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Patents Form 1

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Request for grant of a patent

Concept House
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Application number **GB1620246.7**

1. Your reference	630-75GB		
2. Full name, address and postcode of the applicant or of each applicant	BEND-ALL INCORPORATED 575 Waydom Drive Ayr N0B 1E0 Ontario Canada		
Patents ADP number (<i>if you know it</i>)			11847571001
3. Title of the invention	FIRST FILL VALVE ELEMENT		
4. Name of your agent (<i>if you have one</i>)	ASQUITH, Mr. Anthony 123 Main Street Scholes Leeds LS15 4DP Yorkshire United Kingdom		
"Address for service" to which all correspondence should be sent. This may be in the European Economic area or Channel Islands (see warning note below) (<i>including the postcode</i>)			1184758900
Patents ADP number (<i>if you know it</i>)			1
5. Priority declaration: Are you claiming priority from one or more earlier-filed patent applications? If so, please give details of the application(s)			
	Country	Application number	Date of filing
6. Divisionals etc: Is this application a divisional application, or being made following resolution of an entitlement dispute about an earlier application. If so, please give the application number and filing date of the earlier application			PDAS Access Code
		Number of earlier UK application	Date of filing (<i>day / month / year</i>)
7. Inventorship: (Inventors must be individuals not companies)			
Are all the applicants named above also inventors?	No		
8. Are you paying the application fee with this form?	No		

Patents Form 1

9. Accompanying documents: please enter the number of pages of each item accompanying this form.

Continuation sheets of this form

Description: **6**
Claim(s): **n/a**
Abstract: **n/a**
Drawing(s): **3**

If you are not filing a description, please give details of the previous application you are going to rely upon

Country	Application number	Date of filing	PDAS Access Code
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10. If you are also filing any of the following, state how many against each item.

Priority documents: **0**

Statement of inventorship and right to grant of a patent
(Patents Form 7): **0**

Request for search (Patents Form 9A): **0**

Request for substantive examination (Patents Form 10): **0**

Any other documents (please specify): **PDAS Registration Form
Form 23**

11. I/We request the grant of a patent on the basis of this application.

Date: **29 Nov 2016**

12. Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant

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TITLE: FIRST FILL VALVE ELEMENT

. ABSTRACT

BACKGROUND

5 Fluid flow (TOC) lines forming engine and transmission components are designed to be
. opened and closed upon certain predetermined operating conditions. In many cases these
lines are thermally controlled and operate either precipitously or gradually upon the
increase or decrease of the thermal and pressure conditions within the engine system as by
. a valving mechanism. As engine system operational parameters are very sensitive
10 operation of the fluid flow lines are not able to be effectively filled and tested during the
manufacturing and assembly process.

. Thermal or pressure bypass valves are normally closed at the ambient temperatures or
pressures operative during the manufacturing and assembly process as the engine system is
idle. The valve is first opened for heated fluid flow as the engine system reaches operating
15 temperature in use, long after it has left the factory floor.

An inability to make an effective fill during manufacturing and assembly limits the ease of
inexpensive integrity testing at that stage. This in turn increases the risk of costly and
. damaging repairs at a later date or during actual use of the engine system.

THE INVENTION

20 The invention provides an in-line valve element acting, preferably, axially with the line of
. valve action which changes its axial properties as the system conditions change:

- . • from ambient (ie valve state 1), preferably open, on the factory floor,
- . • to operational (ie valve state 2), also preferably open, upon system operation in
actual use, and,
- 25 • back to ambient (ie valve state 3), preferably closed, upon cessation of the system
needs in use, and
- . • continued operation in conjunction with the engine system between valve states 2

and 3 on a demand basis.

Alternatively, the valve element may change state from solid to liquid at the engine system
30 operating temperature and thereby flow out of axial alignment with the line of valve
action.

Preferably the valve element includes a material which is soluble, preferably readily
. soluble, in the typical fluid used in the line when the engine system is operating.

Most preferably, the first fill valve element of the invention uses a microcrystalline wax
35 included in an axial valve poppet which holds the inline combination of wax motor and
. inline valve in an extended position (the 'open' position of valve state 1) until it 1st reaches
operating temperatures where it commences to melt into a liquid form and then dissolves
in the engine fluid traveling in the line.

. Further, the wax motor plunger and the poppet are cylindrical and are adapted for sliding
40 engagement with the cylindrical poppet receiver to restrain melting and melted wax within
the poppet cavity for a period. When the actuator pin plunger approaches the bottom out
. condition against the poppet inline wall or receiving surface the melting or melted wax
flows out of the axial alignment with the valve action.

