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(56) Documents Cited

GB 1563331 A	**GB 1209186 A**
GB 0774226 A	**US 4315616 A**
US 4089504 A	**US 4050473 A**

(58) Field of Search
UK CL (Edition S) **F2V VG4 VP102 VP11 VP182 VW46 VW5 VW54 VW67**
INT CL[7] **F16K 1/36 1/38 1/46 1/48**
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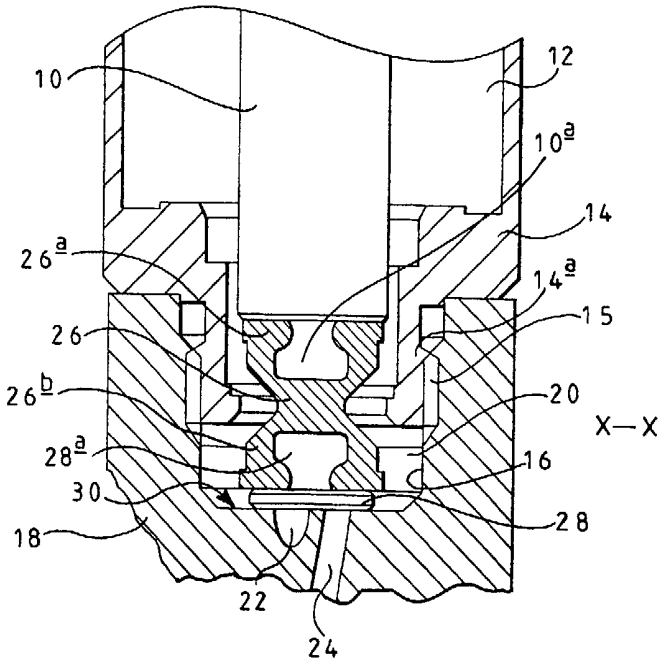
(54) Abstract Title
Valve arrangement

(57) A valve arrangement for use in controlling the supply of fuel to a first fuel passage (22) defined in a housing (18) comprises a valve member (10) which is movable under the influence of an actuator arrangement to control fuel delivery from a chamber (20) to the first fuel passage (22), the valve member carrying a resilient member (26) which carries an end member (28), the end member (28) being engageable with a seating surface (30) so as to provide a substantially fluid tight seal between the chamber (20) and the first fuel passage (22). The valve member (10) is preferably movable under the influence of a magnetic field, the resilient member (26) being arranged to break the magnetic field so that the end member (28) may be of magnetic material such as mild steel. Preferably, the housing (18) has two fuel passages (22,24).

