

(12) **UK Patent Application** (19) **GB** (11) **2 425 585** (13) **A**

(43) Date of A Publication **01.11.2006**

(21) Application No: **0608188.9**
(22) Date of Filing: **26.04.2006**
(30) Priority Data:
(31) **10908165** (32) **29.04.2005** (33) **US**

(71) Applicant(s):
Cooper Cameron Corporation
(Incorporated in USA - Delaware)
1333 West Loop South, Suite 1700,
Houston, Texas 77027-9109,
United States of America

(72) Inventor(s):
Loc Gia Hoang

(74) Agent and/or Address for Service:
N J Akers & Co.
Carines, Cubert, NEWQUAY, Cornwall,
TR8 5ET, United Kingdom

(51) INT CL:
F16K 31/05 (2006.01) **F16K 3/00** (2006.01)

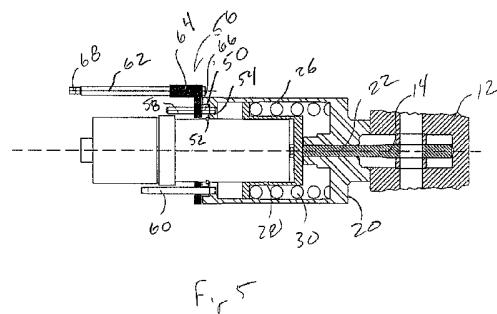
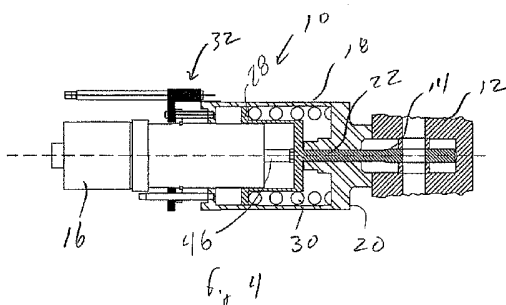
(52) UK CL (Edition X):
F2V VS1 VS16 VS28

(56) Documents Cited:
GB 0782270 A **EP 1333207 A2**
US 4213480 A1

(58) Field of Search:
UK CL (Edition X) **F2V**
INT CL **F16K**
Other: **Online: EPODOC, WPI**

(54) Abstract Title: **Valve system with mechanical override**

(57) A valve system 10 comprises a closure member 14 linearly translatable within a valve body 12, a fail safe assembly 18 having a first end 20 connected to the valve body and a second end engaged with a linear actuator 16, and a mechanical override system 32 connecting the linear actuator to the fail safe assembly. In normal operation, the linear actuator moves a first rod member 22, which in turn moves the closure member to open the valve (Fig. 4). The linear actuator may comprise a rod 46 which moves the first rod member, and the fail safe assembly may comprise a spring 30 which biases the first rod member 22 towards the second end unless the rod 46 is extended. If the linear actuator fails, then the mechanical override system is operable to move the linear actuator relative to the valve body, therefore moving the closure member to open and close the valve (Fig. 5). The mechanical override system may comprise a gear assembly 56, threaded rod 58 and drive rod 62, and the drive rod may include an interface 68 for a remotely operated vehicle (ROV).



