



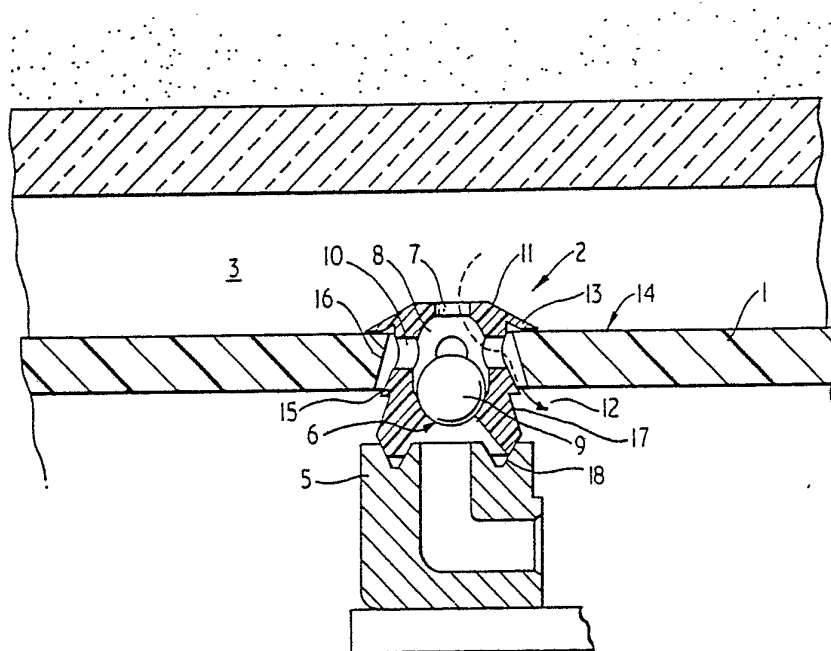
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(54) Title: MÉTHOD AND APPARATUS FOR GROUTING BETWEEN PIPES

(57) Abstract

A method of grouting between pipes, for example between an existing sewer pipe (4) and a coaxial inner lining pipe, (1) comprises providing a number of grouting holes (16) in the wall of the inner pipe, fitting valves (2) into the holes, and injecting liquid grouting material through each hole in turn by means of a remotely controlled machine situated inside the inner pipe. Each valve is a two-way valve in that it is shaped to be housed in its respective hole in at least two alternative positions. Initially each valve is fitted in a first venting position so that when grouting material is injected through a neighbouring valve the operator can determine when the intervening annular space between the pipes has been filled by observing the venting of grouting material through the former valve using for example a remotely controlled TV camera. In a second position of the valve, to which it can be pushed by the grouting machine, the valve acts as a non-return valve to prevent the reverse flow of grouting material while it is still liquid. Also disclosed is a device (27) for plugging the annula space at lateral branching locations.



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METHOD AND APPARATUS FOR GROUTING BETWEEN PIPES

This invention relates to a method of introducing grout between an outer pipe and an inner, lining pipe, and to apparatus for use in the said method. The invention is particularly applicable to grouting between
5 and existing sewer pipe and a smaller diameter, plastics slip-lining pipe which has been placed inside the sewer to repair it when the diameter of the sewer pipe is too small to permit human access.

It is known to introduce a liquid or foaming
10 grouting material between an existing sewer pipe and a newly fitted plastics slip-lining pipe by feeding the material under pressure into the annular space between the pipes at an external access point where for example a section of the outer sewer pipe has been removed.
15 It is possible to inject grout material up to 900 metres from the break in the pipe, but often it is difficult to determine whether air gaps remain in the annular space. A further problem arises at locations where branching pipes are connected to the pipe in consideration, in that the grouting material must be prevented
20 from leaking into the branch or into the inner slip-lining.

It is an object of this invention to provide a more reliable method of grouting.

25 According to one aspect of this invention a method of introducing grouting material into the space between an outer pipe and an inner lining pipe comprises the steps of: (i) providing a plurality of grouting holes in the inner pipe at longitudinally spaced locations;
30 (ii) injecting liquid grouting material by remote



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control into the space from the interior of the inner pipe through a first one of the grouting holes at least until the escape of grouting material from a neighbouring hole is detected; (iii) blocking the first hole to prevent the material flowing back into the inner pipe; and (iv) repeating steps (ii) and (iii) at subsequent grouting holes until a required length of piping has been grouted.

