

## VALVE

The present invention relates to a valve suitable for use in injection of fluid into a wellbore, typically an offshore wellbore for petroleum production, particularly, but not exclusively, for use in a chemical injection system or a gas lift system.

## 5 BACKGROUND

In hydrocarbon production, where a production tubing extends down a wellbore into a hydrocarbon containing formation, it may be necessary to inject a fluid into the production tubing and/or into the formation itself. The fluid could be a specialised chemical selected to perform a specific function such as to reduce foaming, reduce  
10 corrosion, improve the separation of gas, oil and water, alter the viscosity of the production fluid. The fluid is typically injected into the production tubing via an injection valve which is operable to control flow of fluid through an injection port which extends through the sidewall of the production tubing to connect the main passage of the production tubing with the annular space surrounding the production  
15 tubing.

It is also known to use an artificial lifting system such as "gas lift system" to improve flow of hydrocarbons from the formation and up the production tubing. A gas lift system is one in which a high pressure gas is injected into the production tubing. The high pressure gas may be supplied through the annulus between the production  
20 tubing and the wellbore casing, and injected into the production tubing via one or more injection valves which are arranged on the production tubing at the required depth in the wellbore.

Such an injection valve may be arranged in the production tubing itself, or it may be mounted in a side pocket mandrel. The valve typically has a housing with an inlet  
25 port which is fluidly connected to the annulus or to a chemical injection line, an outlet port which is fluidly connected to the main passage of the production tubing, and a valve member which is movable between an open position in which flow of fluid between the inlet port and the outlet port is permitted and a closed position, in which the valve member substantially prevents flow of fluid between the inlet port and the  
30 outlet port.

Such injection valves are required to be compact and operationally reliable. With the current trend in the industry to explore more unconventional resources, and the continuous need for improved technical solutions for downhole tools, there is a need

for improved valves suitable for downhole use in oil and gas wells. The present invention has the objective to provide a valve which provides advantages over known solutions and techniques.

#### SUMMARY

- 5 According to a first aspect of the invention we provide a valve comprising a housing having housing wall which encloses a interior space, an inlet port, an outlet port, and a valve member which is located in the interior space of the housing and which is movable to control flow of fluid through the interior space from the inlet port to the outlet port, wherein the valve member has a valve body which is provided with a
- 10 screw thread which extends around and generally radially outwardly of a radially outwardly facing surface of the valve body and which meshes with a corresponding housing screw thread provided on a radially inwardly facing surface of the housing wall, wherein the radially outwardly facing surface of the valve body is not parallel to the radially inwardly facing surface of the housing wall.
- 15 In one embodiment, the height of the screw thread and / or the housing screw thread decreases from a first end to a second end thereof.

In one embodiment, the valve member is provided with a sealing part, and the valve member is movable relative to the housing along a longitudinal axis thereof to bring the valve member into a closed position in which the sealing part sealingly engages

20 with a valve seat to substantially prevent flow of fluid from the inlet port to the outlet port, and one surface of the radially outwardly facing surface of the valve member and the radially inwardly facing surface of the housing wall is parallel to the longitudinal axis, whilst the other surface is inclined relative to the longitudinal axis.

The valve member may further comprise a first sealing part which is provided on the

25 valve body, the valve member being movable relative to the housing into a closed position in which the first sealing part sealingly engages with a first valve seat to substantially prevent flow of fluid from the inlet port to the outlet port. The first valve seat may be provided in a portion of the housing wall which surrounds either the inlet port or the outlet port.

- 30 The valve member may further comprise a second sealing part which is provided on the valve body, the valve member being movable relative to the housing into a second closed position in which the second sealing part sealingly engages with a

second valve seat to substantially prevent flow of fluid from the inlet port to the outlet port.

