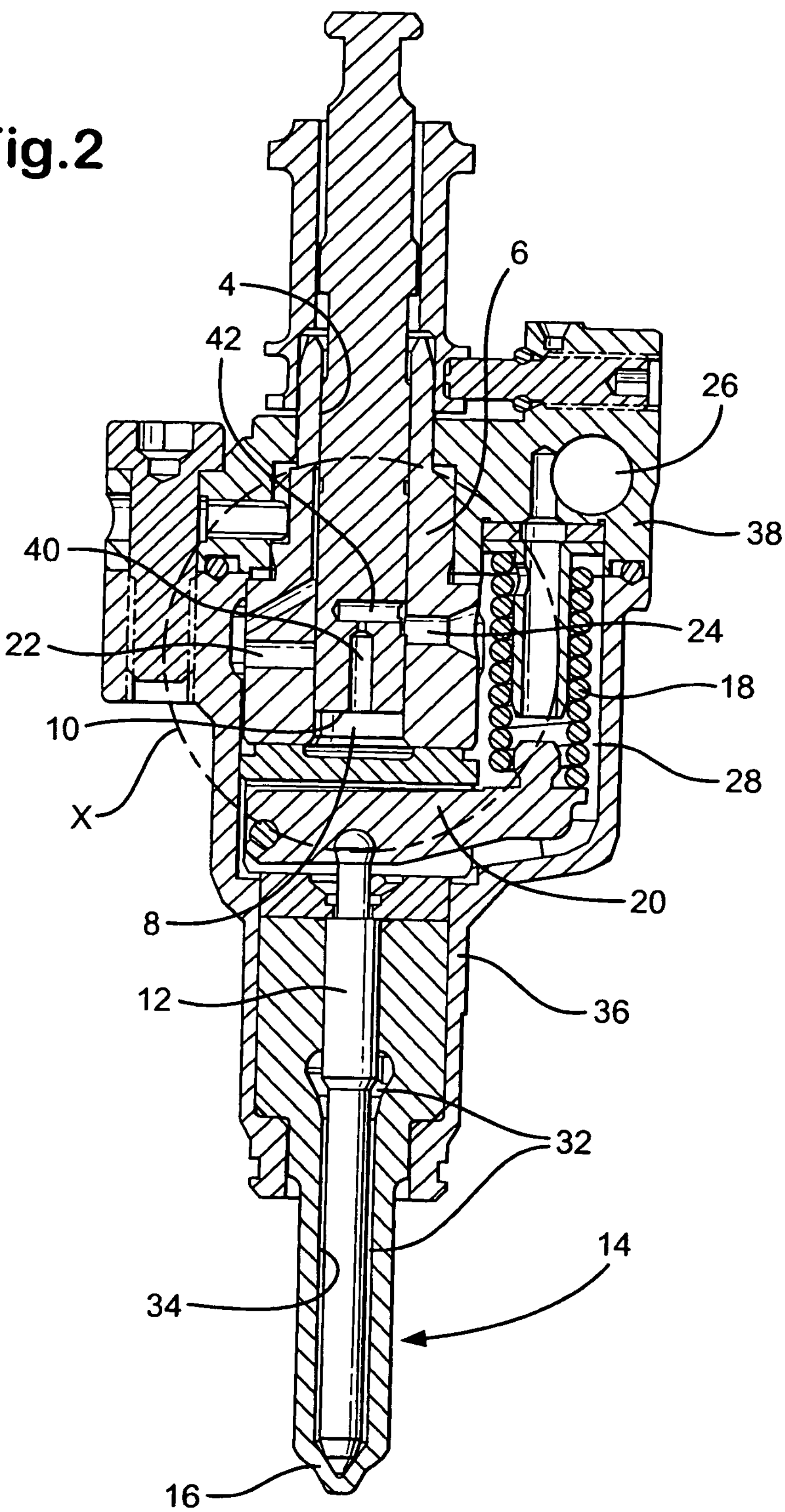

Fig.3