Detection of the escaping grouting material from a hole ahead of the injection point may be performed by remote observation with a closed circuit TV camera inside the inner pipe. In this way, an operator can check that the length of piping between the injection point and the observed hole has been substantially filled with grouting material before moving on to the next hole. The open holes also allow air to escape ahead of the grouting material. Thus, a relatively long stretch of sewer piping can be reliably grouted with comparatively few excavated access points.

For convenience, it is preferable to fit each grouting hole initially with a two-way valve which can act either as a vent for the escaping grouting material or as a non-return valve to prevent reverse flow of the material from the hole through which it was injected or from previous holes.

Thus according to a second aspect of the invention a grouting valve for insertion in an aperture in a pipe wall comprises a hollow body having an inlet at one end and an outlet at the other end, the inlet communicating with the outlet via an internal connecting passage, and a movable blocking member for blocking



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the passage so as to prevent the flow of liquid grouting material from the outlet to the inlet but allowing the flow of liquid grouting material in the opposite direction, wherein the body further includes:-

5 means for locating the valve in an aperture in at least two alternative positions; and

a side opening positioned relative to the locating means so that in a first venting position of the valve the opening is exposed to the interior of the pipe to
10 allow inward flow of liquid from outside the pipe through the opening to the interior, and so that in a second grout injection position the said opening is shut off by the pipe wall whereby the valve acts as a non-return valve preventing the said inward flow of
15 liquid.

The valve may be moulded from flexible plastics material, the locating means comprising flexible ribs or lips on the sides of the valve body so that the valve can be 'snap' located by pushing the valve body from
20 within the inner pipe. Prior to grouting a length of piping several valves may be fitted, all in their first venting position. When grouting material is to be injected through one of the valves, the valve is pushed into its second position, preferably by the
25 same remotely-controlled machine that is used to inject the grouting material. The machine would proceed in this manner along the inner pipe, pushing each valve into its second position and injecting grouting material until venting is detected at the next hole.

30 In cases where the inner pipe is of a considerably



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smaller diameter than the existing sewer pipe, there may be a tendency for the inner pipe to float upwards during grouting, leading to possible distortion and damage of the inner pipe. One embodiment of valve in accordance with the invention has an elongate body with locating lips positioned so that the valve projects from the exterior surface of the inner pipe and acts as a stand-off spacer which bears against the existing sewer pipe during and after grouting. Alternatively, separate plain spacers may be fitted in additional holes in the inner pipe.

To realise the full benefits of this section-by-section remote grouting process, it is preferable temporarily to seal off the annular space between the pipes at branching locations. According to a third aspect of the invention there is provided a plug device which fits into an aperture cut in the inner pipe in registry with a branch pipe, the device comprising a flange for locating the device against the interior surface of the inner pipe, and an inflatable sealing member attached to the flange which, when inflated, extends outwardly from the flange for engaging the perimeter of the branch pipe opening. Once inflated, the device is self-supporting so that machinery used to fit it in the aperture can be withdrawn from the pipe. The flange lies on the inside of the inner pipe, leaving the interior of the pipe largely unobstructed to permit the passage of travelling sledges or trolleys. To avoid the build up of waste in the branch pipe, the seal member may take the form of an inflatable ring or



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toroid, with a corresponding opening being provided in the flange.

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

5 Figure 1 is sectional side view of a grouting valve fitted in a pipe wall;

Figure 2 is a partly sectioned side view of an elongate grouting valve;

10 Figure 3 is sectional side views of a plain spacer;

Figure 4 is a sectional side view of a first plug device in position at a branch location; and

Figure 5 is a sectional side view of a second plug device having a central opening.

15 Referring to Figure 1, in the preferred method of the invention, grouting holes in an inner lining pipe 1 are each fitted with a plastics valve 2 so that the annular space 3 between the inner pipe 1 and an existing sewer outer pipe 4 can be filled with grouting material through the valve 2 from a grout supply nozzle 5. The grout supply nozzle 5 is attached to a remotely controllable carriage (not shown) which travels inside the inner pipe 1 and carries means for moving the nozzle into engagement with the valve, both to push
20 it from its first venting position (as shown) into its second injection position and to inject liquid grouting material through the valve 2 into the space 3.

