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U1S S1915 S2219

(56) Documents cited
GB 2014253 A **GB 1257098 A** **GB 1115436 A**
EP 0179722 A

(58) Field of search
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(54) Seals for use in pipeline systems

(57) A valve 10 for use in forming a seal in a pipe branch 60 comprises a first outer ring 11 which forms the main body portion of the valve 10, and a second outer ring 12 forming an end cap for the valve 10. Both rings 11, 12 comprise a generally ring shaped cross-section and contained within them are inner rings. Each inner ring comprises two ring portions 14, 15 and 16, 17 which fit together to form a respective inner ring 13. A resiliently deformable seal 19 is positioned between ring portions 14, 15 and ring portions 16, 17 to form a radially inner member 51. By means of the valve it is possible to insert a camera attached to a fibre optic cable through into a main pipeline.

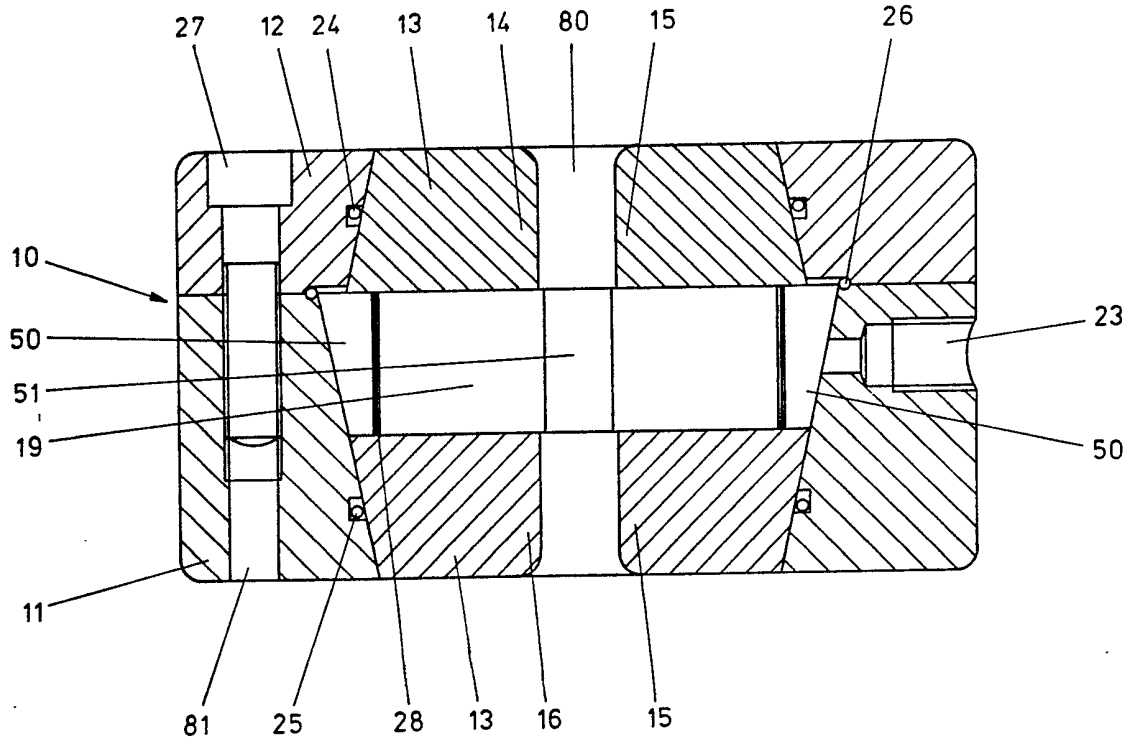

FIG. 1

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

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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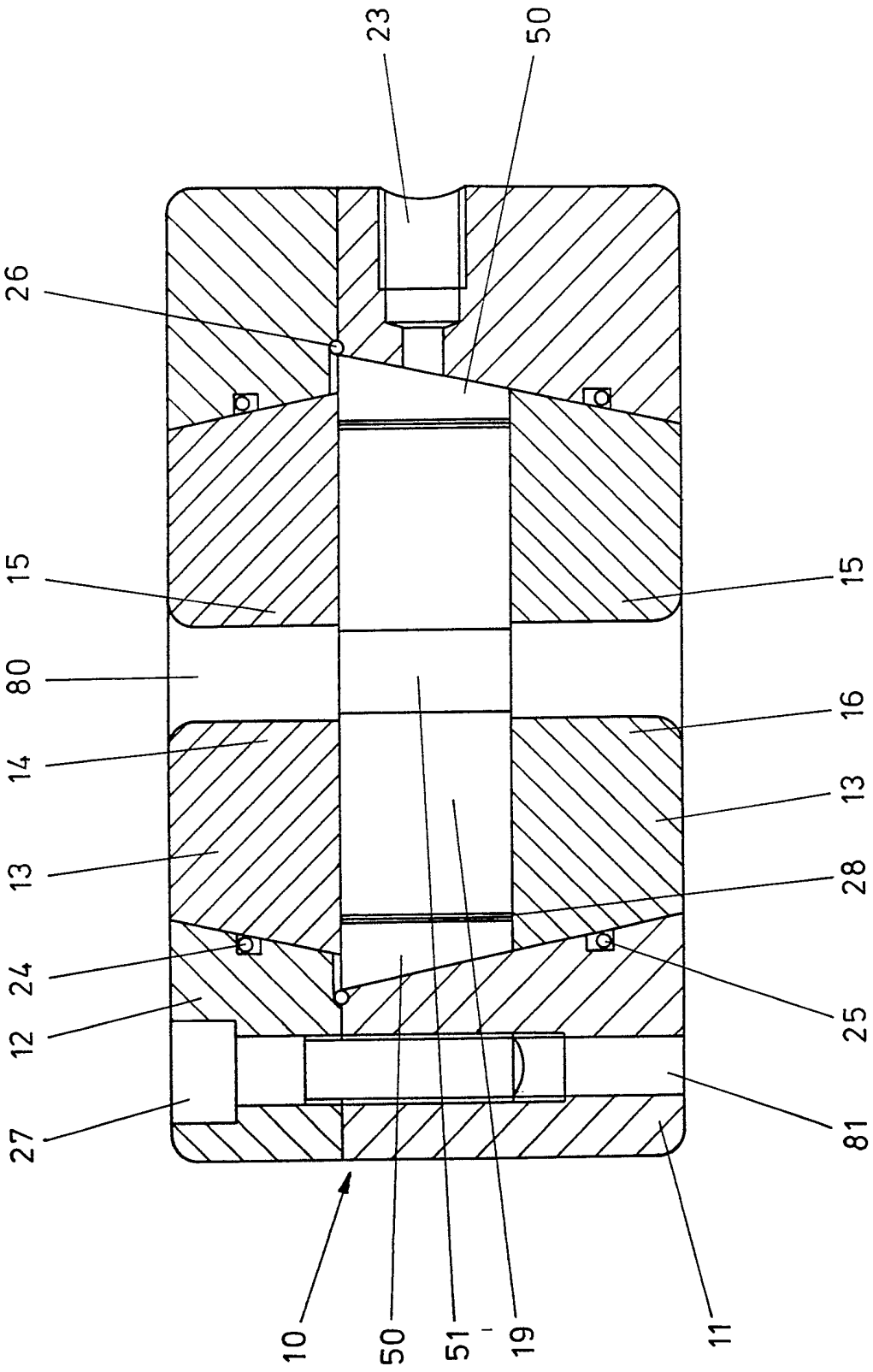


FIG. 1

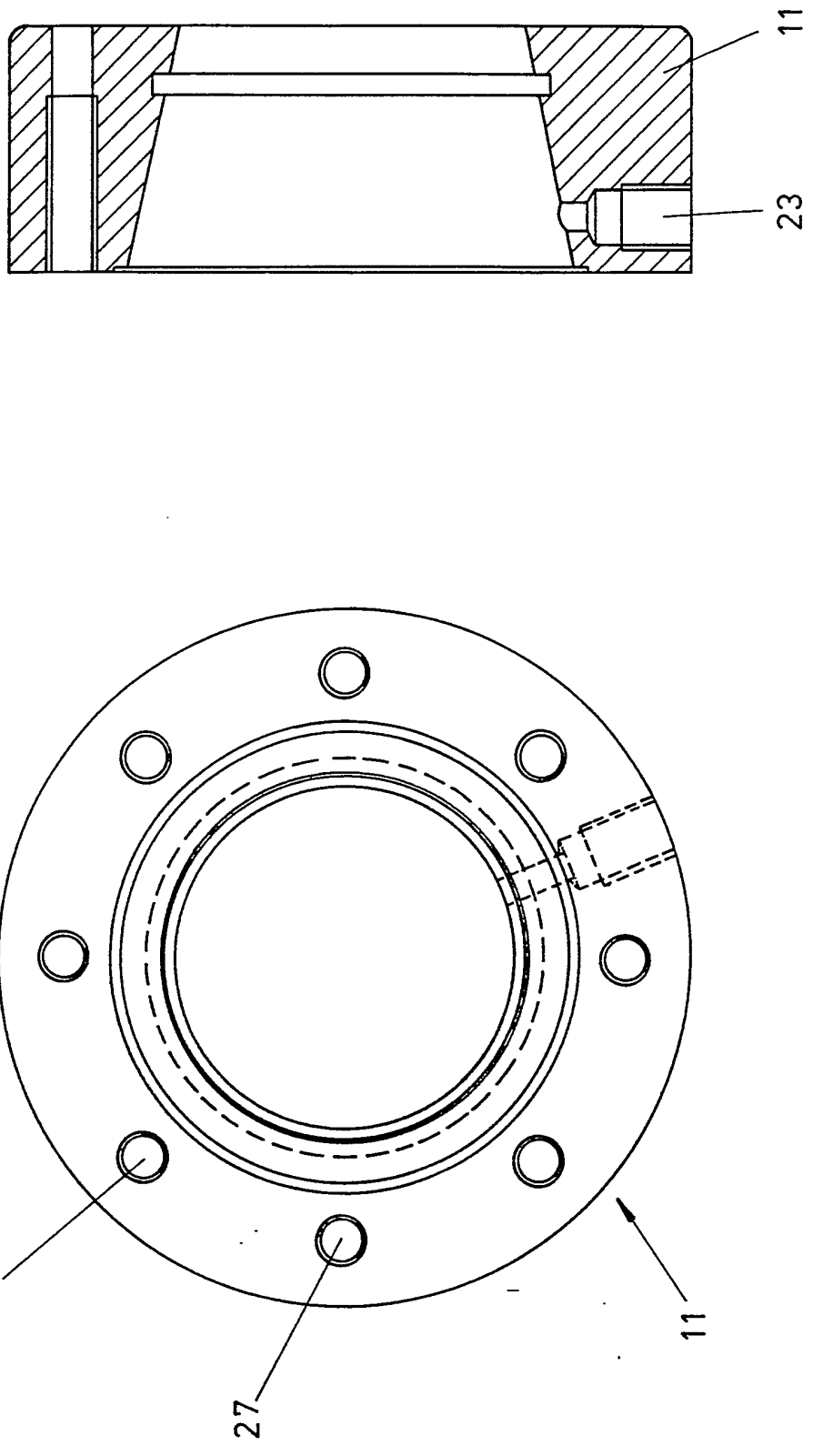
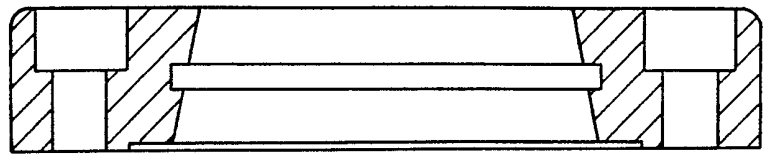


