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(58) Field of search
UK CL (Edition J) **F2P**
INT CL⁴ **F16L**

(54) Displaceable valve assembly or pig

(57) A unit or pig (112) displaceable along a pipeline (10) contains valve means (46, 47) which can be closed by a piston 52. The pig is lockable at a desired location, and subsequently releasable. Thus a hydraulic piston (122) may be actuable to displace clamping segments (112) outwardly against the pipe interior. This may also compress a seal (140) to enhance sealing to the pipe (10). Displacement of the piston (122) may be prevented by a resiliently urged clamping sleeve (126 Fig 4, not shown) unless this is withdrawn by a hydraulic actuator (128). The pig may be locked by spring loaded wedges (28, Fig 1 not shown) engageing recess (26) in the pipe (10). The wedges (28) may be released by a hydraulically operated annular actuator (38).

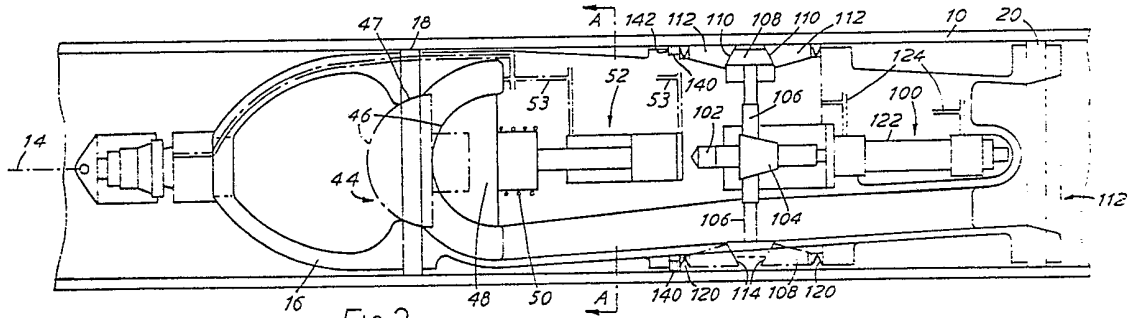

FIG 2

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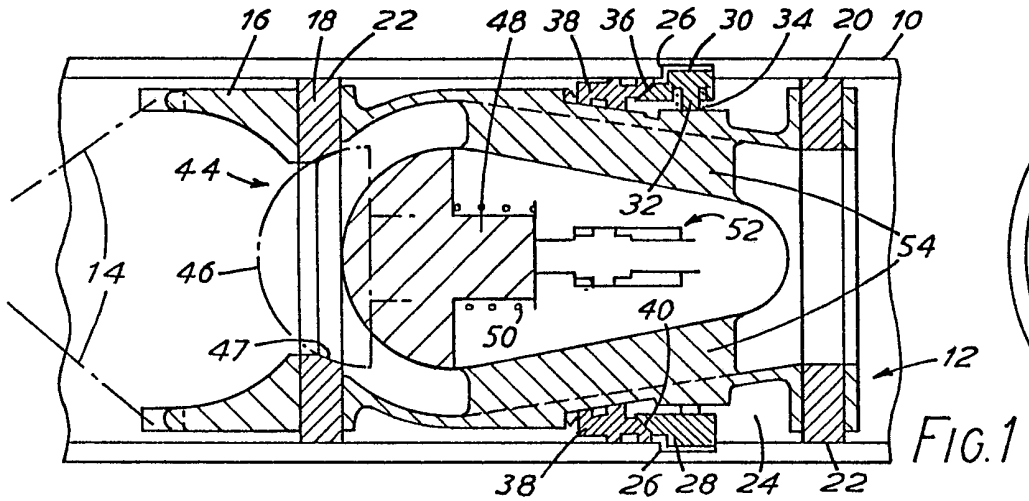