FIG 1



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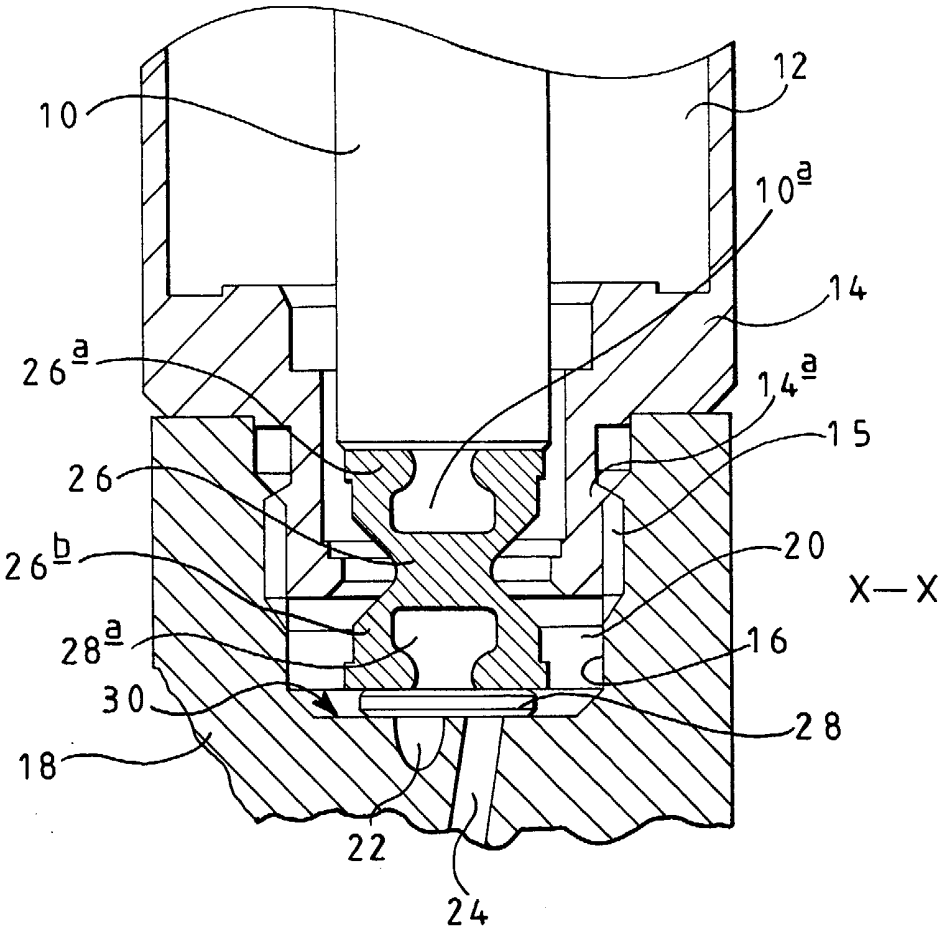
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG 1


10
12
10a
14
26a
14a
15
26
20
26b
X—X
16
28a
30
28
18
22
24

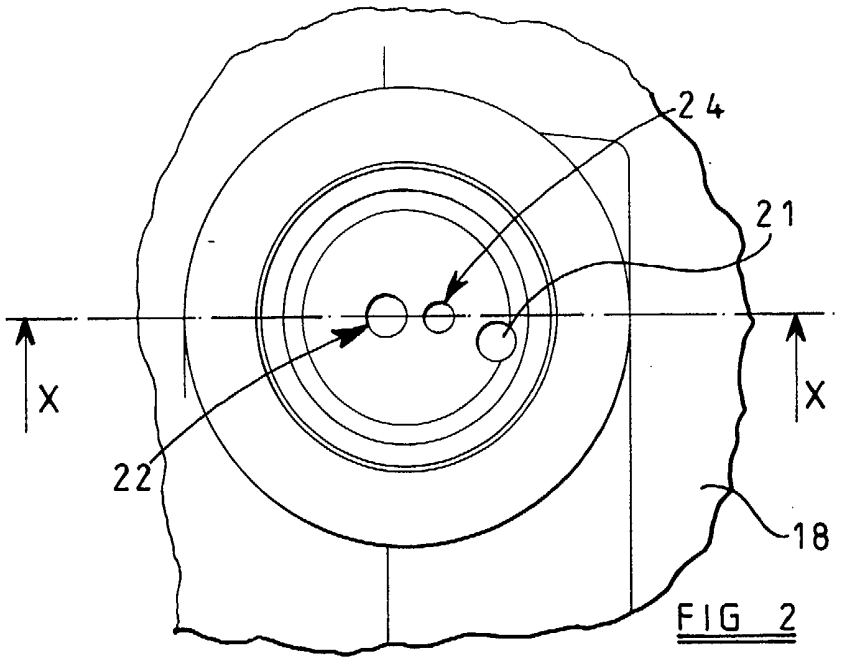

24
21
X
X
22
18

FIG 2

VALVE ARRANGEMENT

This invention relates to a valve arrangement. In particular, but not exclusively, the invention relates to an electromagnetically controlled valve arrangement for use in an advance arrangement for controlling the timing of fuel delivery by a high pressure fuel pump to an internal combustion engine.