FIG. 2



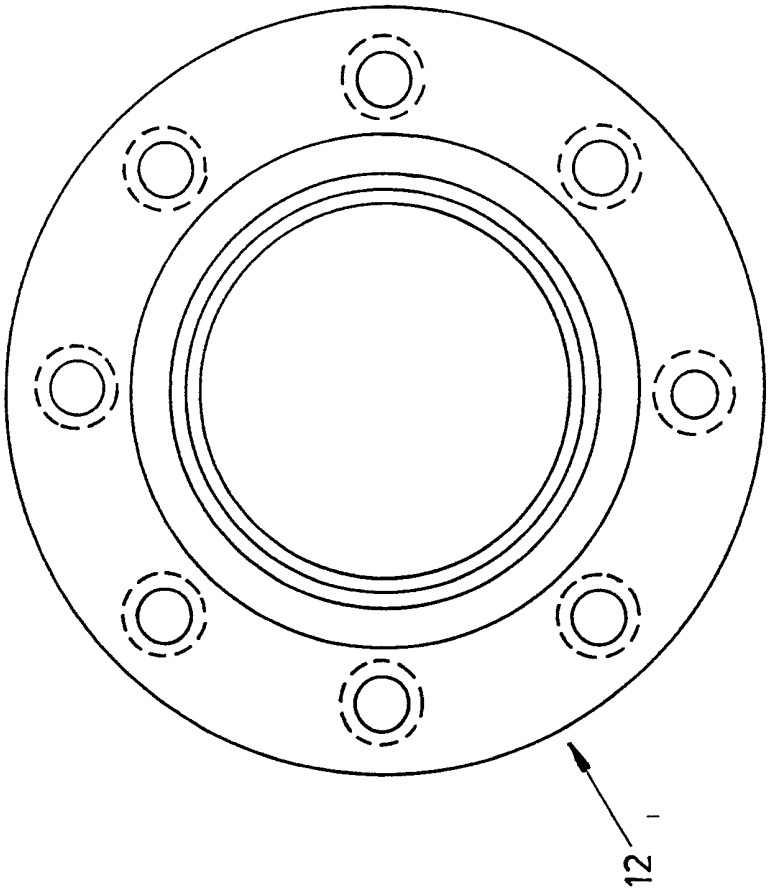
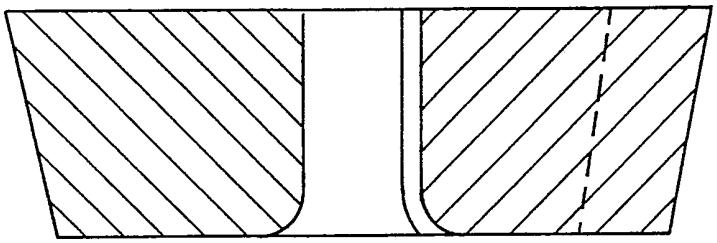