FIG.1

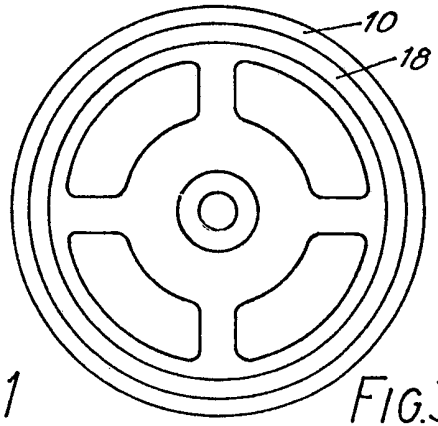

FIG.3

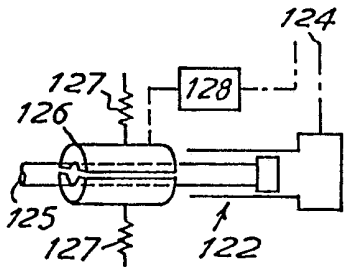

FIG.4

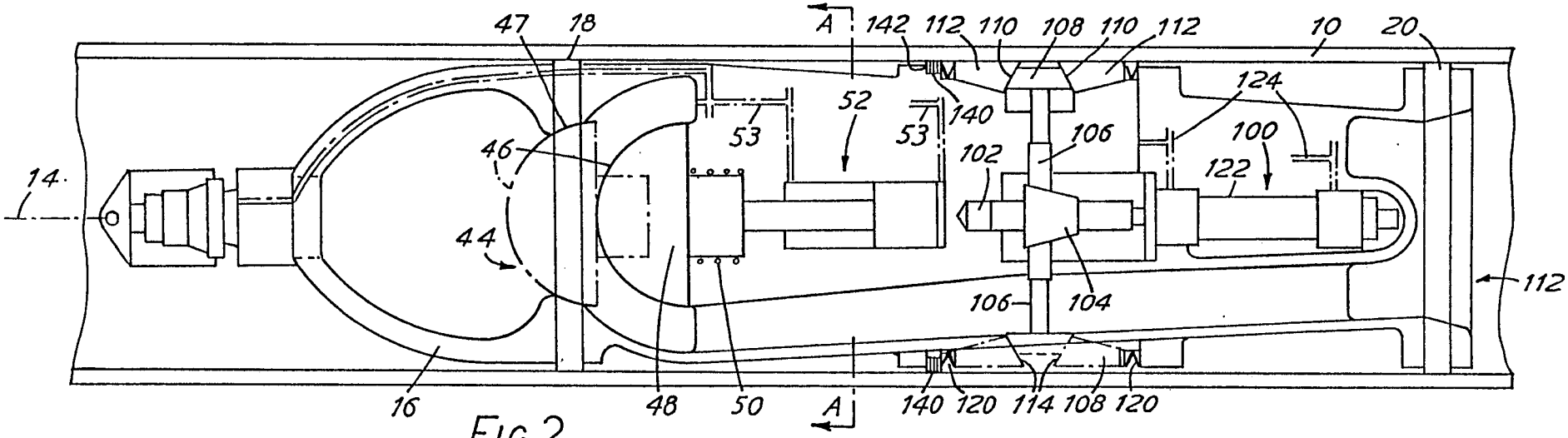

FIG.2

DISPLACEABLE VALVE ASSEMBLY

The present invention relates to a displaceable valve assembly, particularly for subsea use in oil pipelines.

The offshore oil industry employs oil rigs which have platforms at or near the sea surface, and structures extending to the sea bed. These structures include oil pipelines. Increasingly, it may be desirable to have oil storage tanks at the sea bed. It is necessary to be able to control the flow of oil through the pipelines. But plainly it is very difficult to install and maintain a conventional valve in a pipeline hundreds of feet below the surface of the sea.

The present invention provides a valve assembly having an obturator assembly mounted in a housing, the housing being adapted to be displaceable along the interior of a pipeline and having means to lock it releasably within the pipeline, with the obturator assembly arranged to control flow along the pipeline. The locking means may comprise one or more clamping members which are radially displaceable or expandable to effect locking. They may be intended to engage in recesses provided in the pipeline, or to lock by being forced against the inner surface of the pipeline. Generally, there will be one or more circumferential sealing members for sealing to the pipeline. The assembly may be adapted to serve as a pig.

The obturator assembly suitably provides a check valve having a check valve member and a seat. The seat may be

provided by an annular support disc whose outer periphery is adapted to engage the pipeline, preferably sealingly. The valve member may be resiliently urged to its closed configuration (abutting the seat), and displaceable therefrom (1) by fluid flow in the pipeline in an intended flow direction; and (2) by a (preferably hydraulic) actuator, which may also be operable to urge the valve member in the other sense. If the actuator fails, the valve member is resiliently urged to the closed configuration.

The locking means also preferably uses hydraulic actuation, and also preferably has resilient means providing fail-safe operation. Thus a hydraulic piston may have resiliently urged clamping means such that the piston is displaceable only when further hydraulic means release the clamping means. Such a fail-safe arrangement may also be used with non-hydraulic actuators.

In a further aspect the invention provides a method of installing a valve assembly at a desired location in a pipeline which comprises inserting a valve assembly according to the first aspect into a pipeline, effecting displacement of the assembly along the pipeline to the desired location, and locking the assembly at that location. The valve assembly may be displaced by the normal flow of fluid along the pipeline. The assembly may subsequently be moved (to a new position or out of the pipeline) after release of the locking.