In one embodiment, the screw thread is provided on a frusto-conical portion of the valve body which has an outer diameter which increases from a first end of the  
5 frusto-conical portion to a second end of the frusto-conical portion, the first end of the screw thread being at or adjacent to the first end of the frusto-conical portion and the second end of the screw thread being at or adjacent to the second end of the frusto-conical portion. Advantageously, in this embodiment, the housing screw thread is provided on a tubular portion of the housing wall which encloses a  
10 cylindrical space, the tubular portion of the housing wall having a first end from which the first end of the housing screw thread extends, and a second end, from which the second end of the housing screw thread extends. Advantageously, the first sealing part is provided at or adjacent to the first end of the frusto-conical portion of the valve body, and the second sealing part is provided at or adjacent to  
15 the second end of the frusto-conical portion of the valve body.

In an alternative embodiment, the screw thread is provided on a cylindrical portion of the valve body, the first end of the screw thread being at or adjacent to the first end of the cylindrical portion and the second end of the screw thread being at or adjacent to the second end of the cylindrical portion. In this embodiment, the  
20 housing screw-thread may be provided on a tubular portion of the housing wall which encloses a frusto-conical space the diameter of which decreases from a first end of the tubular portion to a second end of the tubular portion, the first end of the housing screw thread extending from the first end of the tubular portion and the second end of the housing screw thread extending from the second end of the  
25 tubular portion. Advantageously, in this embodiment, the first valve seat is provided adjacent to the second end of the tubular portion of the valve housing, and the second valve seat is provided at or adjacent to the first end of the tubular portion of the housing wall.

In one embodiment the inlet port and outlet port are located in the housing wall such  
30 that the portion of the housing wall bearing the housing screw thread encloses at least part of a fluid flow path between the inlet port and the outlet port. In one embodiment, the inlet port is provided in the tubular portion of the housing wall whilst the outlet port is provided in an end face of the housing.

The valve may be configured such that rotation of the valve member about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the valve member undergo translational movement along the interior space of the housing between a closed position in which the first  
5 sealing part engages with the first valve seat and the valve member substantially prevents flow of fluid from the inlet port to the outlet port and an open position in which the first sealing part is spaced from the first valve seat and flow of fluid from the inlet port to the outlet port is permitted.

Where a second sealing part and second valve seat are provided, the valve may be  
10 configured such that rotation of the valve member in one direction about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the valve member undergo translational movement along the interior space of the housing from a first closed position in which the first sealing part engages with the first valve seat and the valve member substantially prevents flow  
15 of fluid from the inlet port to the outlet port, to an open position in which the first sealing part is spaced from the first valve seat and flow of fluid from the inlet port to the outlet port is permitted, and then to a second closed position in which the second sealing part engages with the second valve seat and the valve member substantially prevents flow of fluid from the inlet port to the outlet port.

20 In one embodiment, when the valve member is in the first closed position, the screw thread of the valve member engages with the tubular portion of the housing wall and the housing screw thread engages with the valve body.

In one embodiment the valve further comprises a drive apparatus, such as an electric motor, which is operable to drive rotation of the valve member relative to the  
25 housing about the axis of rotation.

The drive apparatus may be connected to the valve member by means of a drive shaft, the housing being further provided with a bearing assembly which supports the drive shaft.

According to a second aspect of the invention we provide a valve comprising a  
30 housing having housing wall which encloses a interior space, an inlet port, an outlet port, and a valve member which is located in the interior space of the housing and which is movable to control flow of fluid through the interior space from the inlet port to the outlet port, the valve member having a valve body, wherein the valve member further comprises a first sealing part which is provided at on the valve body, the

valve member being movable relative to the housing into a first closed position in which the first sealing part sealingly engages with a first valve seat to substantially prevent flow of fluid from the inlet port to the outlet port, and a second sealing part which is provided on the valve body, the valve member being movable relative to the

5 housing into a second closed position in which the second sealing part sealingly engages with a second valve seat to substantially prevent flow of fluid from the inlet port to the outlet port.