1/3

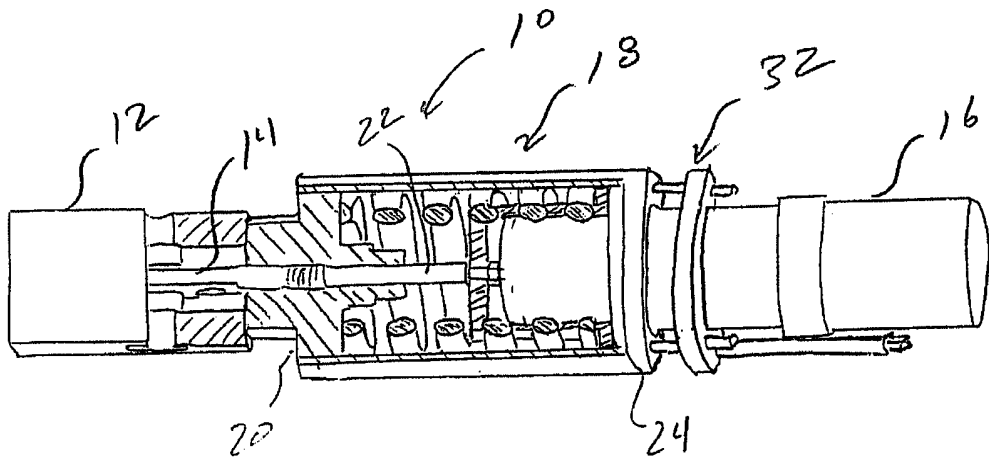


Fig 1

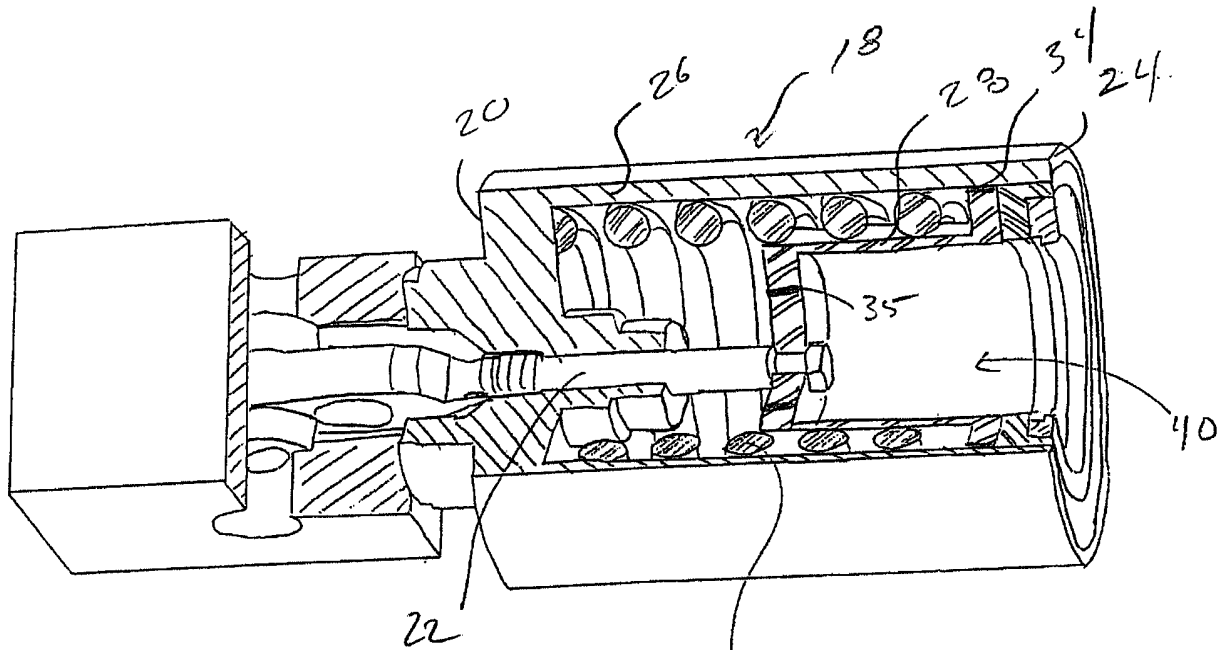


Fig 2

2/3

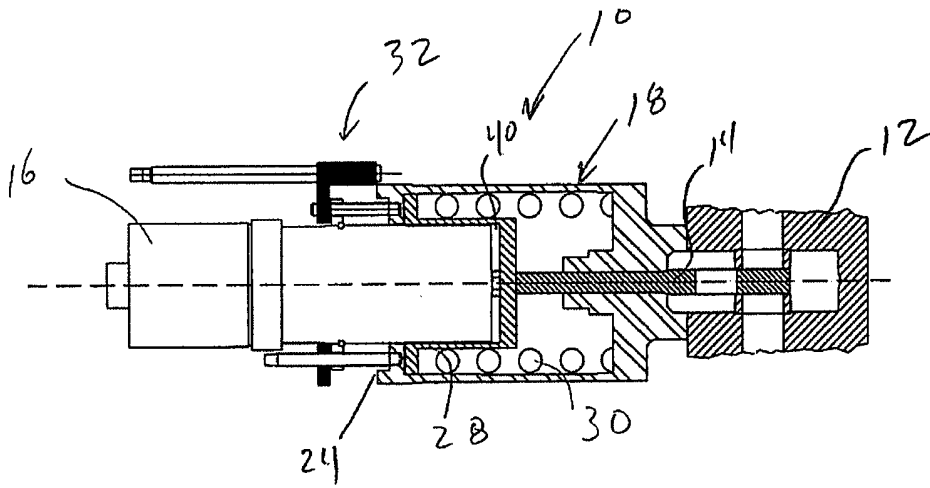


Fig 3

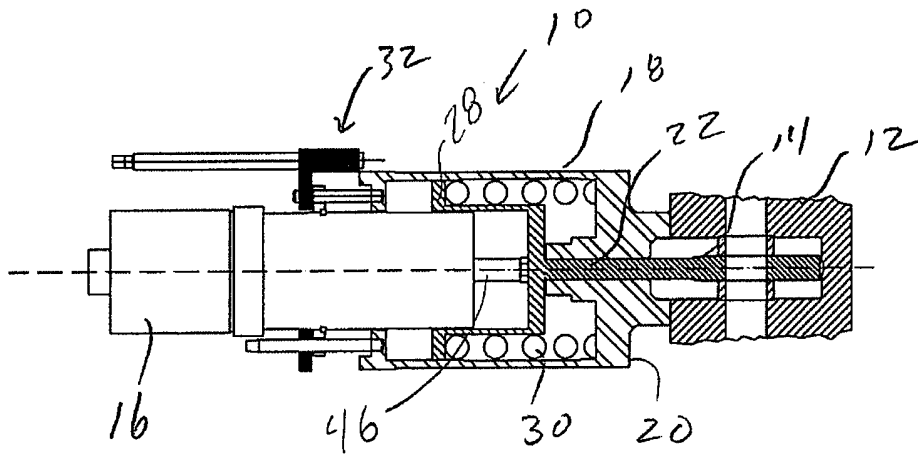


Fig 4

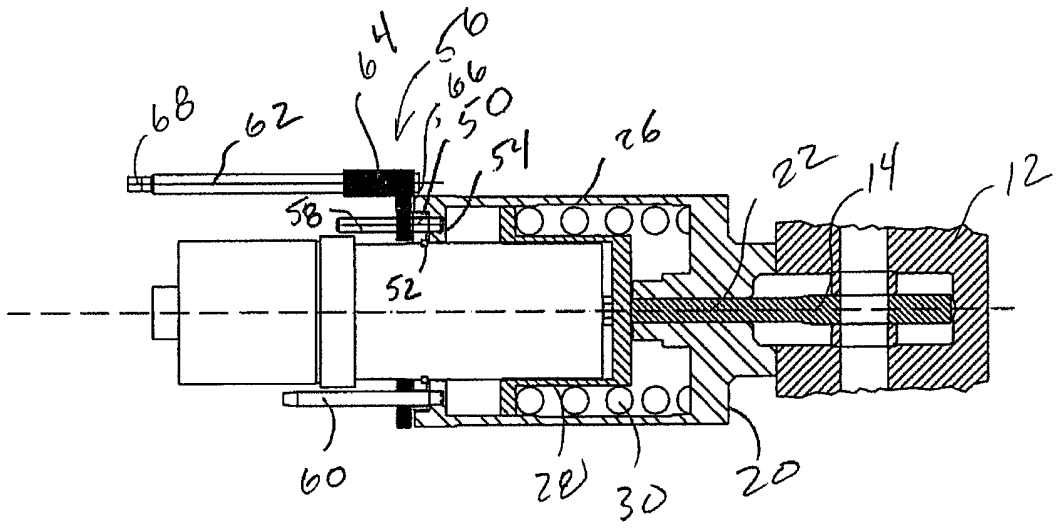


Fig 5

MECHANICAL OVERRIDE

The present invention relates generally to valve actuators. More specifically, the present invention relates to override and backup systems for subsea valve actuators. Still
5 more specifically, the present invention relates to override systems for subsea valve applications.

Increasing performance demands for subsea hydrocarbon production systems have led to a demand for high performance control systems to operate subsea pressure control equipment, such as valves and chokes. Hydraulic actuators are used to operate
10 many of the pressure control equipment used subsea. Pressurized hydraulic fluid may be supplied to the hydraulic actuators by a direct hydraulic control system or an electrohydraulic control system. Direct hydraulic control systems provides pressurized hydraulic fluid directly from the surface to the subsea valve actuators. Electrohydraulic control systems utilize electrical signals transmitted to an electrically actuated valve
15 manifold that controls the flow of hydraulic fluid to the hydraulic actuators of the pressure control equipment.