Some embodiments of the invention will now be described in greater detail with reference to the accompanying drawings in which:

Fig. 1 is a schematic axial section of a pipeline portion containing a valve assembly according to a first embodiment;

Fig. 2 is a like view showing a pipeline portion containing a second embodiment;

Fig. 3 is a section on A-A in Fig. 2; and

Fig. 4 is a schematic view of an actuator assembly.

Fig. 1 shows a pipeline portion 10 containing a valve assembly 12 coupled at its upstream end to (schematically shown) hydraulic lines 14. The assembly 12 has a generally tubular body 16 to which are mounted front and rear support discs 18,20. These are annular sealing discs, similar to those used on pipeline cleaning pigs. Thus, each is an annulus with an outer circumferential surface 22 that is an interference fit with the interior of the pipeline 10. Between the discs 18,20, the body 16 has an external shape such that the rear portion tapers away from the pipeline interior, to create an annular surrounding cavity 24. This houses locking members. In this example, the pipeline portion 10 has an annular recess 26. The body 16 carries four lock wedges 28, which together form an annulus. Each wedge 28 has an engagement portion 30 adapted to be received in the recess 26, and an opposed inner shank portion 32 that bears a compression spring 34 which acts to

urge the wedge radially outwardly, to engage in the recess 26. At one axial side, each wedge 28 has an angled cam follower surface 36. An annular actuator member 38 has a complementary cam surface 40 such that axial displacement of the actuator member 38 towards the wedges urges radially inwardly, to free them from the recess 26. The actuator member 38 is urgeable in this sense by hydraulic means (not shown).

Within the body 16, there is a check valve member 44. This has a convex head 46, and the front support disc 18 provides a complementary seat 47 for this. At the rear, the valve member has a shank 48 which bears a compression spring 50, by which the valve member 44 is urged against the seat. It is displaceable in the other direction by means of a hydraulic piston and cylinder arrangement 52. The valve assembly is supported within the body by a plurality of axially extending radial support ribs 54.

Figs. 2 and 3 show a second form of valve assembly 112 which is lockable at any position within a pipeline, since it does not require an engagement recess. Many of the parts are similar to those of the first embodiment, and are given the same reference numerals. Thus there is a tubular body 16 with a pair of support discs 18,20, the front one (18) of which provides a seat 47 for the head 46 of a check valve member 44. This member 44 has a rearward shank 48 about which is engaged a compression spring 50 by which the member 44 is urged against the seat 47. A hydraulic

assembly 52 is actuable to counter the force of the spring 50, to pull the member 44 away from the seat 47. (The hydraulic fluid supply and return galleries 53 are indicated in chain-dotted lines.)

Within the rear portion of the body there is an actuator assembly 100 for the locking means. An axial actuation shaft 102 bears a coaxial conical cam member 104, such that rearward movement of the shaft 102 urges radius rods 106 radially outwardly. There are four radius rods 106, circumferentially disposed at 90° intervals. At the radially outer ends, each is fast with a double cam member 108, which provides a pair of angled cam surfaces 110. There are two sets of circumferential clamping segments 112, each set consisting of four segments which together make up an almost-complete annulus at a respective axial side of the double cam member 108. Each segment 112 has an angled cam follower surface 114 which cooperates with one of the cam surfaces of the associated double cam member 108. Thus, when the radius rods 106 are urged outwardly, the clamping segments 112 are urged radially outwardly, as well as axially away from the cam member 108. Some axial movement is possible, taken up by annular springs 120.

The actuation shaft 102 is displaceable by means of a hydraulic piston assembly 122 (whose hydraulic fluid supply/return galleries 124 are indicated in chain-dotted lines). The hydraulic piston/cylinder assembly 122 incorporates positive locking. In a suitable form, shown

schematically in Fig. 4, the piston shaft 125 passes through a split clamping sleeve 126 which is resiliently urged to clamp it (e.g. by springs 127). These prevent its movement. To permit movement, the clamping sleeve must be urged away from the shaft 125, and a further hydraulic actuator system 128 is provided for this purpose. Thus, should the hydraulic fluid supply fail, the actuator shaft 102, and hence the clamping segments 112, are locked in their existing configuration.

When the valve assembly 112 is installed in a pipeline, any fluid flow through the pipeline must pass through the valve body, and is therefore under the control of the check valve element 44. To ensure the fluid tight fit of the assembly within the pipeline, further sealing elements 140 are provided. As shown, they are located between an annular shoulder 142 provided by the body, and the annular spring 120 which engages one set of clamping segments 112. Thus when the segments are urged outwardly (radially and axially) to effect clamping, they also urge compression of the sealing elements 140, which therefore provide a stronger seal. Conversely, when the clamping segments are released, this sealing is reduced, so that the movement of the valve assembly within the pipeline is facilitated.