25 The valve has an inlet end with an inlet opening 6, and an outlet end with an outlet opening 7. A
30 passage 8 connects the inlet and outlet openings, and



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a ball 9 is situated in the passage to prevent liquid from flowing back through the inlet opening 6. Side openings 10 are formed in the side wall of the valve body 11 to allow the reverse flow of grouting material out of the annular space 3 when the valve is in its first venting position as shown by the arrow 12. Thus in its venting position the valve allows the escape of grouting material so that the operator can judge when the annular space 3 is filled between the venting valve and a neighbouring valve when grouting material is being injected. In the venting position, the valve is located by a first projecting flexible lip 13, which snaps out to engage the exterior surface 14 of the pipe 1 when the valve is first fitted.

When grouting material is to be injected through the valve 2, the valve is pushed outwardly to a second, injection position in which a second, relatively stiff lip 15 engages the exterior surface 14 of the pipe. Now the side openings 10 are no longer in communication with the interior of the inner pipe 1 and the valve acts as a non-return valve, the ball 9 preventing any reverse flow when the supply nozzle is removed. The hole 16 in the lining pipe 1 is preferably slightly conical to improve the flow of grout from the side openings 10 when the valve is in its first position, and to prevent the valve from being pushed completely through the hole 16, the sides of the hole 16 engaging a corresponding conical surface 17 on the valve body.

The valve body 11 is tapered at the inlet end to assist location of the supply nozzle 5, which has a



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corresponding concave conical surface 18 arranged to contract the inlet end of the body 11 to assist insertion of the valve to its second position.

5 The grout supply nozzle 5 may include a pressure-sensitive valve or remotely controlled shut-off valve to prevent spillage when the nozzle is removed from the valve.

Referring to Figure 2, flotation of the inner pipe 1 may be prevented by an elongated valve 2A. As before
10 the valve is capable of being fitted into a hole 16 in more than one position so that it can act firstly as a vent for observing the extent to which grout has penetrated along the annular space 3, from an adjacent supply point, and secondly as a non-return
15 supply valve. In this embodiment several locating lips 15A, 15B and 15C are provided to vary the extent to which the valve body projects into the annular space in the injection position of the valve depending on the distance between inner lining pipe and the
20 existing sewer pipe. Side openings 10 in the sides of the valve body communicate with the lining pipe interior when the valve is in its first position (defined by lip 13) so that grout can vent to the lining pipe interior as shown by the dotted arrows 12.
25 When the valve is pushed home to any of the injection positions the openings 10 act as an additional supply outlet in the same manner as the outlet opening 7.

The length of the valve may be chosen to suit the spacing between the lining pipe 2 and the existing
30 sewer pipe 3. In addition, the configuration of the



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openings 10 may be varied, or additional lips provided to cater for larger spacings.

When separate means of preventing flotation are required, plain spacers such as that shown in Figure 3 may be inserted into the lining pipe 1. This spacer 20 has no grouting passage or valve, its upper end being closed. A number of flexible lips 21 allow the spacer to be inserted from inside the lining pipe 1 to any of a number of positions depending on the spacing required. Plain spacers of this kind may be fitted not only in the upper wall of the lining pipe 1, but also in the sides or bottom at circumferentially spaced positions to provide positive all-round location of the lining pipe concentrically with the existing sewer.

To seal off the annular space 3 at branch connections a plug device is inserted in an aperture 25 cut in the wall of the inner pipe 1 in registry with the branch pipe 26. A seal member in the form of an inflatable bag 27 is attached to a part-cylindrical flange plate 28 which engages the inner surface 29 of the inner pipe 1. The plate 28 is preferably a laminate of steel and rubber with the bag 27 being integral with an outer rubber layer 30. The plate 28 has a releasable fixing such as a bracket 31 for engaging a support member on a remotely controlled travelling sledge (not shown). A nozzle 32 is provided for inflating the bag 27. This may be fitted in the plate 28 as shown, or may be arranged to connect with a releasable fitting attached to the travelling sledge. In the latter case the nozzle



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may incorporate a non-return valve to prevent escape of air from the bag when the air supply and sledge are withdrawn. The bag 27 is shown in its uninflated (dotted lines) and inflated (solid lines) positions.

5 It will be seen that both the annular space 3 and the branch 26 are blocked by the inflated bag. Liquid grout injected into the annular space 3 thus flows around the branch opening substantially without leakage, allowing uninterrupted grouting of the main
10 sewer.