FIG. 3



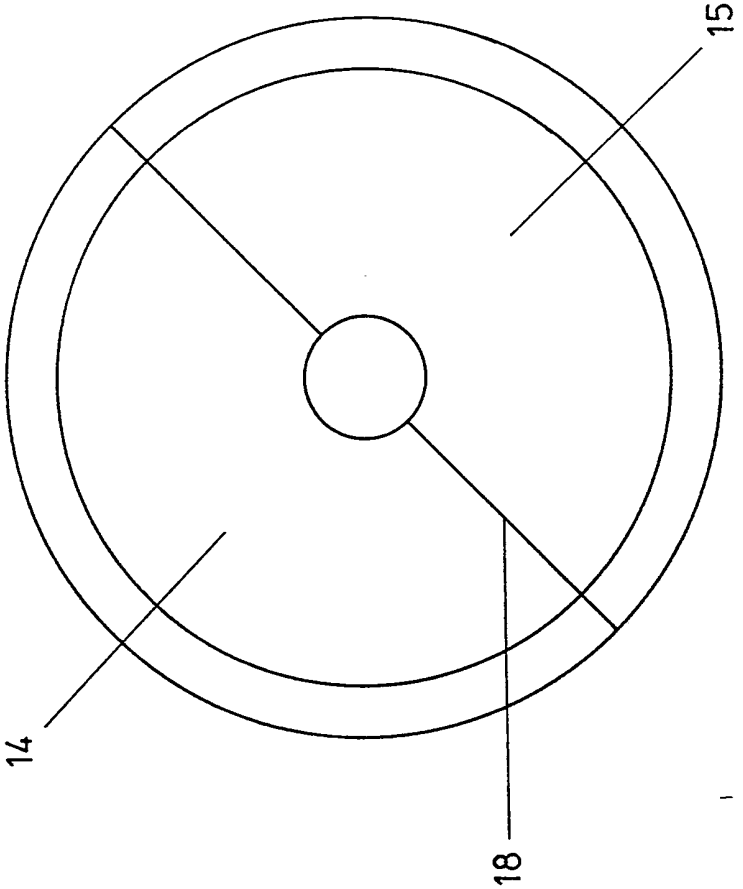


FIG. 4

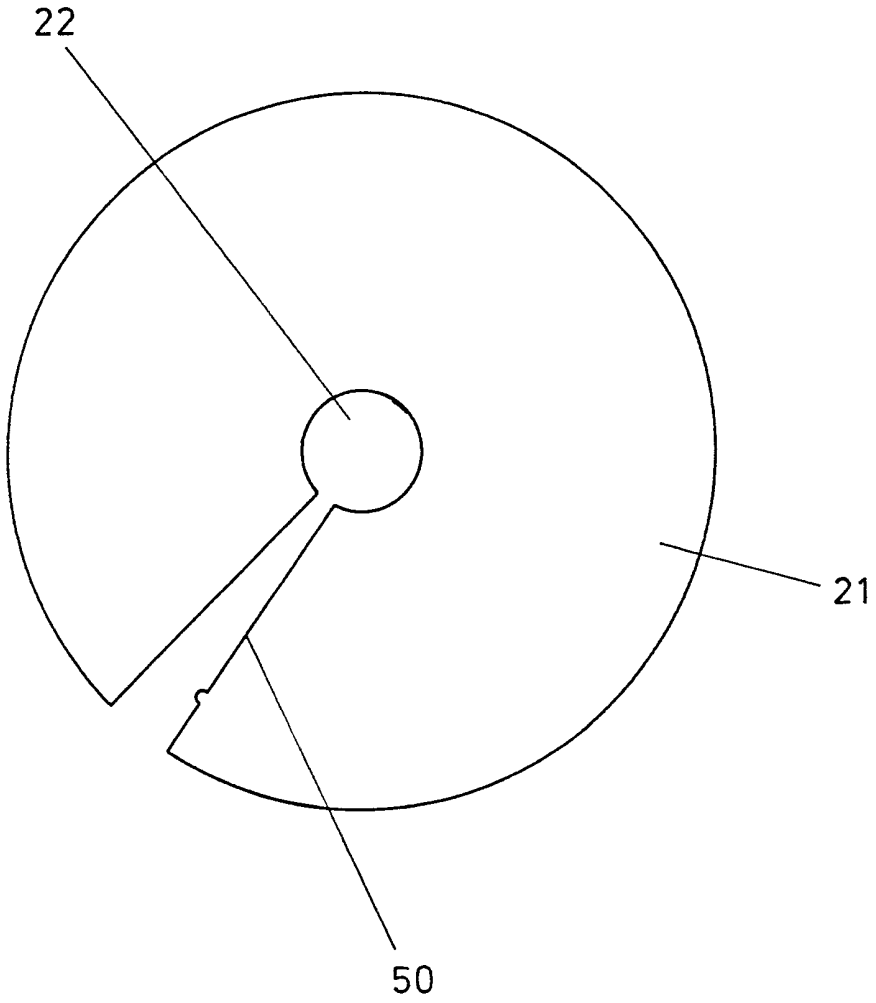


FIG. 5

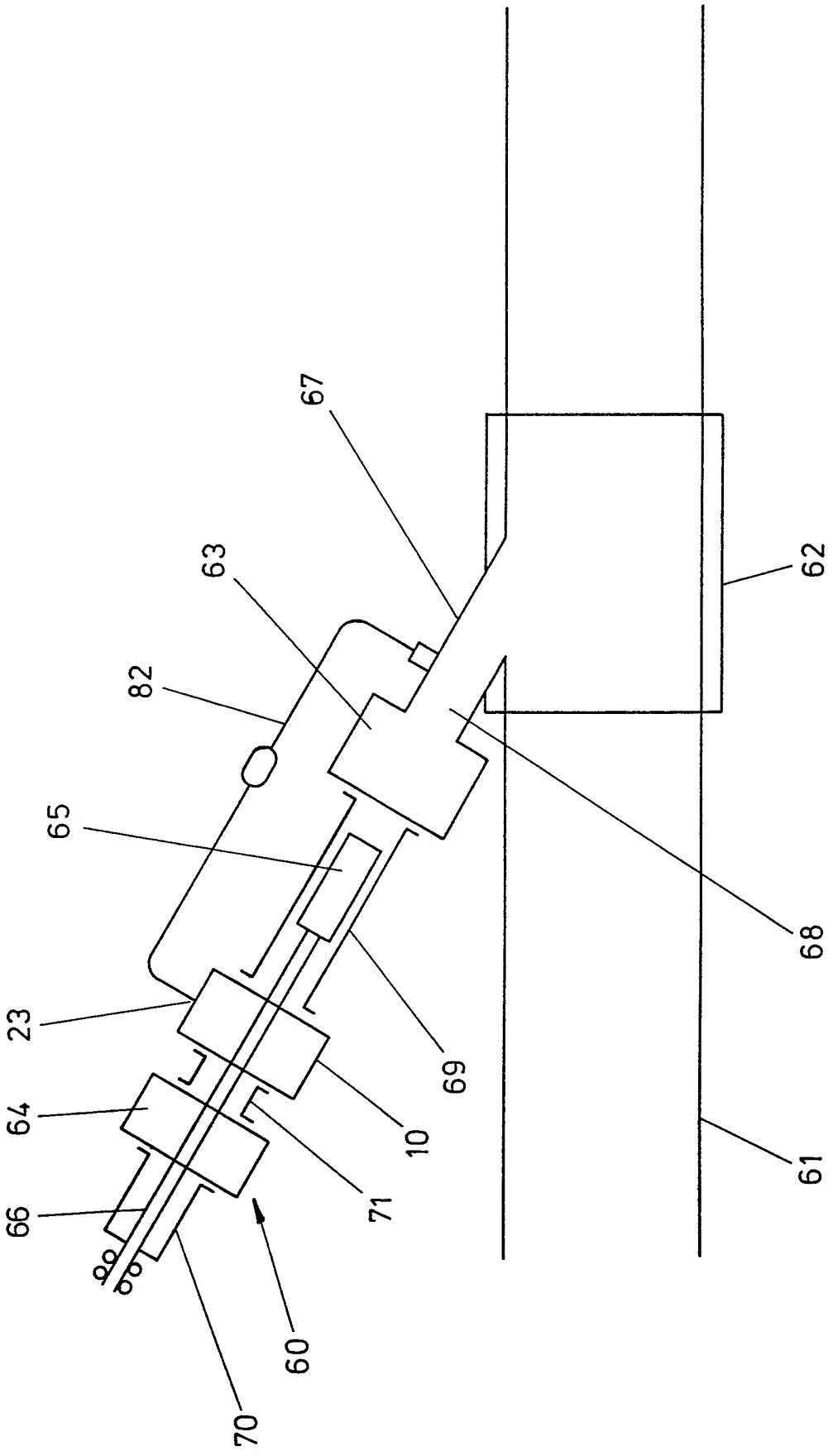


FIG. 6

A SEAL

This invention relates to a seal for use in pipeline systems of the type used for carrying gases or liquids such as water over long distances, and to a pipe branch for allowing entry to and exit of a cable such as a fibre optic cable to the pipeline system.

To maintain such pipeline systems in a good state of repair, it is necessary to inspect the inner walls of the pipelines in the system to determine their condition.

In order to inspect the inner walls of a pipeline without having to stop the flow of fluid through the pipeline, it is known to pass a camera which is connected to a length of optical fibre cable through the pipe. The camera is pushed along the length of the pipe being inspected by a tractor unit such that the condition of the inner walls may be viewed on monitor screens.

It is known to introduce the camera and associated optical fibre cable into a pipeline system via a pipe branch having a smaller diameter than the pipeline, and being typically inclined at an angle of approximately 30° to the pipeline.

Known pipe branches of this type comprise a sluice value positioned towards the end of the pipe branch closest to the pipeline, and a hydraulic seal spaced apart from the sluice valve, and positioned towards the end of the pipe branch remote from the pipeline. The known pipe branch may also include a back-up seal positioned between the sluice valve and the hydraulic seal, and is necessary in order that the hydraulic seal may be replaced when necessary. The back-up seal in the known pipe branch is of the type currently used in the petrochemical industry, and is expensive to manufacture.

According to a first aspect of the invention, there is provided a valve for forming a fluid-tight seal around a

cable comprising: a housing having a central bore through which the cable may pass extending axially through the housing and having an axially inner and radially enlarged inner bore portion; radially inwardly resiliently deformable seal means positioned in the inner bore portion of the housing defining a radially inner chamber of the inner bore portion through which the cable may pass and a radially outer chamber of the inner bore portion; and pressure means for introducing a fluid into the radially outer chamber to pressurise the outer chamber, whereby the seal means deforms radially inwardly to form a fluid-tight seal around the cable, the housing being capable of withstanding the pressure in the chamber.