The intended mode of use of the two embodiments is generally similar, and should be apparent from the preceding description. Thus, with the second embodiment,

the valve assembly initially has the actuation shaft 102 at its leftward position, so that the clamping segments are not urged outwardly, nor are the sealing elements 140. It can thus be placed relatively easily within a pipeline. Respective supplies of hydraulic fluid are connected via the hose assembly 14. The valve assembly is moved along the pipeline, e.g. by the force of fluid flowing normally through the pipeline. (To facilitate this, the check valve may be locked in its closed configuration using the hydraulic cylinder/piston 52, though this may not be necessary.) When the valve assembly reaches a desired location, it is locked in place by firstly releasing the clamping sleeve 126 on the piston shaft of the actuator shaft 102 by means of the hydraulic actuator 128. The actuator shaft 102 is then moved to the right by means of the hydraulic piston/cylinder 122, so that the two sets of four clamping segments are urged outwardly against the wall of the pipeline. The clamping sleeve 126 is then released, so that the actuation shaft 102 is locked in the locking configuration, and hydraulic pressure is not required to maintain the locking of the valve assembly at that location in the pipeline. The check valve assembly can then function normally. If the hydraulic piston/cylinder assembly 52 is not in use, the valve acts as a non-return valve, since fluid flow in the intended direction can move the check valve member 44 away from the seat 47 whereas flow in the contrary direction urges closure of the check

valve, enhanced by the action of the compression spring 50. If it is desired to permit reverse flow, then the valve member can be held away from the seat by actuating the hydraulic piston/cylinder 52.

It will be apparent that it is a simple matter to release the locking of the valve assembly, by first releasing the clamping sleeve 126 from the actuation shaft 102, and then displacing that shaft to permit the double cam members 108 to move radially inwardly, under the influence of the springs 120.

The valve assemblies illustrated above can be regarded as combinations of check valve assemblies and pigs. Indeed, such a valve assembly can be employed as a pig. Normally, this would not be cost-effective, though of course a valve assembly which was no longer required for controlling flow, or which was worn out, might be used for this purpose. Generally, such a valve assembly would simply be removed and, if necessary, serviced and returned to use.

CLAIMS:

1. A valve assembly having an obturator assembly mounted in a housing, the housing being adapted to be displaceable along the interior of a pipeline and having means to lock it releasably within the pipeline, with the obturator assembly arranged to control flow along the pipeline.

2. A valve assembly according to claim 1 wherein the locking means comprise one or more clamping members which are radially displaceable or expandable to effect locking.

3. A valve assembly according to claim 1 or 2 wherein the clamping members are adapted to engage in recesses provided in the pipeline.

4. A valve assembly according to claim 1 or 2 wherein the clamping members are adapted to lock by being forced against the inner surface of the pipeline.

5. A valve assembly according to any preceding claim having one or more circumferential sealing members for sealing to the pipeline.

6. A valve assembly according to any preceding claim which is adapted to serve as a pig.

7. A valve assembly according to any preceding claim wherein the obturator assembly provides a check valve having a check valve member and a seat.

8. A valve assembly according to claim 7 wherein the seat is provided by an annular support disc whose outer periphery is adapted to engage the pipeline sealingly.

9. A valve assembly according to claim 7 or 8 wherein the valve member is resiliently urged to its closed configuration (abutting the seat), and displaceable therefrom (1) by fluid flow in the pipeline in an intended flow direction; and (2) by an actuator, which may also be operable to urge the valve member in the other sense.

10. A valve assembly according to any preceding claim wherein the locking means are hydraulically actuable.

11. A valve assembly according to any preceding claim wherein the locking means includes: a displaceable locking member; resiliently urged clamping means which act to restrain displacement thereof; and release means actuable to release the clamping means to permit said displacement.

12. A valve assembly according to any preceding claim wherein the locking means comprises a radially displaceable cam having an angled cam surface, and a plurality of clamping segments having complementary angled cam follower surfaces such that radially outward displacement of the cam urges the segments radially outwardly and axially; the assembly further including sealing elements arranged to be compressed by axial displacement of the segments whereby the elements are urged to expand radially outwardly to seal to the pipeline interior.

13. A valve assembly substantially as herein described with reference to and as illustrated in the accompanying drawings.

14. A method of installing a valve assembly at a desired location in a pipeline which comprises inserting a valve assembly according to any preceding claim into a pipeline, effecting displacement of the assembly along the pipeline to the desired location, and locking the assembly at that location.

15. A method according to claim 14 wherein the valve assembly is displaced by the normal flow of fluid along the pipeline.

16. A method of installing a valve assembly at a desired location in a pipeline substantially as herein described with reference to and as illustrated in the accompanying drawings.

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