In one embodiment, the valve body is provided with a screw thread which extends around and generally radially outwardly of the valve body and which meshes with a

10 corresponding housing screw thread provided on the housing wall

In one embodiment, the valve is configured such that rotation of the valve member in one direction about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the valve member undergo translational movement along the interior space of the housing from the first closed

15 position to an open position in which the first sealing part is spaced from the first valve seat, the second sealing part is spaced from the second valve seat and flow of fluid from the inlet port to the outlet port is permitted, and then to the second closed position.

The valve according to the second aspect of the invention may comprise any feature

20 or any combination of features of the valve according to the first aspect of the invention.

According to a third aspect of the invention we provide an injection system for injecting fluid into a production tubing of a hydrocarbon well comprising a valve according to the first or second aspect of the invention.

25 In one embodiment, the injection system comprises a side pocket mandrel in which the valve is located.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics will become clear from the following description of illustrative embodiments, given as non-restrictive examples, with reference to the

30 attached drawings, in which

FIGURE 1 is a perspective view of an embodiment of valve according to the first aspect of the invention,

FIGURE 2 is an illustration of a longitudinal cross-section of the valve illustrated in Figure 1,

FIGURE 3a is an illustration of a longitudinal cross-section of the valve illustrated in Figure 1 wherein the valve member is in a first closed position,

5 FIGURE 3b is an illustration of a longitudinal cross-section of the valve illustrated in Figure 1 wherein the valve member is in an open position,

FIGURE 3c is an illustration of a longitudinal cross-section of the valve illustrated in Figure 1 wherein the valve member is in a second closed position,

FIGURE 4 is a schematic illustration of the detail of the cross-sectional view of the screw thread of the valve member of the valve illustrated in Figure 1 (not to scale),  
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FIGURE 5 is a schematic illustration of a longitudinal cross-section through a fluid injection system for a hydrocarbon well including a valve according to the first aspect of the invention,

FIGURE 6 is a schematic illustration of a side pocket mandrel of the fluid injection  
15 system illustrated in Figure 5.

#### DETAILED DESCRIPTION

The following description may use terms such as "horizontal", "vertical", "lateral", "back and forth", "up and down", "upper", "lower", "inner", "outer", "forward", "rear", etc. These terms generally refer to the views and orientations as shown in the drawings and that are associated with a normal use of the invention. The terms are  
20 used for the reader's convenience only and shall not be limiting.

Figures 1 - 3 show a valve 10 comprising a housing 12 having housing wall 14 which encloses an interior space 16, an inlet port 18, an outlet port 20, and a valve member 22 which is located in the interior space of the housing 12 and which is  
25 movable to control flow of fluid through the interior space 16 from the inlet port 18 to the outlet port 20. The valve member 22 has a valve body 24 which is provided with a screw thread 26 which extends around and generally radially outwardly of a radially outwardly facing surface of the valve body 24 and which meshes with a corresponding housing screw thread provided on a radially inwardly facing surface  
30 of the housing wall 14. The radially outwardly facing surface of the valve body 24 is not parallel to the radially inwardly facing surface of the housing wall 14. The height of the screw thread 26 and the housing screw thread 28 decreases from a

first end 26a, 28a to a second end 26b, 28b thereof. The screw threads 26, 28 are both helical screw threads which when viewed in longitudinal cross-section, forms a series of peaks separated by troughs. In this context, by the height of the screw thread is intended to mean the distance between a line connecting the bottom of the two trough on either side of a peak, and a parallel line passing through the top of the peak. This is illustrated in Figure 4, the height of the screw thread being labelled h,

In this embodiment, the screw thread 26 is provided on a frusto-conical portion of the valve body 24 which has an outer diameter which increases from a first end 24a of the frusto-conical portion to a second end 24b of the frusto-conical portion. The first end 26a of the screw thread 26 is at the first end 24a of the frusto-conical portion and the second end 26b of the screw thread 26 is at the second end 24b of the frusto-conical portion. The valve body 24 is configured such that the frusto-conical portion is the frustum of a right circular cone, i.e. a cone in which the cone's vertex is immediately above the centre of its base. The frusto-conical portion has a longitudinal axis A which falls along the line which would extend from the vertex of the full cone to the centre of its base.