The performance of both direct hydraulic and electrohydraulic control systems is affected by a number of factors, including the water depth in which the components operate, the distance from the platform controlling the operation, and a variety of other
20 constraints. Thus, as water depth and field size increases, the limits of hydraulic control systems become an increasing issue. Further, even when the use of a hydraulic control system is technically feasible, the cost of the system may preclude its use in a smaller or marginal field.

In order to provide an alternative to hydraulic control systems, full electrical
25 control systems, including electric actuators, have been developed. Instead of relying on

pressurized hydraulic fluid to actuate the pressure control components, electrical actuators are supplied with an electric current. The reliance on electric current can allow for improved response times, especially over long distances and in deep water.

Even with electrical control systems and actuators, many operators still desire
5 some sort of system that allows for operation of the actuators in the case of failure of the electric actuator or interruption in the supply of electrical current. In certain applications, an operator may want to be able to override the electrical control system and operate a valve, or some other components, via remote operation or direct intervention, such as with a remotely operated vehicle (ROV).

10 Thus, there remains a need to develop methods and apparatus for allowing operation of subsea actuators that overcome some of the foregoing difficulties while providing more advantageous overall results.

The embodiments of the present invention are directed toward methods and
15 apparatus for a valve system comprising a closure member that is linearly translatable within a valve body. A fail safe assembly is connected to the valve body and a first rod member that is connected to the closure member. A linear actuator is movably connected to the fail safe assembly and is operable to move the first rod member by moving the linear actuator relative to the valve body. A mechanical override system is connected to
20 the linear actuator and is operable to move the linear actuator relative to the valve body.

Thus, the present invention comprises a combination of features and advantages that enable it to overcome various problems of prior devices. The various characteristics described above, as well as other features, will be readily apparent to those skilled in the art upon reading the following detailed description of the preferred embodiments of the
25 invention, and by referring to the accompanying drawings.

For a more detailed description of the preferred embodiment of the present invention, reference will now be made, by way of example only, to the accompanying drawings, wherein:

5 Figure 1 is a partial sectional view of a valve actuator with an override system constructed in accordance with embodiments of the invention;

 Figure 2 is a partial sectional view of an override system constructed in accordance with embodiments of the invention;

 Figure 3 is a partial sectional view of a valve actuator with an override system
10 constructed in accordance with embodiments of the invention;

 Figure 4 is a partial sectional view of a valve actuator with an override system constructed in accordance with embodiments of the invention; and

 Figure 5 is a partial sectional view of a valve actuator with an override system constructed in accordance with embodiments of the invention.

15

 Referring now to Figure 1, valve system 10 comprises valve body 12, closure member 14, linear actuator 16, fail safe assembly 18, and mechanical override system 32. First end 20 of fail safe assembly 18 is connected to valve body 12. Rod 22 of fail safe assembly 18 is coupled to closure member 14. Linear actuator 16 is connected to second
20 end 24 of fail safe assembly 18 by a mechanical override system 32. Referring now to Figure 2, fail safe assembly 18 comprises cylindrical body 26, piston 28, and spring 30. Piston 28 forms receptacle 40 and closely engages the inner surface of body 26. Rod 22 is connected to one end of piston 28. Spring 30 is disposed between first end 20 and piston 28 so as to bias the piston toward second end 24.

Piston 28 operates in a pressure-balanced mode where the hydraulic fluid moves across the piston through annular gap 34 between the piston and body 26. In certain embodiments, piston 28 may also comprise additional fluid passageways 35 that allow fluid to flow through the piston. Annular gap 34 and fluid passageways 35 may be sized so as to restrict the flow of fluid across piston 28 and thus limit the speed at which the piston may travel.

Referring now to Figure 3, receptacle 40 receives a portion of linear actuator 16 that is connected to override assembly 18 by mechanical override system 32. Figure 3 shows valve assembly 10 in a retracted position where piston 28 is positioned toward second end 24 and spring 30 is expanded. To shift closure member 14, linear actuator 16 is activated and rod 46 extends from the actuator, as shown in Figure 4.