FIGURES

45 Figure 01 shows a partial exploded perspective view of the prior art axial valve.

Figure 02 shows an axially exploded perspective view of the first fill axial valve element of
the preferred embodiment.

. Figures 03 and 04 provide a detailed view of the prior art (Figure 03) and the preferred
embodiment (Figure 04).

50 Figures 05 and 06 provide a cross-section of the axial valve in valve states 1 and 2-3
. respectively.

THE PRIOR ART

The prior art used on most engines and motors include variable fluid flow lines which are
. valved to open and close, whether completely or partially, based upon temperature and/or
55 pressure conditions. In Figures 01 and 03 the valve is axially aligned with a valve spring

and a valve poppet for in/out extension motion along a main axis. The valve poppet is driven, most often by a wax motor with an extensible plunger, an actuator pin or a linear drive shaft, against an axial valve spring.

Figure 03c shows a pictorial perspective view of the prior art poppet.

60 Figures 03A and 03B show central cross-sections of the poppet of Figures 01 and 03A and piston or actuator pin aligned along the valve axis of motion.

The drive end of actuator pin in Figure 03B is rounded to show a close fit within the interior cavity of the poppet along the side of the interior surface and abutting against the receiving surface. On assembly the pin is mated into the receiving surface and the whole
65 valve held in axial compression against springs to facilitate assembly, ensure axial alignment and accommodate manufacturing tolerances.

PREFERRED EMBODIMENT

Figure 02 includes a full wax motor valve support 05 aligned in the direction of valve travel. The valve is retained axially within support 05 by a spring clip arrangement with sealing by
70 a 1st and a 2nd O-ring. Wax motor 02 is, preferably, temperature dependent and acts axially in extension against motor spring 04 and the valve spring from a valve-closed position at ambient temperature to an extended valve-open position at an elevated temperature. The poppet closes the end of the valve spring and centers actuator pin 03 on axis within the valve spring.

75 As shown in the expanded view, drive shaft 03 includes an enlarged cylindrical drive end adapted for a sliding fit along the axis of valve motion within the top-hat shape of poppet 01. Assembly is facilitated as the top-hat poppet has an exterior surface which may be self-aligning within the interior of the valve spring over its initial turns.

Figures 04A, 04B and 04C show pictorial perspective and cross-section views respectively of
80 an embodiment of the poppet element of the invention. The poppet is shaped as a top-hat with a laterally extending circular alignment flange providing a spring support surface and a monolithic cylindrical central portion with:

- an outer cylindrical wall acting to align the poppet with the valve spring and the main valve axis,

- 85 • an inner cylindrical wall acting to align the poppet with the piston or actuator pin 03, and,
- a receiving surface spaced from the alignment flange along the main valve axis.

The drive shaft actuator pin 03 includes an enlarged diameter cylindrical piston adapted for a sliding fit within the inner cylindrical wall and for engagement with the receiving surface.

90 The poppet of Figure 04A includes a small amount of a waxy material within the interior cavity. The waxy material is chosen to be sufficiently hard and resilient to deformation so as to consistently resist axial compression forces in the valve element at low and ambient temperatures and thereby to maintain the valve in an initial (preferably open) condition. Upon assembly, the piston is driven into the poppet cavity at ambient temperatures, in the
95 usual way, by axial compression of the springs. As the piston pin contacts the resilient waxy material the valve element is driven from a valve-closed position towards a stable valve-open condition as pressure on the waxy material is conveyed to the receiving surface of the poppet and deformation of the waxy material is restrained or prevented.

Thus, upon manufacturing assembly the completed valve is in a stable condition with, preferably, the valve open. Fluid may be readily introduced, pressurized and the system
100 bled and tested for deficiencies such as leaks.

Upon operation of the engine in ordinary working conditions the waxy material of Figure 04A is such that it melts (preferably) or deforms at a temperature just above or below the nominal operating temperature of the wax motor. The melted waxy material is slowly
105 squeezed out (leaking) preferably between the pin and the poppet, or otherwise bled away, allowing the pin drive surface to approach and ultimately act directly against the poppet receiving surface while maintaining the valve motion solely upon the main axis, all parts in alignment. The waxy material may, alternatively, be bled away through a small hole in the poppet.

110 Since the wax motor, the actuator pin and the poppet are fully immersed in the line fluid the slowly leaking waxy material is absorbed or dissolved in to the line fluid where it remains in solution throughout all ambient temperature ranges.