A valve according to the invention may be used in a pipe branch to provide a back-up seal which allows a hydraulic seal to be replaced when necessary. The resiliently deformable seal means provides a fluid tight seal around the cable, without exerting undue force on the cable.

According to a second aspect of the invention, there is provided a pipe branch for allowing a length of cable entry to and exit from a fluid carrying pipeline, the pipe branch comprising: a pipe comprising a first end sealably connected to the pipeline in a fluid-tight manner and a second end remote from the pipeline, a first valve positioned towards the first end; a second valve spaced apart from the first valve and positioned towards the second end; and a third valve positioned between the first and second valves, characterised in that the third valve comprises: a housing having a central bore through which the cable may pass extending axially through the housing and having an axially inner and radially enlarged inner bore portion; radially inwardly resiliently deformable seal means positioned in the inner bore portion of the housing defining a radially inner chamber of the inner bore portion through which the cable may pass and a radially outer

chamber of the inner bore portion; and pressure means for introducing a fluid into the radially outer chamber to pressurise the outer chamber, whereby the seal means deforms radially inwardly to form a fluid-tight seal around the cable, the housing being capable of withstanding the pressure in the chamber.

The third valve of the pipe branch according to the second aspect of the invention acts as a back up valve to the first and second valves.

Preferably, the housing comprises mild steel in order that it may withstand the pressures set up in the outer chamber to radially deform the seal means, which may be of the order of 80 psi in excess of the pipeline internal pressure. However, the housing may also be made from another metal such as aluminium, or a plastics material.

The seal means may comprise a membrane attached to the radially inner face of the housing, but preferably the seal means comprises a ring shaped seal made of a natural gum rubber such as Linatex (Registered Trade Mark).

Preferably, the ring shaped seal means is held in place in the housing by means of a resiliently deformable ring. The deformable ring may be made of an elastomer such as rubber, or artificial rubber.

The radially inner surface of the seal means may be coated with a non-stick substance such as Teflon (Registered Trade Mark) in order that when the pressure in the outer chamber is reduced after a seal has been effected around the cable, to open the valve, the seal means does not stick to the cable.

Advantageously, the fluid used to pressurise the chamber is the same fluid as that being carried by the pipeline, and the pipe branch comprises pump means for pumping the fluid from a part of the pipe branch between the first end and the first valve, to the chamber. Alternatively, compressed air may be used to pressurise the chamber.

A camera for insertion into a pipeline is normally attached to an end of a length of optical fibre cable in a laboratory to ensure that an efficient joint between the fibre cable and the camera is formed. The joint cannot normally be formed in the field. The back-up seal must thus allow both the camera and the optical fibre cable to pass through it initially in order that the camera may gain entry into the pipeline. The back-up seal must therefore be capable of being assembled around the camera.

The fibre optics within the fibre optic cable are sensitive to high pressure forces acting on the outside of the cable, and so the seal must be able to provide a fluid tight seal around the fibre optic cable, without exerting undue pressure on the cable. However, when the valve is in use, and is operable between an open position and a closed position the deformable seal means must be radially deformable sufficiently to form a seal around the cable. To do this it must be deformed radially sufficiently to close around the cable and in order that the forces required are not too high, and the deformability of the seal does not have to be too great, it is desirable that when the valve is in use in a pipe branch, the diameter of central bore is relatively small.

In order to have an aperture of relatively small diameter, yet still allow the back-up seal to be assembled around the camera, the housing may be formed from two or more longitudinal portions which together form the whole housing. One or more of the portions may be radially split. Each portion is as long as the complete housing but has a cross-sectional area which is a fraction of the cross-sectional area of the housing. The valve further comprises means for holding the portions together in order to form a fluid tight chamber in the housing.

Preferably, however the housing comprises first and second housing portions each comprising an outer ring having a predetermined minimum inner diameter sufficient to

allow the camera to pass through, and a radially split inner ring sealably fittable in the outer ring, the inner ring having an inner diameter which defines a portion of the central bore, and comprising a plurality of ring portions each defining a fraction of the inner ring and forming a fraction of the cross-sectional shape of the inner ring. The two inner rings are spaced apart from one another and, together with the outer rings, define the inner bore portion in which the seal means is positioned.

In use before the valve is incorporated into a pipe branch, the camera is first passed through the first outer ring. The ring portions forming the first inner ring are then positioned in the first outer ring around the cable, and the seal means is also positioned around the cable in face to face contact with first ring. The inner ring portions of the second ring are then positioned on either side of the cable in face to face contact with the seal means, and finally the outer ring of the second housing portion is passed over the camera and positioned around the inner ring in face to face contact with the first outer ring.

The valve further comprises screw means for holding the housing together such that the radially outer chamber formed between the housing and the seal means is fluid-tight and able to withstand the pressures necessary to deform the seal means.

The seal means may be formed as a ring and may be sufficiently deformable that its inner diameter may be stretched to allow it to pass over the camera.

Preferably, however, the seal means comprises a ring having a radial slit which allows the seal to be positioned appropriately around the cable relative to the camera.

Advantageously, the valve comprises further seal means positioned between each outer ring and the respective inner ring, and between the first and second outer rings. Conveniently the further seal means

comprise resiliently deformable O rings.