When the grout has hardened, the bag 27 is deflated and withdrawn from the pipe 1. A release agent may be applied to the outside of the bag 27 if necessary.

15 Where there exists the possibility of liquid accumulating in the branch 26 the seal member may take the form of a hollow toroid as shown in section in Figure 5. To allow liquid to drain from the branch 26 into the pipe 1 an aperture 34 is cut in the
20 supporting flange plate 28 concentrically with the toroidal bag 33. The bag 33 is shown in Figure 5 in its inflated position with its outer wall blocking the annular space 9. In this embodiment, as in the Figure 4 embodiment, the interior of the bag 33 is
25 inflated via a supply nozzle 32 fitted in the plate 28. A valve 35 may be provided as shown so that the air supply used for inflation can be removed once the plug device, comprising bag 33 and plate 28, has been positioned and inflated. The nozzle 32 may also
30 double as a support member whereby the plug can be



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coupled to a remotely controlled trolley or sledge for carrying the plug device to the required location.

The seal member 33 is so shaped and so positioned on the plate 28 that it inflates upwardly, away from the plate as shown, the inner wall of the toroid being somewhat thicker and stiffer than the outer wall to preserve the central opening as the outer wall moulds itself to the pipe edges. A secondary advantage of this construction is that the bag, prior to inflation, can be pushed down through the aperture 34, to minimise its projection from the outer surface of the plate 28, thus reducing the chance of it catching on obstructions as it is carried along the pipe 1. Once the plate 28 is in position and inflation is commenced, the bag 33 automatically pops through the aperture 34 into the hole 25 in the pipe 1.



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CLAIMS

1. A method of introducing grouting material into the space between an outer pipe and an inner, lining pipe comprising the steps of:-
- 5 i) providing a plurality of grouting holes in the inner pipe at longitudinally spaced locations;
- ii) injecting liquid grouting material by remote control into the space from the interior of the inner pipe through a first one of the grouting
- 10 holes at least until the escape of grouting material from a neighbouring hole is detected;
- iii) blocking the first hole to prevent the material flowing back into the inner pipe; and
- iv) repeating steps (ii) and (iii) at subsequent
- 15 grouting holes until a required length of piping has been grouted.
2. A method according to claim 1, wherein each grouting hole is provided with a non-return valve which allows the grouting material to be injected into
- 20 the space from inside the inner pipe, but which prevents the flow of the material in the reverse direction.
3. A method according to claim 2, wherein, prior to grouting a length of piping, each hole is fitted with a non-return valve having first and second mounting
- 25 positions, the first position allowing the reverse flow of grouting material from the space to the interior of the inner pipe, and the second position allowing the said injection of grouting material but preventing the said reverse flow, and wherein the valves are
- 30 initially fitted in the first position and are



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subsequently moved into the second position one by one when grouting material is to be injected through each respective valve.

4. A method according to claim 3, including:-

- 5 providing a remotely controlled carriage having a grout supply nozzle;
 positioning the carriage at the first grouting hole;
 moving the nozzle into engagement with the
10 valve fitted in the hole and pushing the valve outwardly to move it from the first position to the second position;
 injecting grouting material through the valve at least until the escape of grouting material at the next subsequent hole is observed;
- 15 withdrawing the nozzle from the valve, leaving the valve in its second position; and
 moving the carriage to the next grouting hole and subsequent holes and repeating the above moving, injecting and withdrawing steps at each hole in turn.

- 20 5. A method according to claim 1 in which prior to grouting, the space between the pipes is sealed off at each lateral branch by remotely fitting an inflatable plug in an aperture cut in the inner pipe in registry with the lateral branch, the plug comprising a flange
25 for engaging the interior surface of the inner pipe adjacent the perimeter of the aperture and an inflatable seal attached to the flange, wherein the plug is fitted by positioning the flange against the interior surface of the inner pipe using a remotely controlled travelling
30 carriage inflating the seal so that it engages the



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outer pipe at its junction with the branch, and withdrawing the carriage, leaving the inflated plug in position with the adjacent inner pipe interior substantially unobstructed.