Upon engine system cooling any remaining waxy material not otherwise dissolved will

. return to its hardened state and act as a bonding agent between the piston and the poppet.
115 Throughout, the valve components remain in compression by the action of the springs.

. Figure 04A shows the poppet of the invention as slightly elongated in relation to the poppet
. of the prior art shown in Figure 03A. Due to the small amount of waxy material which
may be employed in the valve element of the invention, most preferably, the poppet of
Figure 04A is of the same dimensions as that of Figure 03A with the small axial extension
120 required accommodated in the valve springs well within existing manufacturing tolerances.

Figures 05 and 06 show a cross-sectional view of the valve element of the invention:

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125 .
. .
. .
130 .

- Figure 05, in valve state 1, shows the valve upon final assembly at ambient temperature. The waxy material is shown hardened so as to extend the spacing between the poppet and the actuator pin while in compression against the upper and lower valve springs. The valve is fixed in an open condition.

- Figure 06, in valve states 2 and 3, shows the valve after first operation of the engine at its nominal operating temperatures for a period of time. The waxy material has deformed and/or melted allowing spring compression and the wax motor operation to drive the actuator pin more fully into the poppet and thus operate the valve and the engine system normally for the duration.

. Upon commencement of the melting or deformation process, the waxy material is driven
. out of the poppet cavity or otherwise from between the actuator pin and the valve, from
the axial line of valve movement at a rate determined by the supply of heat energy, the
deformation characteristics of the waxy material as it is heated and the axial spacing of the
135 valve components. Preferably the waxy material is provided in the limited spacing between
the actuator pin and the interior surface of the poppet.

. As the waxy material is driven from the cavity, the combination of spring pressure and wax
. motor actuation forces drive the actuator pin further into the cavity along the axis of
movement to ultimately impact upon a receiving surface. Preferably the waxy material is
140 fully soluble in the system fluid and of such a small amount so as to cause no concern
. whatsoever regarding routine and long term engine operation.

CLAIMS

We claim the first fill valve element, valve and process as described in the specification and drawings herein.

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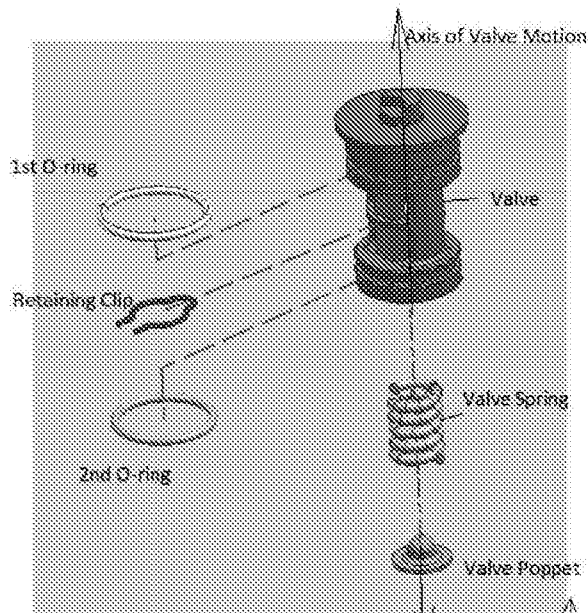