The rate of decrease of the height of the screw thread 24 is set to match the angle of incline of the sloping face of the frusto-conical portion of the valve body 24 relative the longitudinal axis A so that the perpendicular distance between the longitudinal axis A and the highest portion of screw thread (labelled D in Figure 4) is substantially the same along the length of the screw thread 26 from the first end 26a to the second end thereof 26b.

In this embodiment, the housing screw thread 28 is provided on a tubular portion of the housing wall 14 which encloses a cylindrical space.

The inlet port 18 and outlet port 20 are located in the housing wall 14 such that the cylindrical space enclosed by the tubular portion of the housing wall 16 forms part of a fluid flow path between the inlet port 18 and the outlet port 20. In this embodiment, the inlet port is provided in the tubular portion of the housing wall 14 whilst the outlet port is provided in an end face 30 of the housing 12. The housing screw thread is provided on the tubular portion of housing wall 14 between the inlet port 18 and the outlet port 20, so the meshing of the screw thread 26 of the valve member 22 with the housing screw thread 28 means that the valve member 22 is located within and at least partially blocks the fluid flow path between the inlet port 18 and the outlet port 20.

Although the housing 12 could be formed from a single part, in this particular embodiment, it is formed from a plurality of connected parts. Specifically, in this embodiment, the housing 12 comprises a tubular outer sleeve 14a through which the inlet port 18 extends. The housing screw thread 28 is, in this embodiment,  
5 provided on a separate tubular end part 14b which is secured to and extending into an end of the outer sleeve 14a. The end face 30 is integral with the end part 14b.

The valve member 22 further comprise a first sealing part 32 which is provided on the valve body 24, in this embodiment at the first end 24a of the valve body 24. A  
10 corresponding first valve seat 34 is supported by the housing 12, and the valve member 22 is movable relative to the housing 12 into a first closed position (illustrated in Figure 3a) in which the first sealing part 32 sealingly engages with the first valve seat to substantially prevent flow of fluid from the inlet port to the outlet port. The first valve seat 34 can be integral with the housing wall 14 and in this  
15 embodiment is provided in a portion of the end face 30 which surrounds the outlet port 20.

In this embodiment, the valve member 22 further comprise a second sealing part 36 which is provided on the valve body 24, in this embodiment at the second end 24b of the valve body 24. A corresponding second valve seat 38 is supported by the  
20 housing 12 and the valve member 22 is movable relative to the housing 12 into a second closed position (illustrated in Figure 3c) in which the second sealing part 36 sealingly engages with the second valve seat 38 to substantially prevent flow of fluid from the inlet port 18 to the outlet port 20.

In one embodiment the valve further comprises a drive apparatus 40 which is  
25 operable to drive rotation of the valve body 24 about its longitudinal axis A. In this embodiment, the drive apparatus is an electric motor. It may, for example, be a stepper motor.

The drive apparatus 40 is connected to the valve member 22 by means of a drive shaft 42, and the valve 10 is further provided with a bearing assembly 44 which  
30 supports the drive shaft 42 in the interior space 16 of the housing 14. In this embodiment, the bearing assembly 44 provides a seal between the outer sleeve 14a of the housing wall 14 and the tubular end part 14b, thus substantially preventing fluid from leaking of the interior space 16 of the housing 12 between the outer sleeve 14a and the tubular end part 14b. The bearing assembly 44 in this

embodiment is located in the interior space 16 of the housing 12 close to the second end 24b of the valve body 24, and supports the drive shaft 42 so its longitudinal axis coincides with the longitudinal axis A of the valve body 24.

In this embodiment, the second valve seat 38 is provided on the bearing assembly  
5 44 as an annular surface which surrounds the drive shaft 42 and which is inclined at an angle of around 45° to the longitudinal axis A.