Preferably, each outer ring has a radially inner surface which tapers axially such that the inner diameter of each outer ring increases axially inwardly, and each corresponding ring portion has a radially outer surface which tapers axially such that the ring portions may be positioned in tight face to face contact with the corresponding outer ring. The tapering shape of the outer rings and the inner ring portions facilitates the assembly of the valve, and the forming of fluid-tight seals between the components, in conjunction with the further seal means.

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings in which :

figure 1 is a cross sectional representation of a valve according to a first aspect of the invention;

figure 2 is a schematic representation of a first outer ring of the valve of figure 1;

figure 3 is a schematic representation of a second outer ring of the valve of figure 1;

figure 4 is a schematic representation of two inner ring portions of the valve of figure 1;

figure 5 is a schematic representation of the seal of the valve of figure 1; and

figure 6 is a schematic representation of a pipe branch according to a second aspect of the invention incorporating the valve of figures 1 to 4.

Referring to figures 1 to 5, a valve according to the first aspect of the invention is denoted generally by the reference numeral 10. The valve 10 comprises a first outer ring 11 made of mild steel which forms the main body portion of the valve 10, and a second outer ring 12 made of mild steel forming an end cap for the valve 10. The first outer ring 11 has a generally ring shaped cross section (fig 2) as does the second outer ring 12 (fig 3). Positioned within outer rings 11, 12 are inner rings 13.

Each inner ring 13 comprises two ring portions 14, 15, and 16, 17 (fig 4) which fit together to form respective inner rings 13. The ring portions 14,15, and 16,17 are made from mild steel and the joint surfaces, indicated by joint line 18 in figure 4 are ground flat to form a mirror finish. Each outer ring 11,12 is tapered as shown in figure 1 such that the inner diameter increases towards the centre of the valve 10. The inner ring portions 14,15 and 16,17 taper in a corresponding manner. A resiliently deformable seal 19 is positioned between ring portions 14,15 and ring portions 16,17 to form a radially inner chamber 51. The seal 19 is held in place by resiliently deformable ring 28. The seal 19 has a generally ring shaped cross-section, and has a slit 20 extending radially from an outer edge 21 to an inner edge 22 (fig 5). A radially outer chamber 50 is defined between the first and second rings and the seal 19. A nozzle 23 in the first outer ring 11 provides a passage into the outer chamber 50. 'O' ring seals 24,25 together with the tapered shape of the outer and inner rings ensure a fluid tight seal between each outer ring and the corresponding inner ring portion. 'O' ring seal 26 ensures a fluid tight seal between the first outer ring 11 and the second outer ring 12. The whole assembly is held together by socket cap screws 27, in holes 81.

Turning to figure 6, a pipe branch 60 is shown, providing an entry and exit into a pipeline 61 carrying water. The pipe branch 60 is sealed to the pipeline 61 by means of a collar 62 which clamps the pipe branch 60 to the pipeline 61. The pipe branch 60 comprises a sluice valve 63, a hydraulic valve 64, and a back-up valve formed from valve 10 illustrated in figures 1 to 4. The pipe branch 60 is used to allow a camera 65 attached to a fibre optic cable 66 into and out of the pipeline 61. Valve 10 is necessary in case of failure of either of valves 63 and 64.

The camera 65 is attached to fibre optic cable 66 in a laboratory to ensure an efficient joint between the camera

65 and the fibre optic cable 66. The cable may have a length of the order of tens of kilometers.

The pipe branch 60 comprise a first portion 67 comprising a length of pipe 68, and sluice valve 63 which are permanently fixed to pipeline 61. When the pipe branch 60 is not in use, the sluice valve 63 will remain in a closed position. In order to introduce the camera 65 into pipeline 61 via pipe branch 60, the camera 65 is first passed through pipe portion 70, hydraulic valve 64 and pipe portion 71. The camera 65 and cable 66 are then passed through valve 10 as follows. The camera is first passed through first outer ring 11 which has a minimum inner diameter great enough to allow the camera to pass through. Inner ring portions 16,17 are then pushed into place within outer ring 11 to take up the position shown in figure 1. O ring 25 ensures a fluid tight seal between the components.

The outer ring 11 is tapered as shown in figure 1 such that the inner diameter increases towards the centre of the valve 10. This shape facilitates the positioning of the inner ring portions in the outer ring 11. The optical fibre cable 66 attached to camera 65 is now situated within the central bore 80 of the valve. Next, the seal 19 is positioned around the cable 66 by means of the radial slit 20 and is positioned on the inner ring portions 16, 17. The seal 19 is held in place by an elastomer ring 28 which is formed from rubber or artificial rubber. Ring 28 is stretched over the camera and positioned on the inner ring portions 16,17 prior to the positioning of the seal 19. The inner ring portions 14,15 are then placed on the seal 19 around the cable 66. Outer ring 12 is then positioned around inner ring portions 15,16. O rings 24, 26 ensure a fluid-tight seal between the components. Socket cap screws 27 are then introduced into holes 81 to clamp the components together. Typically, eight screws will be used. The camera is now positioned outside of the valve 10 close to outer ring 11, and the cable 66 runs through the valve

