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Fig. 1A

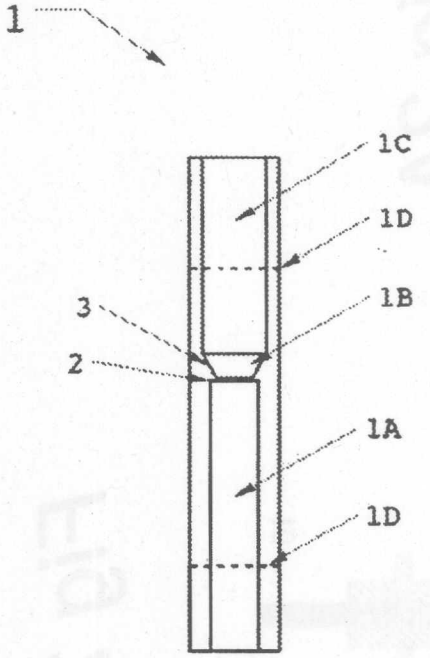


Fig. 1B

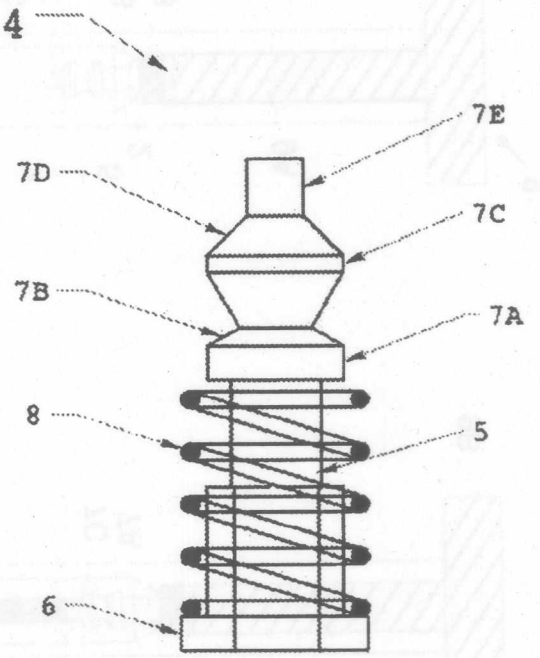
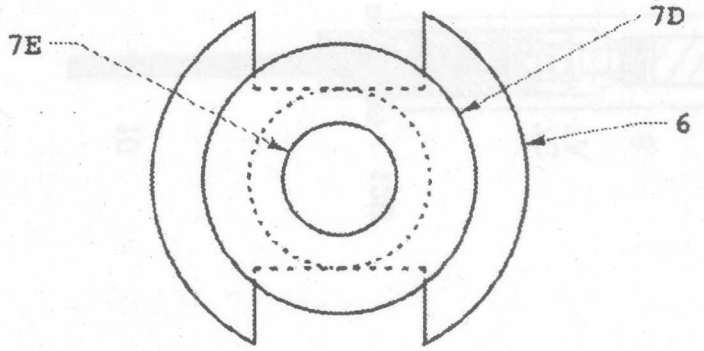