In this embodiment, a second bearing assembly 48 is provided at the opposite end of the housing 12 to the end plate 30. The drive shaft 42 extends through this second bearing assembly 48 to the motor, which is located at the exterior of the  
10 housing 12. The second bearing assembly 48 can be of any known configuration of bearing assembly which is suitable for providing a fluid tight seal around a rotating shaft, and thus prevents fluid from leaking out of the housing 12 at the opposite end thereof to the end plate 30. As such, the inlet port 18 and outlet port 20 provide the only means for fluid to pass into and out of the interior 16 of the housing 12.

15 The valve 10 is configured such that operation of the motor 40 to rotate the drive shaft (and thus also the valve member 22) in a first direction (for example in a clockwise direction) about the longitudinal axis A and the meshing of the screw thread 26 of the valve member 22 with the housing screw thread 28 causes the valve member 22 undergo translational movement along the interior space 16 of the  
20 housing 12 from a first closed position in which the first sealing part 32 engages with the first valve seat 34 and the valve member 22 substantially prevents flow of fluid from the inlet port 18 to the outlet port 20 (illustrated in Figure 3a), to an open position in which the first sealing part 32 is spaced from the first valve seat 34 and flow of fluid from the inlet port 18 to the outlet port 20 is permitted (illustrated in  
25 Figure 3b). The valve 10 can be moved from the open position to the first closed position by operating the motor 40 to rotate the drive shaft (and thus also the valve member 22) about the longitudinal axis A in a second direction which is opposite to the first direction (for example in an anticlockwise direction) to move the first sealing part 32 back into engagement with the first valve seat 32. When in the first closed  
30 position, the second sealing part 36 is spaced from the second valve seat 38.

Alternatively, the motor 40 can be operated to continue to rotate the drive shaft 42 (and thus also the valve member 22) in the first direction, so that the valve member 22 continues to move along the interior space 16 of the housing 12, the separation of the first sealing part 32 and the first valve seat 34 increases and the second

sealing part 36 moves towards the second valve seat 38. Eventually the valve member 22 arrives at a second closed position in which the second sealing part 36 engages with the second valve seat 38 and the valve member 22 again substantially prevents flow of fluid from the inlet port 18 to the outlet port 20. The provision of a  
5 second closed position allows the valve 10 to be fully closed in the event of damage to first sealing part 32 or first valve seat 34 which allows leakage of fluid from the interior 16 of the housing 12 to the outlet port 20, or in the event of a mechanical malfunction which prevents the valve from being returned to the first closed position.

In this embodiment, when the valve member 22 is in the first closed position, the  
10 first end 26a of the screw thread 26 of the valve member 22 engages with the first end 28a of the housing screw thread 28, and the second end 26b of the screw thread 26 of the valve member 22 engages with the second end 28b of the housing screw thread 28. Moreover, the screw thread 26 of the valve member 22 engages with the tubular portion of the housing wall 14 and the housing screw thread 28  
15 engages with the valve body 24. In other words, the screw threads 26, 28 mesh so that the troughs formed by each screw thread 26, 28 are substantially filled by the corresponding screw thread 26, 28.

As the valve member 22 moves along the interior space 16 of the housing 12 from the first closed position to the second closed position, the first end 26a of the screw  
20 thread 26 of the valve member 22 moves along the housing screw thread 28 from the first end 28a of the housing screw thread 28 towards its second end 28b.

When the valve member 22 is in the second closed position, the first end 26a of the screw thread 26 of the valve member 22 engages with the second end 28b of the housing screw thread 28, whilst the remainder of the screw thread 26 extends into  
25 an unthreaded portion 50 of the housing wall 14. Advantageously, the screw thread 26 is spaced from the unthreaded portion 50 of the housing wall 14.