- 5 6. A grouting system for introducing grouting material into the space between an outer pipe and an inner, lining pipe, the system including:-

a plurality of valves shaped to be fitted in grouting holes produced at longitudinally spaced locations in the
10 wall of the inner pipe;

a remotely controlled carriage having a movable grout supply nozzle;

means for supplying liquid grouting material under pressure to the nozzle;

15 means for drawing the carriage through the inner pipe so that the nozzle can be positioned adjacent each valve in turn;

means for lifting the nozzle into engagement with the said each valve so that grouting material can be
20 injected through the valve into the space between the pipes;

and a remotely controlled television camera for monitoring manipulation of the nozzle and for observing the escape of grouting material from the next grouting
25 hole.

7. A system according to claim 6 further including:-

a plurality of plugs for sealing off the said space at lateral branches, each plug comprising a flange for engaging the wall of the inner pipe around the perimeter
30 of an aperture cut in the inner pipe in registry with



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the branch and an inflatable seal attached to the flange for extending through the aperture to engage the outer pipe at its junction with the branch;

means for remotely transporting each plug through
5 the inner pipe to a respective branch and positioning it over the respective aperture;

means for inflating each plug so that the plug is self-supporting and so that the transporting means can be withdrawn.

10 8. A grouting valve for insertion in an aperture in a pipe wall, the valve comprising a hollow body having an inlet at one end and an outlet at the other end, the inlet communicating with the outlet via an internal connecting passage, and a movable blocking member for
15 blocking the passage so as to prevent the flow of liquid grouting material from the outlet to the inlet but allowing the flow of liquid grouting material in the opposite direction, wherein the body further includes:-

means for locating the valve in an aperture in at
20 least two alternative positions; and

a side opening positioned relative to the locating means so that in a first, venting position of the valve the opening is exposed to the interior of the pipe to allow inward flow of liquid from outside the pipe
25 through the opening to the interior, and so that in a second, grout injection position the said opening is shut off by the pipe wall whereby the valve acts as a non-return valve preventing the said inward flow of liquid.

30 9. A valve according to claim 8, wherein the locating



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means comprises flexible lips projecting from the side of the body for providing snap location of the body in the aperture by engagement with the exterior surface of the pipe wall.

- 5 10. A valve according to claim 9 having at least three flexible locating lips at spaced positions on the body between the inlet end and the outlet end, a first lip defining the venting position, a second lip defining a first injection position, and an additional lip or
- 10 lips defining one or more additional injection positions, whereby the distance by which the valve projects outside the pipe wall in the injection position can be varied to space the pipe wall from a neighbouring surface by a predetermined distance.
- 15 11. A valve according to claim 8, wherein the side opening communicates directly with the internal connecting passage.
12. A valve according to claim 8, wherein the blocking member is a ball which co-operates with a valve seat
- 20 formed in the wall of the internal passage.
13. A plug device for sealing the annular space between two generally coaxial pipes at a branch pipe opening where a branch pipe joins the outer of the two pipes and where an aperture has been cut in the inner pipe
- 25 in registry with the branch pipe, the device comprising a flange for locating the device against the interior surface of the inner pipe, and an inflatable sealing member attached to the flange which, when inflated, extends outwardly from the flange for engaging the
- 30 perimeter of the branch pipe opening.