Figure 01 - Prior Art

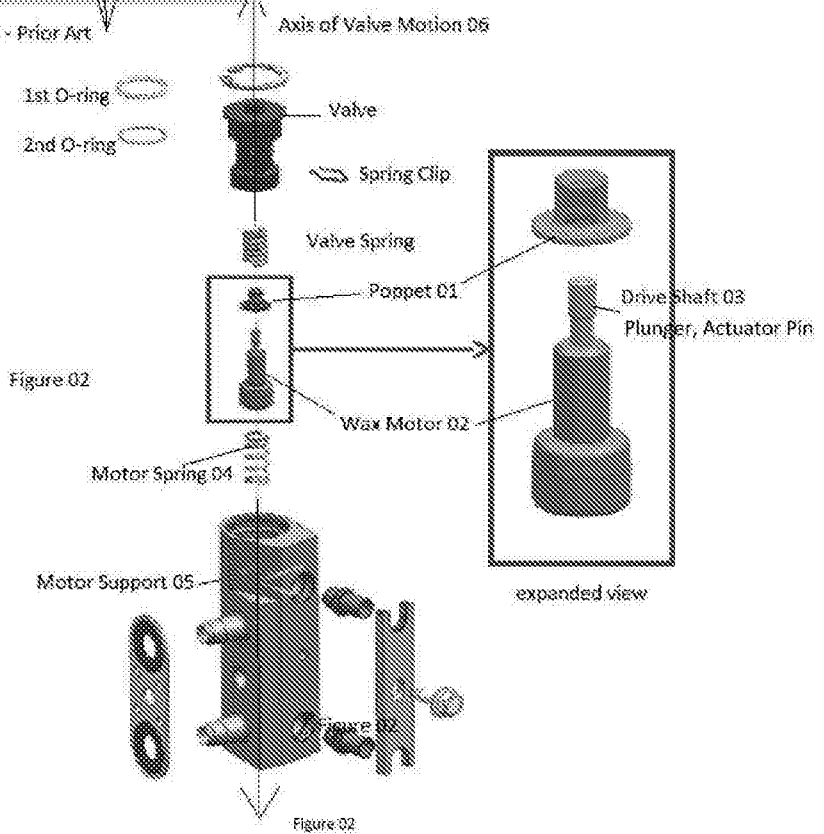


Figure 02

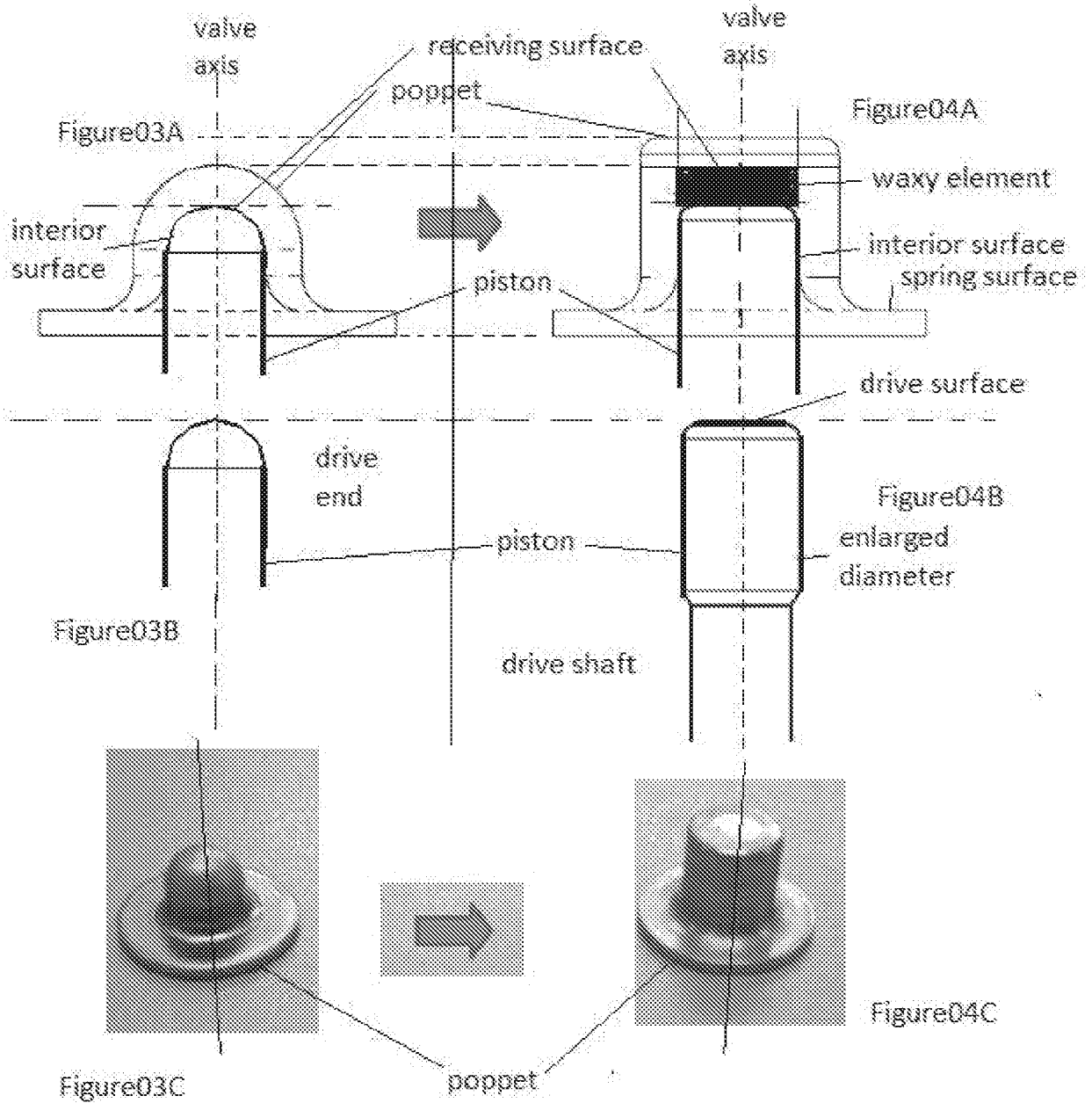


Figure 03