As mentioned above, the inlet port 18 and outlet port 20 are located in the housing wall 14 such that the space enclosed by the portion of the housing wall 16 carrying the housing screw thread 28 forms part of a fluid flow path between the inlet port 18  
30 and the outlet port 20. This means that, when the valve 10 is in the first closed position, not only is flow of fluid between the inlet port 18 and the outlet port 20 blocked by the engagement of the first seal part 32 with the first valve seat 34, such flow of fluid is also impeded by the meshing of the screw threads 26, 28. Whilst the

meshed screw threads 26, 28 do not provide a fluid tight seal, they significantly impede flow of fluid along the interior space 16 of the housing 12.

When the motor 40 is operated as described above to rotate the valve member 22 and move the first sealing part 32 out of engagement with the first valve seat 34, the  
5 decreasing height of the screw threads 26, 28 from the first end 26a, 28a to the second end 26b, 28b thereof causes a gap to open up between the peak of the housing screw thread 28 and the valve body 24. This gap provides a path for flow of fluid around the valve body 24 at a greater flow rate than is permitted by leakage of fluid between the screw threads 26, 28 are fully meshed, with each screw thread 26,  
10 28 essentially completely filling the trough of the corresponding thread. The rate of flow of fluid from the inlet port 18 to the outlet port 20 at a given pressure differential between fluid at the inlet port 18 and the outlet port 20 depends on the minimum effective cross-sectional area of the flow path provided by this gap.

The gap opens up, and therefore its effective cross-sectional area increases, as the  
15 valve member 22 moves from the first closed position towards the second closed position. As a result, relatively fine control of the rate of flow of fluid through the valve 10 can be achieved by operating the motor 40 to control the exact position of the valve member 22 within the housing 12. Low flow rates can be achieved by rotating the valve member 22 so that it only moves a small distance towards the  
20 second closed position, and the flow rate can be increased by rotating the valve member 22 to move it closer to the second closed position. In effect, this means that there is no single "open position" of the valve 10 – there are, in fact, a range of open positions. The valve member 22 is in an open position whenever there is no engagement of the first sealing part 32 with the first valve seat 34 and no  
25 engagement of the second sealing part 36 with the second valve seat 38.

The valve 10 is advantageously provided used to control the flow of an injection fluid from a well annulus into a well conduit of a hydrocarbon well. The injection fluid may be water, a chemical (and the valve 10 a chemical injection valve), or gas (and the valve is a gas lift valve). The inlet port 18 of the valve 10 may be fluidly  
30 connected to the well annulus, and the injection fluid delivered to the injection valve 10 via the well annulus, or the inlet port 18 may be connected to an injection fluid delivery line. The outlet port 20 of the valve 10 is fluidly connected to the well conduit. The well conduit typically comprises the main passage of a section of production tubing.

Such a fluid injection system is illustrated in Figure 5. This shows a production tubing 90 which extends from a wellhead 93 located on a land surface 94. The wellhead 93 may alternatively be located on a subsea surface, or a platform deck. A well casing 95 extends towards a subterranean reservoir (not shown). The

5 production tubing 90 comprises a pipe 91 having at least one side pocket mandrel 92a-c. Each side pocket mandrel 92a-c has an opening which permits fluid communication between the inside 97 of the production tubing 90 and an annulus 96 between the well casing 95 and the production tubing 90. At least injection valve 10 is arranged in each respective side pocket mandrel 92a-c.

10 One such side pocket mandrel 92 is illustrated in Figure 6. The side pocket mandrel 92 can be installed in the pipe 91 of the production tubing 90 in a well bore by means of end connectors 104 and 105. The side pocket mandrel 92 has a main passage 102 which, when installed, is aligned with the main passage of the production tubing 90. This allows production fluids to pass through the side pocket  
15 mandrel 92, and it allows access to the inside of the side pocket mandrel 92 through the inside of the production tubing 90.

The side pocket mandrel 92 also has a laterally offset side pocket bore 104, the main passage 102 and the laterally offset side pocket bore 104 being separated by an internal wall 105. An inlet opening 106 (or, alternatively, several inlet openings)  
20 is provided on the outside surface of the side pocket mandrel 92 to connect the annulus 96 with the side pocket bore 104.