It is known to provide an advance arrangement with an electromagnetically controlled valve arrangement which is operable to control the supply of fuel at transfer pressure to the advance arrangement depending on the load under which the engine is operating. It is also known to provide the advance arrangement with an electromagnetically controlled valve arrangement which is operable in response to the operating temperature of the engine. An example of such an advance arrangement is described in EP 0921 300.

The electromagnetic valve arrangement includes an armature which is movable under the influence of a magnetic field generated by supplying current through a winding. The valve arrangement is arranged to control the supply of fuel at transfer pressure to first and second fuel passages, through which fuel is delivered to control chambers associated with the advance arrangement, by controlling movement of a valve member or armature. Fuel pressure within the control chambers acts on a piston arrangement so as to control the position of an advance piston, the position of the advance piston controlling the timing of fuel delivery to the engine.

The first and second fuel passages are defined by first and second drillings respectively provided in a housing for the advance arrangement. In order to ensure the correct functioning of the advance arrangement, it is important that the first and second drillings are substantially sealed from one another and can be sealed from fuel at transfer pressure.

It is an object of the present invention to provide a valve arrangement which enables this to be achieved.

According to the present invention, there is provided a valve arrangement for use in controlling the supply of fuel to a first fuel passage defined in a housing, the valve arrangement comprising a valve member which is movable under the influence of an actuator arrangement to control fuel delivery from a chamber to the first fuel passage, the valve member carrying a resilient member which carries an end member, the end member being engageable with a seating surface so as to provide a substantially fluid tight seal between the first fuel passage and the chamber.

A second fuel passage may be defined in the housing, the valve arrangement being arranged to control fuel delivery from the chamber to the second fuel passage, the end member providing a substantially fluid tight seal between the first and second fuel passages when the end member is seated against the seating.

It has been proposed to provide an end of the armature of the valve arrangement with a resilient seal member which engages a seating surface to provide a substantially fluid tight seal between the first and second fuel passages and to seal the passages from fuel at transfer pressure. However, it has been found that extrusion of the seal member occurs due to the high pressure of fuel flowing through the passages. This has an adverse effect on the sealing properties of the valve arrangement. The present invention provides the advantage that, as the end member engages the seating surface, rather than the resilient member, extrusion of the resilient member is substantially prevented.

Preferably, the valve member is arranged to be movable between a first position, in which the chamber communicates with the first fuel passage, and a second position in which communication between the first fuel passage and the chamber is broken by means of engagement between the end member and the seating surface.

Movement of the valve member in an axial direction may be controlled by means of an electromagnetic actuator arrangement.

Preferably, the valve member takes the form of an armature forming part of the electromagnetic actuator arrangement, the valve member being movable under the influence of a magnetic field generated by the electromagnetic actuator arrangement.

The resilient member is arranged such that the magnetic field generated by the electromagnetic actuator arrangement is broken. This provides the advantage that the end member need not be formed from a non-magnetic material but may be formed from a magnetic material, for example mild steel. This enables the cost of the arrangement to be reduced.

Manufacturing tolerances are also improved as any planar misalignment between the surface of the end member which engages the seating surface and the seating surface itself can be compensated for due to the flexibility of the resilient member. Any coaxial misalignment between the axis of the valve member and the axis of the bore which defines the seating surface can also be compensated for by flexing of the resilient member.

The housing may take the form of an advance housing forming part of an advance arrangement for controlling the timing of fuel delivery by a high pressure fuel pump to an internal combustion engine.

Preferably, the chamber is defined, in part, by a blind bore provided in a first housing part forming part of the advance housing. The seating surface may be defined by a blind end of the bore.

The invention will now be described, by way of example only, with reference to the accompanying figures in which;

Figure 1 is a sectional view, along line X-X, of a valve arrangement in accordance with an embodiment of the present invention; and

Figure 2 is a different sectional view of the arrangement in Figure 1.