Figure 4 shows valve assembly 10 in an extended position where piston 28 is positioned toward first end 20 and spring 30 is collapsed. Piston 28 is moved toward first end 20 by the operation of actuator 16. Actuator 16 extends rod 46 that bears against rod 22 that is connected to piston 28. The movement of piston 28 toward first end 20 compresses spring 30. As actuator 16 retracts rod 46, spring 30 pushes piston 28 toward second end 24 and the initial position as shown in Figure 3.

Thus, piston 28 and spring 30 operates as a fail-safe device where spring 30 pushes piston 28 toward second end 24 unless rod 46 is extended from linear actuator 16. Rod 46 of actuator 16 may also be coupled to piston 28 such that the piston can be used to control the speed at which rod 46 retracts.

Mechanical override system 32 maintains the position of actuator 16 relative to valve body 12 so that the extension of rod 46 places closure member 14 in the proper position. Mechanical override system 32 also allows actuator 16 to be moved relative to valve body 12 so as to move closure member 14 when rod 46 can not be extended due to

component malfunction or other failure. Mechanical override system 32 may comprise a gear system, screw drive, or other mechanically activated translation mechanism that can move actuator 16 with sufficient force to compress spring 30 and shift closure member 14 within valve body 12. Mechanical override system 32 may also comprise an ROV interface that allows the mechanical override system to be operated by an ROV.

Referring now to Figure 5, one embodiment of mechanical override system 32 comprises retainer 50, split ring 52, base 54, gear assembly 56, threaded rod 58, guide rod 60, and drive rod 62. Base 54 is fixably coupled to the end of body 26. Split ring 52 engages linear actuator 16 and is held in place by retainer 50 that is slidably mounted to threaded rod 58 and guide rod 60. Gear assembly comprises drive gear 64 that is mounted to drive rod 60 and traveling gear 66 that engages threaded rod 58. Drive rod 62 has an ROV interface 68 that allows an ROV to rotate the rod and operate the mechanical override system.

As drive rod 62 is rotated, drive gear 64 rotates traveling gear 66. The rotation of traveling gear 66 causes it to move along threaded rod 58, pushing retainer 50 toward base 54. As retainer 50 moves, linear actuator 16 is moved toward valve body 12, compressing spring 30 and moving closure member 14 within the valve body to the fully actuated position of Figure 5. Gear assembly 56 may preferably be a self-locking system that will maintain the position of linear actuator 16 until drive rod 62 is rotated in the opposite direction.

Thus, valve system 10 can be actuated in a first mode (as shown in Figure 4), where linear actuator 16 extends rod 46 so as to move piston 28 toward first end 20 of fail safe assembly 18. In the first mode, the position of linear actuator 16 relative to valve body 12 is maintained by override system 32. Valve system 10 can also be actuated in a second mode (as shown in Figure 5), where linear actuator 16 is moved relative to valve

body 12 by mechanical override system 32. The movement of linear actuator 16 moves piston 28 toward first end 20 of fail safe assembly 18.

Mechanical override system may utilize any of a number of mechanical systems to move the linear actuator and shift the position of the closure member. For example, a
5 mechanical override system may use a geared or threaded system that transforms rotational motion into linear translation of the actuator. Other mechanical override systems may comprise external hydraulic rams or other type devices to push the linear actuator.

While preferred embodiments of this invention have been shown and described,
10 modifications thereof can be made by one skilled in the art without departing from the scope or teaching of this invention. The embodiments described herein are exemplary only and are not limiting. Many variations and modifications of the system and apparatus are possible and are within the scope of the invention. For example, the relative dimensions of various parts, the materials from which the various parts are made, and
15 other parameters can be varied, so long as the mechanical override apparatus retain the advantages discussed herein.

CLAIMS

1. A valve system comprising:
 - a closure member that is linearly translatable within a valve body;
 - a fail safe assembly having a first end that is connected to the valve body and a
5 first rod member that is connected to said closure member;
 - a linear actuator engaged with a second end of said fail safe assembly, wherein
said linear actuator is operable to move the first rod member; and
 - a mechanical override system connecting said linear actuator to said fail safe
assembly, wherein said mechanical override system is operable to move the linear
10 actuator relative to the valve body.