The valve 10 (illustrated schematically in Figure 6) is arranged in the side pocket bore, the inlet port 18 of the valve 10 being in fluid communication with the exterior of the side pocket mandrel via the inlet opening or openings 106, and the outlet port  
25 20 of the valve 10 being in communication with the main passage 102 via an outlet port 108 provided in the internal wall 105.

The invention is not limited by the embodiments described above; reference should be had to the appended claims. Various modifications may be made to the invention within the scope of the claims.

30 For example, in an alternative embodiment, the screw thread may be provided on a cylindrical portion of the valve body, rather than a frusto-conical portion, whilst the housing screw-thread 28 is provided on a tubular portion of the housing wall 14 which encloses a frusto-conical space the diameter of which decreases from a first end of the tubular portion to a second end of the tubular portion, the first end of the

- housing screw thread extending from the first end of the tubular portion and the second end of the housing screw thread extending from the second end of the tubular portion. In this case, the first valve seat would be provided adjacent to the second end of the tubular portion of the valve housing, and the second valve seat
- 5 would be provided at or adjacent to the first end of the tubular portion of the housing wall, so that when the valve member is moved from the first closed position to the open position and then on to the second closed position, the second end of the screw thread of the valve member moves towards the first end of the housing screw thread.
- 10 The inlet port 18 need not be a single port – there could be a plurality of inlet ports distributed around the circumference of the housing wall 14.

## CLAIMS

1. A valve comprising a housing having housing wall which encloses a interior space, an inlet port, an outlet port, and a valve member which is located in the interior space of the housing and which is movable to control flow of fluid  
5 through the interior space from the inlet port to the outlet port, wherein the valve member has a valve body which is provided with a screw thread which extends around and generally radially outwardly of a radially outwardly facing surface of the valve body and which meshes with a corresponding housing screw thread provided on a radially inwardly facing surface of the housing  
10 wall, wherein the radially outwardly facing surface of the valve body is not parallel to the radially inwardly facing surface of the housing wall.
2. A valve according to claim 1 wherein the height of the screw thread and / or the housing screw thread decreases from a first end to a second end thereof.
3. A valve according to claim 1 or 2 wherein the valve member further  
15 comprises a first sealing part which is provided on the valve body, the valve member being movable relative to the housing into a first closed position in which the first sealing part sealingly engages with a first valve seat to substantially prevent flow of fluid from the inlet port to the outlet port.
4. A valve according to claim 3 wherein the first valve seat is provided in a  
20 portion of the housing wall which surrounds either the inlet port or the outlet port.
5. A valve according to claim 3 or 4 wherein the valve member further comprises a second sealing part which is provided on the valve body, the valve member being movable relative to the housing into a second closed  
25 position in which the second sealing part sealingly engages with a second valve seat to substantially prevent flow of fluid from the inlet port to the outlet port.
6. A valve according to any preceding claim wherein the screw thread is  
30 provided on a frusto-conical portion of the valve body which has an outer diameter which increases from a first end of the frusto-conical portion towards a second end of the frusto-conical portion, the first end of the screw thread being at or adjacent to the first end of the frusto-conical portion and the second end of the screw thread being at or adjacent to the second end of the frusto-conical portion.