10, within bore 80. Valve 10 may now be bolted onto pipe portions 69 and 71 pipe portion 71 may be bolted onto hydraulic valve 64, which in turn is bolted onto pipe portion 69. Pipe portion 69 is bolted onto sluice valve 63, and the camera may be introduced into pipeline 61 through sluice valve 63. When it is required to activate valve 10, water in pipe portion 68 is pumped into outer chamber 20 in valve 10 via nozzle 23 and pump 82. The pumping of the water through nozzle 23 increases the pressure in chamber 20 up to approximately 80 psi in excess of the internal pressure of pipeline. This deforms the seal 19 radially inwardly so as to reduce the diameter of bore 80 and to form a fluid tight seal around cable 66. The pressure of the seal will not cause undue deformation of the cable which could reduce the efficiency of the fibre optics in the cable.

Alternatively, compressed air may be introduced into outer chamber 20 to increase the pressure in the chamber.

CLAIMS

1. A valve for forming a fluid type seal around a cable comprising:

a housing having a central bore through which the cable may pass extending axially through the housing and having an axially inner and radially enlarged inner bore portion;

radially inwardly resiliently deformable seal means positioned in the inner bore portion of the housing defining a radially inner chamber of the inner bore portion through which the cable may pass and a radially outer chamber of the inner bore portion; and

pressure means for introducing a fluid into the radially outer chamber to pressurise the outer chamber, whereby the seal means deforms radially inwardly to form a fluid type seal around the cable, the housing being capable of withstanding the pressure in the chamber.

2. A valve as claimed in claim 1 wherein the housing comprises mild steel.

3. A valve according to claim 1 or claim 2 wherein the seal means comprises a ring shaped seal made of a natural rubber.

4. A valve according to claim 3 wherein the ring shaped seal is held in place in the housing by means of a resiliently deformable ring.

5. A valve according to any one of the preceding claims wherein the radially inner surface of the seal means may be coated with a non-stick substance.

6. A valve according to any one of the preceding claims wherein the fluid used to pressurise the chamber is the same fluid as that being carried by the pipe line, and the pipe branch comprises pump means for pumping the fluid from a part of the pipe branch between the first end and the first valve, to the chamber.

7. A valve according to any one of the preceding claims wherein the housing is formed from two or more longitudinal portions which portions together form the whole housing.

8. A valve according to claim 7 wherein the portions are

radially split.

9. A valve according to claim 7 or claim 8 further comprising means for holding the portions together in order to form a fluid type chamber in the housing.

10. A valve according to any one of claims 1 to 8 wherein the housing comprises first and second housing portions each comprising an outer ring having a predetermined minimum inner diameter sufficient to allow the camera to pass through, and a radially split inner ring sealably fittable in the outer ring, the inner ring having an inner diameter which defines a portion of the central bore, and comprising a plurality of ring portions each defining a fraction of the inner ring and forming a fraction of the cross-sectional shape of the inner ring.

11. A valve according to any one of the preceding claims further comprising screw means for holding the housing together such that the radially outer chamber formed between the housing and the seal means is fluid tight and able to withstand the pressures necessary to deform the seal means.

12. A valve according to any one of the preceding claims wherein the seal means is formed as a ring and is sufficiently deformable that its inner diameter is stretchable to allow it to pass over the camera.

13. A valve according to any one of claims 1 to 11 wherein the seal means comprises a ring having a radial slit which allows the seal to be positioned appropriately around the cable relative to the camera.

14. A valve according to any one of the preceding claims further comprising seal means positioned between each outer ring and the respective inner ring, and between the first and second outer rings.

15. A valve as claimed in claim 14 wherein the further seal means comprises resiliently formable outer rings.

16. A valve according to claims 14 and 15 wherein each outer ring has a radially inner surface which tapers axially such that the inner diameter of each outer ring increases axially inwardly, and each corresponding ring portion has a

radially outer surface which tapers axially such that the ring portion may be positioned in tight face to face contact with the corresponding outer ring.

17. A pipe branch for allowing a length of cable entry to and exit from a fluid carrying pipe line, the pipe branch comprising:

a pipe comprising a first end sealably connected to the pipe line in a fluid type manner and a second end remote from the pipe line;

a first valve positioned towards the first end;

a second valve spaced apart from the first valve and positioned towards the second end; and

a third valve positioned between the first and second valve,

characterised in that the third valve comprises;

a housing having a central bore through which the cable may pass extending axially through the housing and having an axially inner and radially enlarged inner bore portion;

radially inwardly resiliently deformable seal means positioned in the inner bore portion of the housing defining a radially inner chamber of the inner bore portion through which the cable may pass and a radially outer chamber of the inner bore portion; and

pressure means for introducing a fluid into the radially outer chamber to pressurise the outer chamber,

whereby the seal means deforms radially inwardly to form a fluid type seal around the cable, the housing being capable of withstanding the pressure in the chamber.

18. A pipe branch according to claim 17 comprising a valve according to any one of claims 1 to 16.

19. A valve substantially as hereinbefore described with reference to the accompanying drawings.

20. A pipe branch substantially as hereinbefore described with reference to the accompanying drawings.

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