Referring to Figures 1 and 2, there is shown a valve arrangement which is controlled by means of an electromagnetic actuator arrangement including an armature and a winding 12. The armature takes the form of a valve member 10 having a projection 10a at one end thereof, the valve member 10 being moveable under the influence of a magnetic field generated by supplying a current to the winding 12 of the actuator arrangement. The actuator arrangement is housed within a first housing 14 including a projection 14a which extends into a blind bore 16 provided in a further housing 18. The housing 18 takes the form of an advance housing for an advance arrangement for controlling the timing of fuel delivery by a high pressure fuel pump to an internal combustion engine. The bore 16 provided in the housing 18 defines, in part, a chamber 20 for fuel at transfer pressure, the chamber 20 receiving fuel through an inlet drilling 21 (as shown in Figure 2) provided in the housing 18. An appropriate seal arrangement 15 is provided to form a substantially fluid tight seal between the housings 14, 18

In use, the valve member 10 is operable to control fuel delivery from the chamber 20 through first and second drillings, 22, 24 respectively provided in the advance housing 18. The valve member 10 is provided with a flexible, resilient member 26 which may be formed, for example, from an elastomeric material. The resilient member 26 is provided with first and second annular flanges 26a, 26b respectively, the first annular flange 26a engaging the projection 10a carried by the valve member 10. The second annular flange 26b engages a projection 28a forming part of an end member 28, the surface of the end member 28 remote from the projection 28a being engageable with a seating surface 30 defined by the blind end of the bore 16 to control communication between the chamber 20 and the first and second drillings 22,24.

In use, de-energisation of the winding 12 of the actuator arrangement causes the valve member 10 to move in an axial direction so as to move the end member 28 into engagement with the seating surface 30. Energisation of the winding 12 causes the valve member 10, and hence the end member 28, to move away from the seating surface 30. In the illustration shown in Figure 1, the valve member 10 is in a first position in which the end member 28 seats against the seating surface 30 to provide a substantially fluid tight seal between the chamber 20 and the first and second drillings 22,24. It will be appreciated, however, that the winding 12 may be arranged such that energisation of the winding 12 of the actuator arrangement causes the valve member 10 to move into engagement with the seating surface 30, de-energisation of the winding 12 causing the valve member 10 to move axially away from the seating surface 30.

The first drilling 22 may be arranged to deliver fuel at transfer pressure to a first chamber associated with the advance arrangement and the second drilling 24 may be arranged to deliver fuel at transfer pressure to a second chamber associated with the advance arrangement, the pressure of fuel within the first and second control chambers being varied, in use, so as to control the position

of an advance piston in a conventional manner which would be familiar to a person skilled in the art. In turn, the position of the advance arrangement controls the timing of fuel delivery to the associated engine. It will therefore be appreciated that axial adjustment of the position of the valve member 10 enables fuel at transfer pressure to be delivered from the chamber 20 to the first and second drillings 22, 24 in order to control the position of the advance piston and, hence, the timing of fuel delivery.

It has previously been proposed to provide the valve member 10 with a resilient seal member at one end thereof, the seal member being arranged to seal the first and second drillings 22, 24 from the chamber 20 when the valve member is seated against its seating. However, such arrangements have the disadvantage that fuel under high pressure within the chamber 20 causes the seal member to extrude into the first and second drillings 22, 24, thereby adversely affecting its sealing properties. In the valve arrangement of the present invention, due to the provision of the end member 28, in addition to the resilient member 26, such adverse effects are avoided.

The invention provides the further advantage that the resilient member 26 breaks the magnetic field generated as a result of current flow through the winding 12. The end member 28 carried by the valve member 10 may therefore be formed from a magnetic material, such as mild steel, and need not be formed from a non-magnetic material such as stainless steel. This reduces the cost of the arrangement. The provision of the flexible, resilient member 26 also enables any planar misalignment between the end surface of the end member 28 and the seating surface 30 with which it engages to be compensated for. Any coaxial misalignment between the axis of the valve member 10 and the axis of the bore 16 can also be compensated for due to the flexibility of the resilient member 26.