7. A valve according to claim 6 wherein the housing screw thread is provided on a tubular portion of the housing wall which encloses a cylindrical space, the tubular portion of the housing wall having a first portion from which the first end of the housing screw thread extends, and a second portion, from which the second end of the housing screw thread extends.
8. A valve according to claim 6 or 7 where dependent on claim 5 wherein the first sealing part is provided at or adjacent to the first end of the frusto-conical portion of the valve body, and the second sealing part is provided at or adjacent to the second end of the frusto-conical portion of the valve body.
9. A valve according to any one of claims 1 - 5 wherein the screw thread is provided on a cylindrical portion of the valve body, the first end of the screw thread being at or adjacent to a first end of the cylindrical portion and the second end of the screw thread being at or adjacent to a second end of the cylindrical portion.
10. A valve according to claim 9 wherein the housing screw-thread is provided on a tubular portion of the housing wall which encloses a frusto-conical space the diameter of which decreases from the first end of the tubular portion to a second end of the tubular portion, the first end of the housing screw thread extending from the first end of the tubular portion and the second end of the housing screw thread extending from the second end of the tubular portion.
11. A valve according to claim 9 or 10 where dependent on claim 5 wherein the first valve seat is provided adjacent to the second end of the tubular portion of the valve housing, and the second valve seat is provided at or adjacent to the first end of the tubular portion of the housing wall.
12. A valve according to any preceding claim wherein the inlet port and outlet port are located in the housing wall such that the portion of the housing wall bearing the housing screw thread encloses at least part of a fluid flow path between the inlet port and the outlet port.
13. A valve according to claim 12 wherein the inlet port is provided in the tubular portion of the housing wall whilst the outlet port is provided in an end face of the housing.
14. A valve according to claim 3 wherein the valve is configured such that rotation of the valve member about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the

valve member undergo translational movement along the interior space of the housing between the first closed position in which the first sealing part engages with the first valve seat and the valve member substantially prevents flow of fluid from the inlet port to the outlet port and an open position in which the first sealing part is spaced from the first valve seat and flow of fluid from the inlet port to the outlet port is permitted.

15. A valve according to claim 5 wherein the valve is configured such that rotation of the valve member in one direction about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the valve member undergo translational movement along the interior space of the housing from the first closed position in which the first sealing part engages with the first valve seat and the valve member substantially prevents flow of fluid from the inlet port to the outlet port, to an open position in which the first sealing part is spaced from the first valve seat, the second sealing part is spaced from the second valve seat and flow of fluid from the inlet port to the outlet port is permitted, and then to a second closed position in which the second sealing part engages with the second valve seat and the valve member substantially prevents flow of fluid from the inlet port to the outlet port.

16. A valve according to claim 14 or 15 wherein when the valve member is in the first closed position, the screw thread of the valve member engages with the tubular portion of the housing wall and the housing screw thread engages with the valve body.

17. A valve according to any preceding claim wherein the valve further comprises a drive apparatus which is operable to drive rotation of the valve member relative to the housing about the axis of rotation.

18. A valve according to claim 17 wherein the drive apparatus is connected to the valve member by means of a drive shaft, the housing being further provided with a bearing assembly which supports the drive shaft.

19. A valve comprising a housing having housing wall which encloses a interior space, an inlet port, an outlet port, and a valve member which is located in the interior space of the housing and which is movable to control flow of fluid through the interior space from the inlet port to the outlet port, the valve member having a valve body wherein the valve member further comprises a first sealing part which is provided on the valve body, the valve member

being movable relative to the housing into a first closed position in which the first sealing part sealingly engages with a first valve seat to substantially prevent flow of fluid from the inlet port to the outlet port, and a second sealing part which is provided on the valve body, the valve member being movable relative to the housing into a second closed position in which the second sealing part sealingly engages with a second valve seat to substantially prevent flow of fluid from the inlet port to the outlet port.

20. A valve according to claim 19 wherein the valve body is provided with a screw thread which extends around and generally radially outwardly of the valve body and which meshes with a corresponding housing screw thread provided on the housing wall,

21. A valve according to claim 20 wherein the valve is configured such that rotation of the valve member in one direction about an axis of rotation and the meshing of the screw thread of the valve member with the housing screw thread causes the valve member undergo translational movement along the interior space of the housing from the first closed position to an open position in which the first sealing part is spaced from the first valve seat, the second sealing part is spaced from the second valve seat and flow of fluid from the inlet port to the outlet port is permitted, and then to the second closed position.

22. An injection system for injecting fluid into a production tubing of a hydrocarbon well comprising a valve according to any preceding claim.

23. An injection system according to claim 22 further comprising a side pocket mandrel in which the valve is located.