2. The valve system of claim 1, wherein said fail safe assembly is operable to
translate said closure member independent of operation of said linear actuator.

- 15 3. The valve system of either of claims 1 or 2, wherein said linear actuator
comprises a second rod member that is operable to move the first rod member.

4. The valve system of claim 3, wherein said valve system has a first mode, wherein
the second rod member extends from said linear actuator so as to move said closure
20 member within the valve body, and a second mode, wherein said linear actuator is moved
relative so said valve body so as to move said closure member within the valve body.

5. The valve system of any preceding claim, wherein said mechanical override
system comprises a gear system operable to translate said linear actuator relative to the
25 valve body.

6. The valve system of any preceding claim, wherein said fail safe assembly comprises:

a cylindrical body coupled to the valve body; and

5 a piston connected to the first rod member and sealingly engaged with said cylindrical body.

7. The valve system of claim 6 wherein said fail safe assembly further comprises a spring disposed within said cylindrical body, wherein said spring biases said piston
10 toward the second end of said fail safe assembly.

8. The valve system of either of claims 6 or 7, wherein a portion of said linear actuator is disposed within said piston.

15 9. The valve system of any preceding claim, further comprising an ROV interface operable to actuate said mechanical override system.

10. A valve actuation system comprising:

a cylindrical body having a first end coupled to a valve body;

20 a linear actuator partially disposed within a second end of said cylindrical body;

and

a mechanical override system connected to said cylindrical body and said linear actuator and operable to move said linear actuator relative to the valve body.

25 11. The valve actuation system of claim 10 further comprising:

a piston disposed within said cylindrical body; and

a first rod member connected between said piston and a closure member disposed within the valve body.

5 12. The valve actuation system of claim 11 further comprising a spring disposed between said piston and said cylindrical member, wherein said spring biases said piston toward the second end of said cylindrical member.

10 13. The valve actuation system of either of claims 11 or 12, wherein said linear actuator comprises a second rod member.

14. The valve actuation system of claim 13 wherein said linear actuator has a first mode wherein the second rod member extends from said linear actuator so as to move said piston toward the first end of said cylindrical body while said linear actuator does
15 not move relative to said valve body.

15. The valve actuation system of claim 14 wherein said linear actuator has a second mode wherein said linear actuator moves relative to said valve body so as to move said piston toward the first end of said cylindrical body.

20

16. The valve actuation system of any of claims 10 to 15, wherein said mechanical override system comprises a gear system operable to translate said linear actuator relative to said cylindrical body.

17. The valve actuation system of any of claims 10 to 16, further comprising an interface for coupling an ROV to said mechanical override system.

18. A valve system comprising:

5 a closure member disposed within a valve body;

a linear actuator having a rod member extendable to translate said closure member within the valve body; and

means for moving said linear actuator relative to the valve body so as to translate said closure member without extending the rod member from said linear actuator.

10

19. The valve system of claim 18 wherein said means for moving said linear actuator connects said linear actuator to the valve body.

20. The valve system of claim 18 wherein said means for moving said linear actuator
15 comprises an ROV interface.

21. A valve system substantially as hereinbefore described having reference to any one of the accompanying figures 1 to 5.

20 22. A valve actuation system substantially as hereinbefore described having reference to any one of the accompanying figures 1 to 5.

23. The use of a valve system according to any of claims 1 to 9 or claims 18 to 21 or a valve actuation system according to any of claims 10 to 17 or 22 in a hydrocarbon
25 production installation.

24. The use of claim 23, wherein the installation is a subsea installation.



For Innovation

12

Application No: GB0608188.9

Examiner: Mr Nick Smith

Claims searched: 1-9, 21-24

Date of search: 22 August 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X: 1, 2; Y: 3, 6-9	GB 782270 A (ELECTRAULIC) See in particular Figs. 1 & 2 and page 2, lines 4-50
Y	3, 6-8	US 4213480 A1 (ORUM) See in particular Fig. 1 and col. 3, line 1 - col. 4, line 16
Y	3, 9	EP 1333207 A2 (DURSLEY) See in particular Fig. 1 and paragraphs [0016]-[0026]

Categories:

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.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

F2V

Worldwide search of patent documents classified in the following areas of the IPC

F16K

The following online and other databases have been used in the preparation of this search report

Online: EPODOC, WPI