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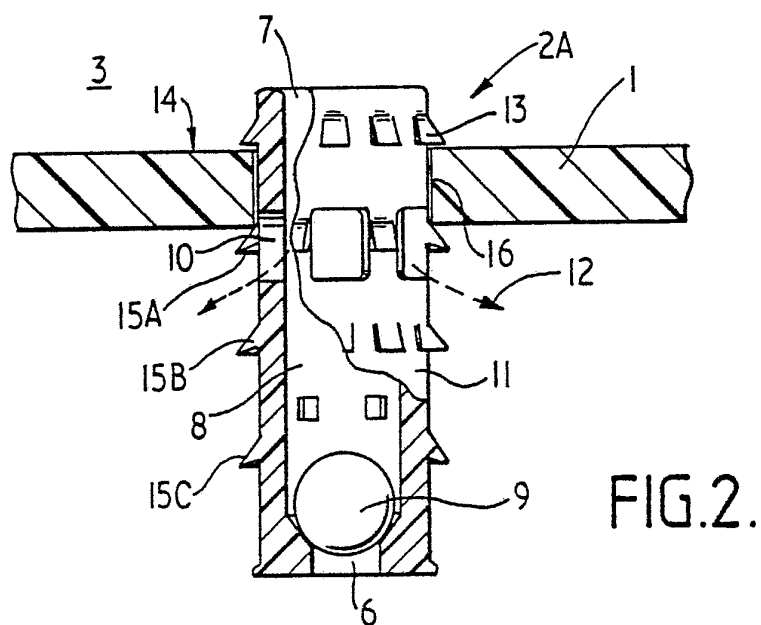
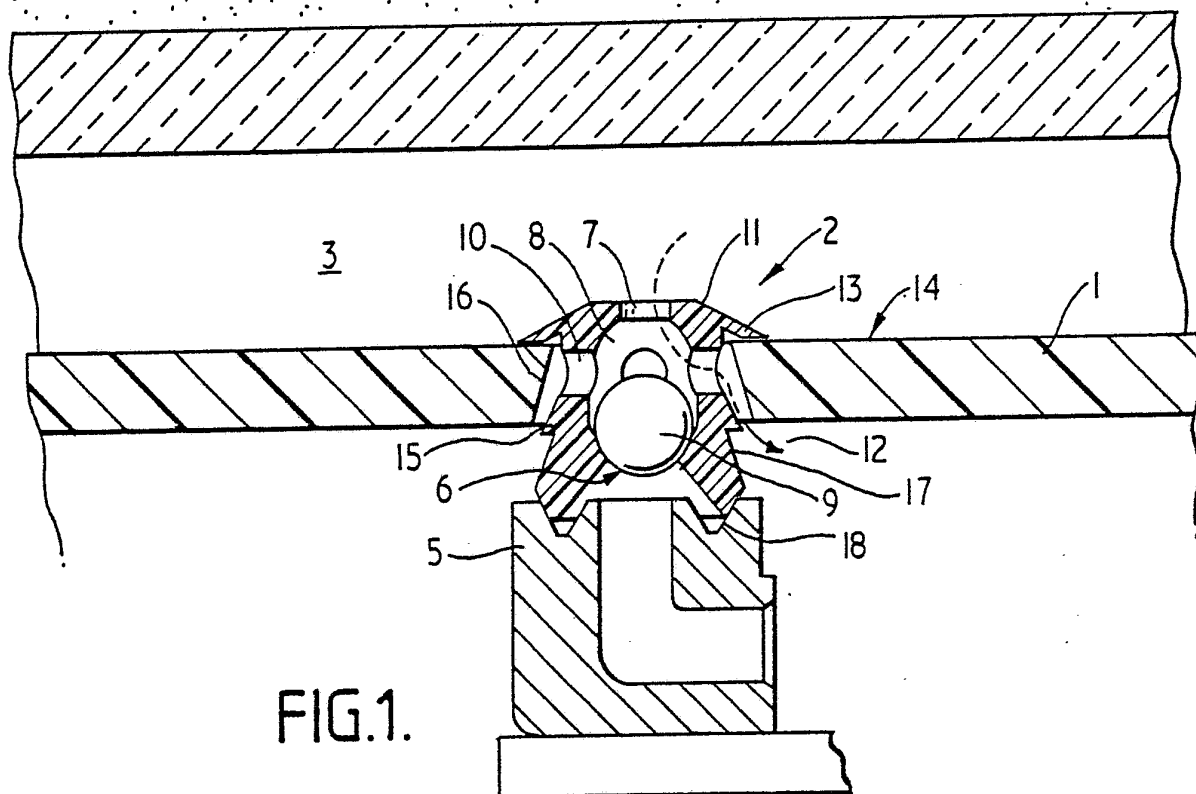
14. A plug device according to claim 13, wherein the seal member is in the form of a hollow toroid.

15. A plug device according to claim 13 including a valve for preventing the escape of fluid from the seal member when inflated.

16. A plug device according to claim 13, wherein the flange is in the form of a part cylindrical plate having a radius of curvature corresponding approximately to the internal radius of the inner pipe.