Fig. 1C



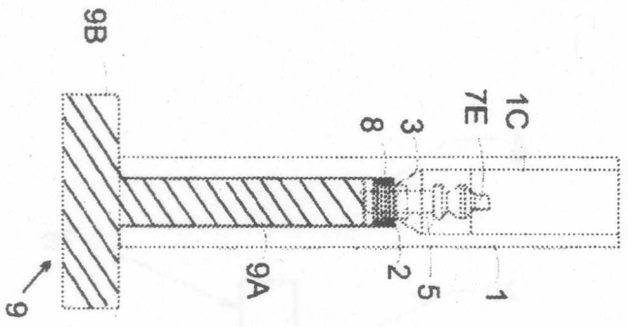


Fig 2A

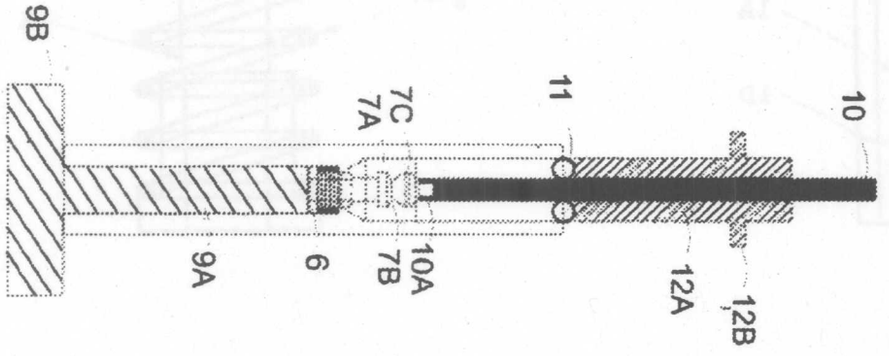


Fig 2B

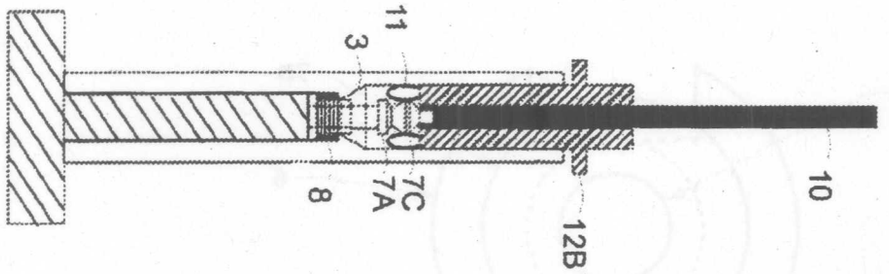
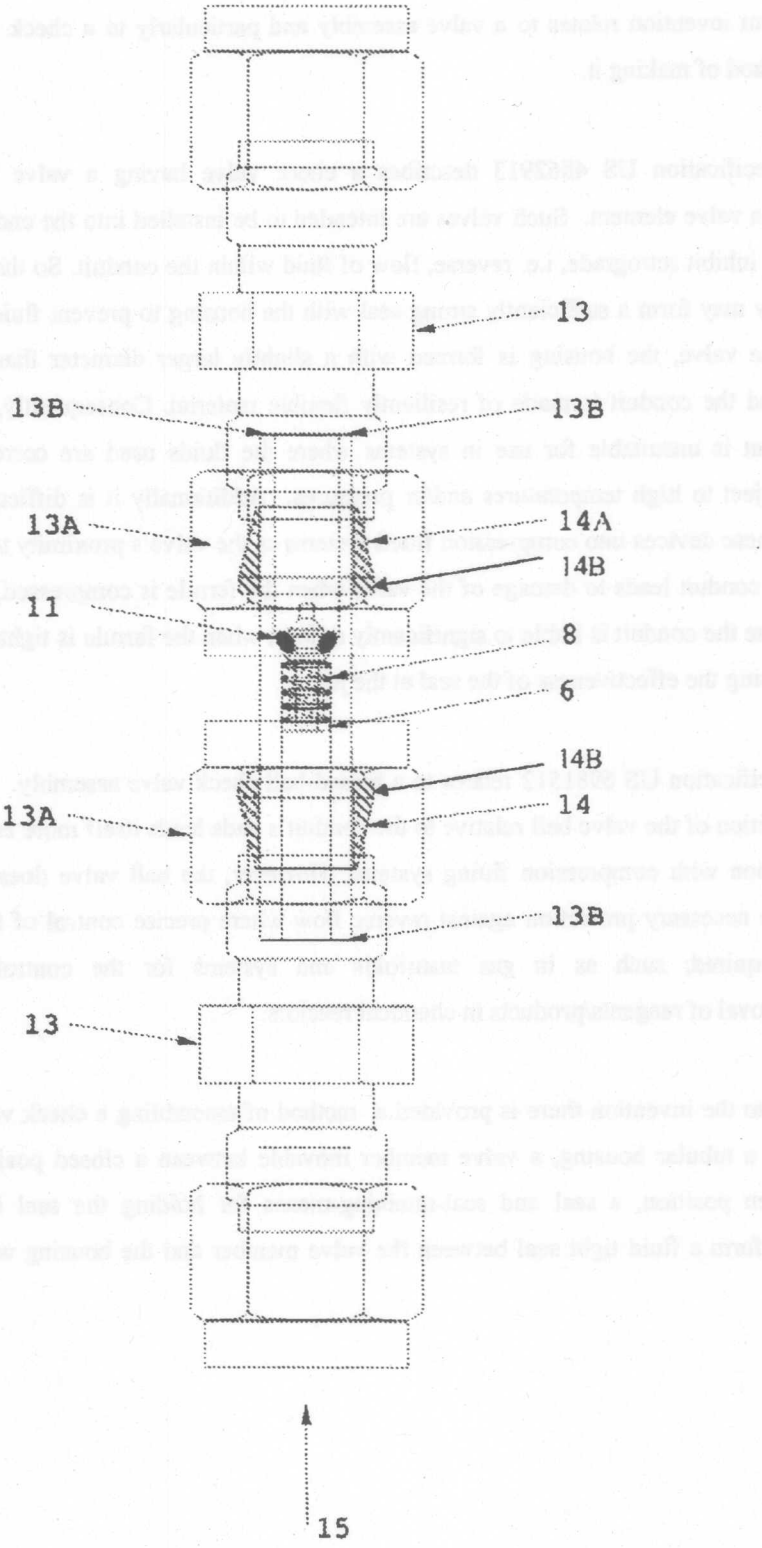