It will be appreciated that the resilient member 26 and the end member 28 may be carried by the valve member 10 by securing or connecting the end member 28 to the resilient member 26, and by securing or connecting the resilient member 26 to the valve member 10 using any appropriate means, and that the projections 10a, 28a and the annular flanges 26a, 26b are not essential to the present invention.

It will further be appreciated that the valve arrangement described hereinbefore need not be of the electromagnetically actuated type. Additionally, the valve arrangement may be used to control fuel delivery to a different number of drillings to those described and is not limited to use in an advance arrangement for controlling the timing of fuel delivery to an internal combustion engine.

CLAIMS

1. A valve arrangement for use in controlling the supply of fuel to a first fuel passage defined in a housing, the valve arrangement comprising a valve member which is movable under the influence of an actuator arrangement to control fuel delivery from a chamber to the first fuel passage, the valve member carrying a resilient member which carries an end member, the end member being engageable with a seating surface so as to provide a substantially fluid tight seal between the first fuel passage and the chamber.

2. A valve arrangement as claimed in Claim 1, wherein a second fuel passage is defined in the housing, the valve arrangement being arranged to control fuel delivery from the chamber to the second fuel passage, the end member providing a substantially fluid tight seal between the first and second fuel passages when the end member is seated against the seating.

3. The valve arrangement as claimed in Claim 1 or Claim 2, wherein the valve member is arranged to be movable between a first position, in which the chamber communicates with the first fuel passage, and a second position in which the communication between the chamber and the first fuel passage is broken by means of engagement between the end member and the seating surface.

4. The valve arrangement as claimed in any of Claims 1 to 3, wherein the valve member takes the form of an armature forming part of an electromagnetic actuator arrangement, the valve member being movable in an axial direction under the influence of a magnetic field generated by the electromagnetic actuator arrangement.

5. The valve arrangement as claimed in Claim 4, wherein the resilient member is arranged such that the magnetic field generated by the electromagnetic actuator arrangement is broken.

6. The valve arrangement as claimed in Claim 5, wherein the end member is formed from a magnetic material.

7. The valve arrangement as claimed in any of Claims 1 to 6, wherein the housing takes the form of an advance housing forming part of an advance arrangement for controlling the timing of fuel delivery by a high pressure fuel pump to an internal combustion engine.

8. The valve arrangement as claimed in any of Claims 1 to 7, wherein the chamber is defined, in part, by a blind bore provided in the housing.

9. The valve arrangement as claimed in Claim 8, wherein the seating surface is defined by a blind end of the bore.

10. A valve arrangement as hereinbefore described with reference to the accompanying Figures 1 and 2.

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Application No: GB 0019346.6
Claims searched: 1 to 10

Examiner: Mike Henderson
Date of search: 15 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): F2V (VP11 VP102 VP182 VW5 VW46 VW54 VW67 VG4)

Int Cl (Ed.7): F16K 1/36 1/38 1/46 1/48

Other: ONLINE:WPI,EPODOC,JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1563331	(BAILEY GILL PRODUCTS LTD) (Fig.1 and corresponding description particularly relevant)	1 & 3
X	GB 1209186	(WELLMAN INDUSTRIAL CONTROLS LTD) (Whole disclosure relevant)	1 & 3 to 5
X	GB 774226	(KOOIMAN et al) (Whole disclosure relevant)	1 & 3
X	US 4315616	(WELKER) (Whole disclosure relevant)	1 & 3
X	US 4089504	(GIULIANI) (Whole disclosure relevant)	1 & 3
X	US 4050473	(CHO) (Whole disclosure relevant)	1 & 3

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.