Prior Art

Figure 04

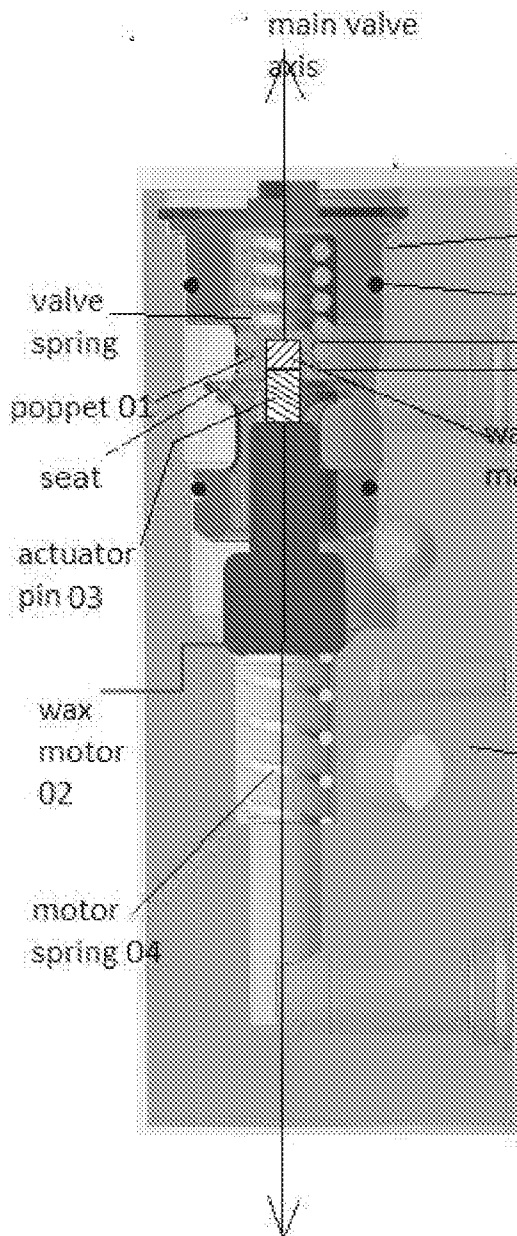


Figure 05

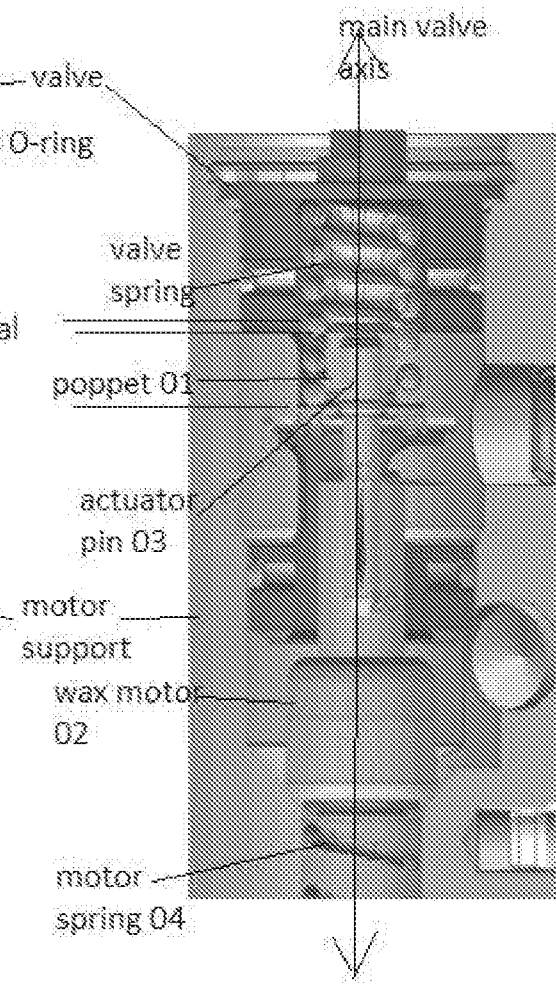


Figure 06