Fig 2C

Fig. 3



A Valve Assembly

The present invention relates to a valve assembly and particularly to a check valve and a method of making it.

Patent specification US 4862913 describes a check valve having a valve body confining a valve element. Such valves are intended to be installed into the end of a conduit to inhibit retrograde, i.e. reverse, flow of fluid within the conduit. So that the valve body may form a sufficiently strong seal with the housing to prevent fluid by-passing the valve, the housing is formed with a slightly larger diameter than the conduit and the conduit is made of resiliently flexible material. Consequently, this arrangement is unsuitable for use in systems where the fluids used are corrosive and/or subject to high temperatures and/or pressures. Additionally it is difficult to integrate these devices into compression fitted systems as the valve's proximity to the end of the conduit leads to damage of the valve when the ferrule is compressed, and also because the conduit is liable to significantly deform when the ferrule is tightened compromising the effectiveness of the seal at the joint.

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Patent specification US 6981512 relates to a biased-ball check valve assembly. The central position of the valve ball relative to the conduit's ends lends itself more easily for adaptation with compression fitting systems. However, the ball valve does not provide the necessary protection against reverse flow where precise control of fluid flow is required, such as in gas manifolds and systems for the control of supply/removal of reagents/products in chemical reactors.

According to the invention there is provided a method of assembling a check valve comprising a tubular housing, a valve member movable between a closed position and an open position, a seal and seal-retaining-means for holding the seal in a position to form a fluid tight seal between the valve member and the housing when

the valve member is in the closed position, and a means to bias the valve member towards the closed position; the method comprising the steps of:

a) locating the valve member and means to bias the valve member within the tube;

b) using a guide to guide the seal into a position where it is retained by the seal-retaining means; and

c) removing the guide.

The invention enables the valve to be assembled at any position along a conduit thereby allowing the conduit to be easily joined to part of a larger system by one or more compression fittings without causing damage to the valve components. Additionally, the invention enables the conduit to act as the housing of the valve thereby reducing the number of components and cost for manufacture and hence in a preferred embodiment, the tubular housing is integral with the conduit which has ends adapted to be inserted into a pipe fitting.

For the purposes of this specification the terms tube and tubular include hollow longitudinal members having circular, variable or other cross sections.

In a preferred embodiment the seal, which may of an O-ring type variety, is passed over the guide and rolled/slid or otherwise moved along the guide into the tube. To hold the guide and valve member in axial alignment it is preferable that the guide be adapted to fit onto or into the valve member to ensure that the seal is guided accurately into position. This may be achieved by providing the valve member with a spigot or other protrusion and providing the guide with a suitably sized recess for receiving the protrusion. This can also assist in guiding the seal off the guide and onto the valve member.

A tool may be used to aid movement of the seal member along the guide. Preferably the tool is shaped so as to pass substantially around and slide over the guide which itself may be rod like in form.

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To guard against the seal member being pushed by the tool beyond the desired position, the tool may be provided with a limiter arranged to engage the tube once the tool has pushed the seal member sufficiently far along the tube.