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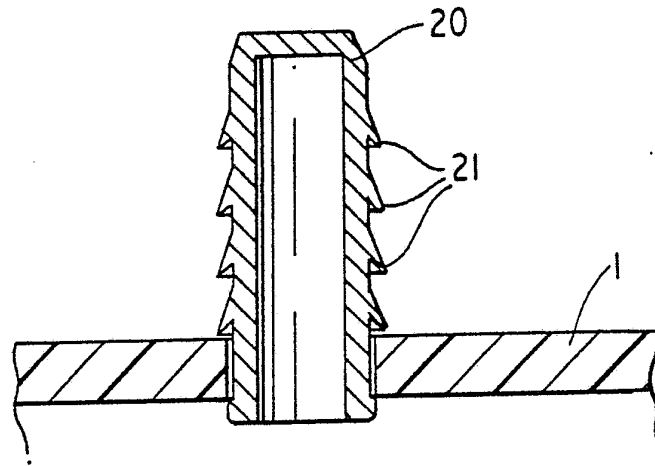


Fig.3.

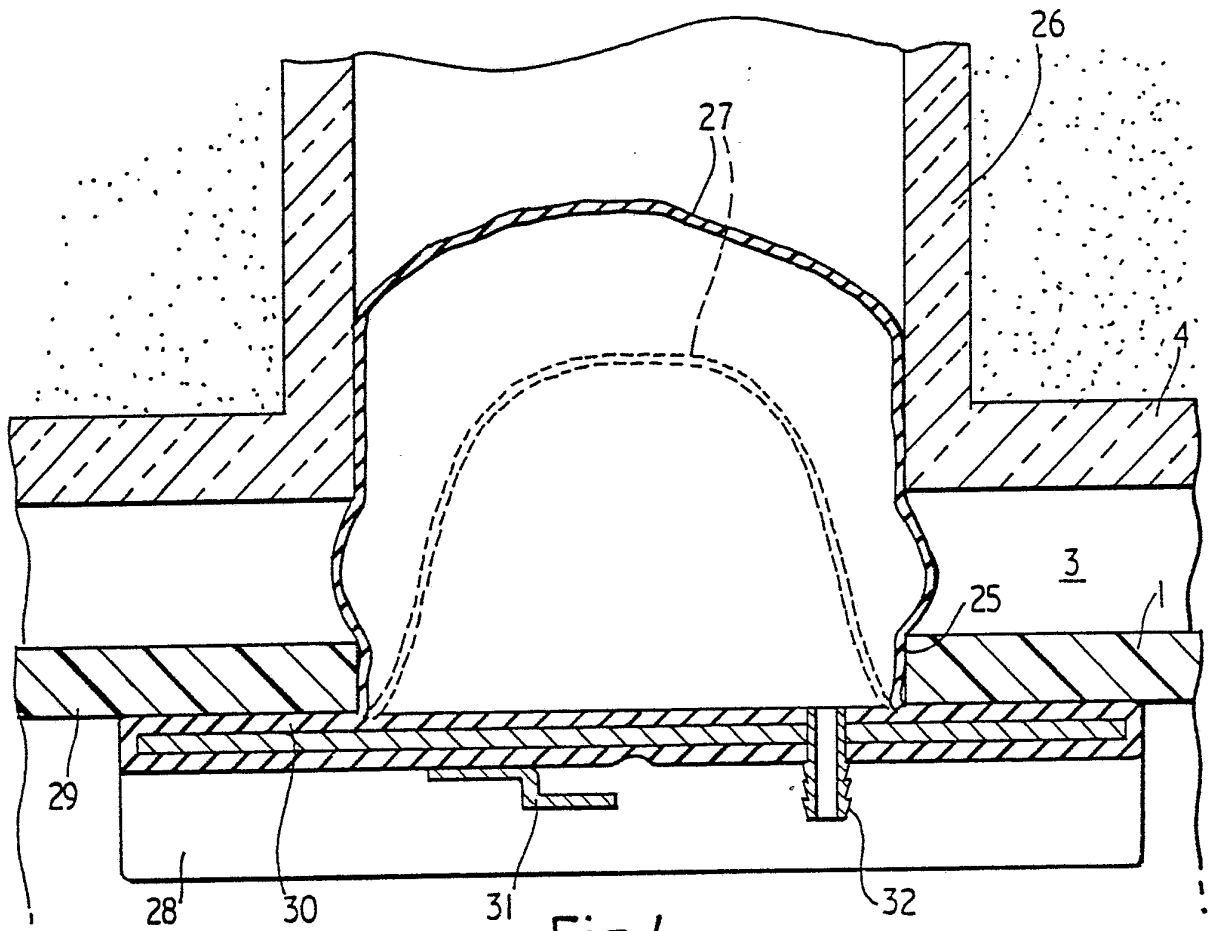


Fig.4.