A support may be used to support the valve member in the tube whilst the seal member is being positioned. Preferably the support is used to hold the valve member in the open position.

The invention will now be described by way of example with reference to the following figures in which:

Figure 1A is a cross sectional side elevation of a tube for holding a valve member

Figure 1B is a side elevation of a poppet and spring adapted to reside in the tube;

Figure 1C is a top elevation of the poppet;

Figures 2A, 2B and 2C are partial cross section views showing stages of assembly of a check valve; and

Figure 3 is a partial cross-section transparency of the assembled check valve in a closed position connected at either end to compression fittings.

Figs 1A, 1B and 1C illustrates a tubular conduit 1 made from a single piece of metal such as stainless steel having a substantially uniform outer diameter. The tube bore has a first portion 1A extending from an inlet of the tube at the bottom end as shown on Fig 1A. The first portion 1A ends at a radial step 2 defining an opening of reduced diameter as compared with the conduit portion 1A. This opening communicates with a second bore portion 1B having a widening diameter so as to define a conical valve seat 3. The second portion 1B leads into a third bore portion 1C having a diameter greater than that of the first portion 1A. The third portion 1C of the bore leads to an outlet at the top of the tube as shown on Fig 1.

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The first and third portions 1A, 1C extend sufficiently far from the step 2 and seat 3 respectively so to allow end parts of the tube as indicated by broken lines 1D to be inserted into a compression fitting.

The various diameters of the bore and seat/step features can be formed by machining out a solid metal rod.

Referring to Figs 1B and 1C there is shown a poppet 4. The poppet 4 has a flange 6 and a head 7 at opposite ends of a stem 5. The head 7 includes an enlarged part 7A, an intermediate part 7C and spigot 7E. Between parts 7A and 7C lies a groove 7B formed by approaching conical shoulders which acts as a retainer for an O-ring seal (not shown in Figs 1). On the other side of the part 7C, a tapered part 7D leads into the spigot 7E. A helical spring 8 sits over the stem 5 and against the flange 6.

During assembly of the valve as illustrated in Figs 2A, 2B and 2C, the poppet 4 is placed head first into the inlet of the conduit 1 and moved to position such that the spring 8 is held and compressed between the flange 6 and step 2 with the head 7 protruding past the seat 3 and into the third portion 1C as shown in Fig 2A. The maximum diameter of the head is marginally smaller than the opening of the valve seat 2 so that it can pass through the latter during assembly.

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The poppet is moved to and maintained in this position with the aid of backstop 9. The backstop 9 comprises a shaft portion 9A having a diameter similar to that of the flange 6 so as to provide good support for the poppet 4, and a stop 9B spaced from the free end of the shaft 9A such that the stop 9B abuts against the end of the conduit 1 when the poppet 4 is in the required location. The position is as shown in Fig 2A

Whilst the poppet 4 is held in this position, a guide rod 10 is inserted into the outlet of the tube 1. A recess 10A in the end of the guide rod 10 receives the spigot 7E so as to hold the guide rod in axial alignment with the poppet. An O-ring seal 11 formed from resiliently flexible plastics material is located over the free end of the guide rod 10.

The position is now as shown in Fig 2B. Using a tool 12, the O-ring is pushed along the guide rod 10 onto the head 7. It is then stretched by the action of the tool 12, over the intermediary portion as shown in Fig 2C, and retained in groove 7B. The insertion tool 12 has a shaft 12A with a bore which allows the shaft 12A to be passed with a sliding fit over guide 10 and into portion 1C behind the O-ring 11.

To prevent the tool 12 from accidentally pushing the O-ring beyond the groove 7B and onto the enlarged portion 7A or stem 5, the tool 12 is provided with a limiter 12B which is located at a position spaced from the free end of the shaft 12A such as to engage with the end of the conduit 1 when the O-ring is between the shoulders 7B. With the O-ring 11 now in place, the tool 12, guide 10 and back stop 9 are removed from the tube 1 allowing the spring 8 to extend causing the head 7 to move into the portion 1B and the O-ring 11 to be compressed between the shoulders of the groove 7B and seat 3 effecting a fluid tight seal and preventing the valve head 7 from passing back through the opening in the valve seat 3.

It will be understood that, for the limiter 12A and stop 9B to perform their functions, the length of the shafts 9A, 12A and positions of the stops 9B 12B must be selected corresponding to the length of the conduit 1, poppet 4 and relative position of the seat 2 within the conduit 1.

In Fig 3 the conduit 1 with assembled valve is shown connected to compression fittings 13. Compression nuts 13A and two part ferrules each comprising a front ferrule 14A and back ferrule/olive 14B (though a single part ferrule may equally be used) are passed over each end of the tube 1. The first and second ends are inserted into the fitting 13 so as to abut against seats 13B and then the compression nuts are tightened about the tube such that the front ferrule 14A deforms and crimps the tube causing a fluid tight seal and slight deformation of the tube. The deformation is not visible in the figure but it can be seen that the first and third portions 1A, 1C are sufficiently long that that the ferrules can be tightened about their ends without causing deformation in the region of the poppet 4 or O-ring 11.

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In use, pressure from fluid flow from the inlet, indicated by arrow 15 urges the poppet 4 to move in the direction of fluid flow, compressing the spring 8 and opening the valve. When fluid flow from the inlet subsides, the spring will causes the O-ring 11 to re-engage with the seat 3 re-effecting the seal.

In an alternative embodiment, the conduits could also be joined by other means such as push fit fittings and solder joints. In the latter case, the distance of the poppet 4 from the ends of the conduit may reduce any damage that could be caused to the components from the application of heat used to solder the joint.

It is believed that the illustrated embodiment provides a check valve suitable for situations where it is required to provide a high reliability seal against reverse flow even in systems where the fluids used are corrosive and at high temperatures and pressures. Furthermore, the valve can be connected into a system using conventional compression fittings using standard compression fittings and occupies no more space than a plain straight length of pipe work. However, it is emphasised that the illustrated embodiment has been described only by way of example and that many variations are possible within the scope of the accompanying Claims. For example, although it is preferred that the features of the inside of the tube, including the seat and shoulder, are defined by the conduit wall, it is possible that the above described method could be used to assemble an alternative embodiment where said features are provided by an insert. In a further alternative the guide may be provided with a spigot or other protrusion and the valve member be provided with a recess instead of the reverse arrangement described. In another variation, the seal may be adapted to be held on the fixed valve housing rather than the movable valve stem. In such an arrangement, a tool, equivalent to the tool 12 would be used to manipulate the seal into its operational position where it is retained on the valve housing, seals against the valve member, and prevents withdrawal thereof during operation.

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Claims

1. A method of assembling a check valve comprising a tubular housing, a valve member movable between a closed position and an open position, a seal and seal-retaining-means for holding the seal in a position to form a fluid tight seal between the valve member and the housing when the valve member is in the closed position, and a means to bias the valve member towards the closed position; the method comprising the steps of:

a) locating the valve member and means to bias the valve member within the tube;

b) using a guide to guide the seal into a position where it is retained by the seal-retaining means; and

c) removing the guide.

2. A method according to claim 1 wherein the seal is passed over and guided along the guide.

3. A method according claim 2 wherein the seal is guided into a recess between shoulders on the valve member.

4. A method according to any previous claim wherein the guide is a guide rod.

5. A method according to any previous claim wherein the guide is held in axial alignment relative to the valve member;

6. A method according to claim 5 wherein the guide is located onto the valve member preferably by means of a spigot which locates within a recess of corresponding size.

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7. A method according to any previous claim wherein a tool is used to push the seal along the guide and into position.

8. A method according to claim 7 wherein the tool passes substantially around and slides over the guide.

9 A method according to claims 8 or 9 wherein the tool is provided with a limiter to prevent the seal member from being pushed beyond the position.

10. A method according to claim 9 wherein the limiter engages with the tube in order to prevent further insertion of the tool.

11. A method according to any previous claim wherein a stop is used to support the valve member in position within the tube whilst the seal is being guided into position.

12. A method according to any previous claim wherein the valve member is inserted into a tubular housing via a first end and held in the open position; the guide is inserted into a second end of the tube and the seal guided into position via the second end.

13. A method according to any previous claim wherein at least one end of the housing is adapted to be inserted into a compression fitting.

14. A valve constructed in accordance with the method of any of Claims 1 to 13.

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