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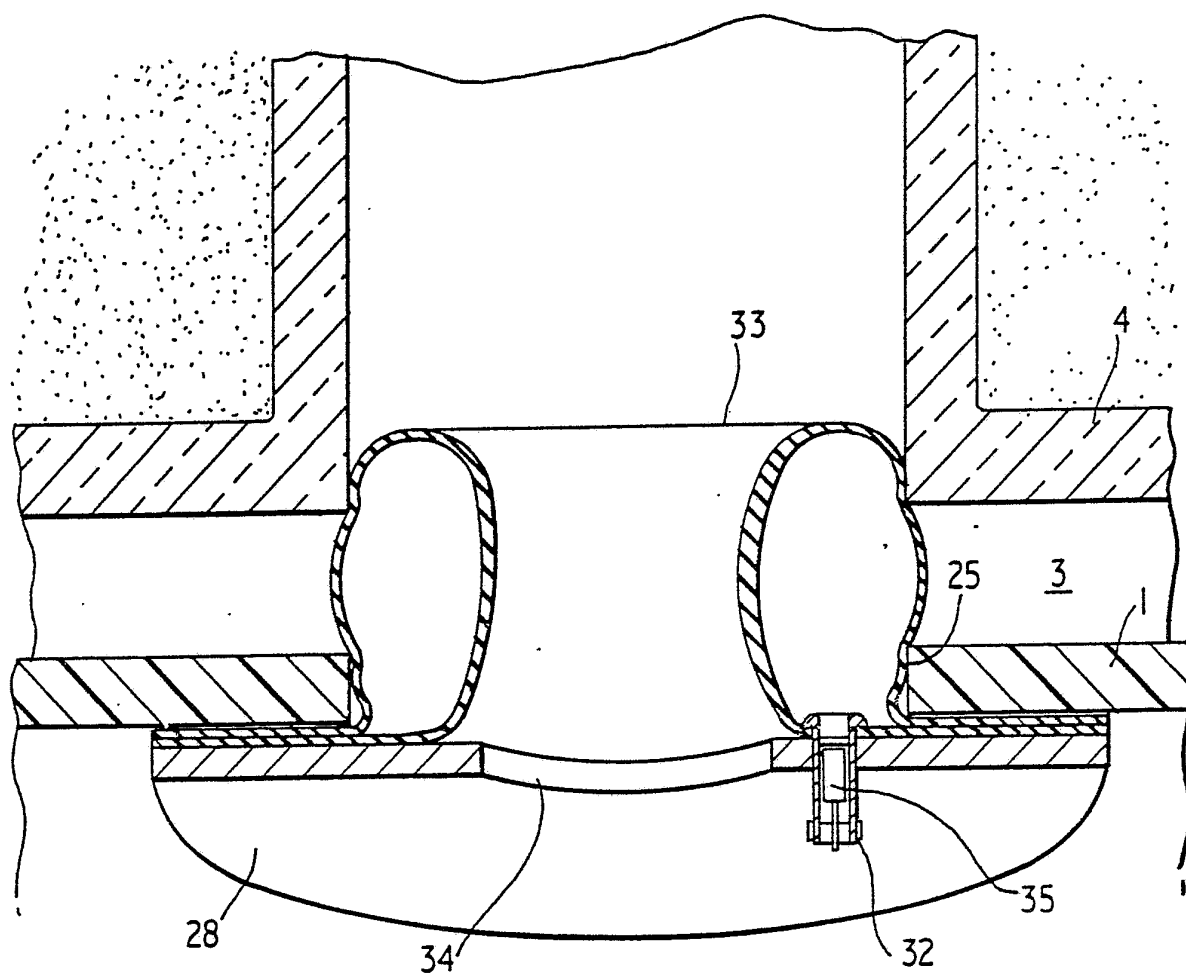


Fig.5.

INTERNATIONAL SEARCH REPORT

International Application No **PCT/GB 83/00002**

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ³ : F 16 L 55/16; E 03 F 3/04		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC ³	F 16 L; E 03 F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	US, A, 2522171 (FURMAN) 12 September 1950, see column 7, lines 27-35; figures --	1
A	US, A, 4245970 (ONGE) 20 January 1981, see figures; abstract --	1
A	GB, A, 2041147 (BRIDGSTOCK) 3 September 1980, see figures; abstract -----	1
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