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(54) A seal for a pipe.

(57) A double seal (110) adapted to be borne on an end of a liner pipe (112) to seal end of the liner pipe and to seal the annular space between the liner pipe and a service pipe into which the liner pipe and the double seal are inserted comprises a tube (114), the downstream portion of which is adapted to fit tightly into the liner pipe and to seal it, a first shoulder ring (118) around the upstream end of the tube, dimensioned to be a push fit in the service pipe, a first resilient flange (120a) extending around the tube downstream of the first shoulder ring and adjacent thereto, the diameter of the first flange being greater than that of the first shoulder ring, so that when the double seal is in a pipe and is retracted, the first flange is urged over the first shoulder ring to seal against the internal wall of the pipe, and a seal is provided across the bore of the tube, which comprises a plug in the upstream end of the bore of the tube which can be pushed out by a rod introduced down the liner pipe.

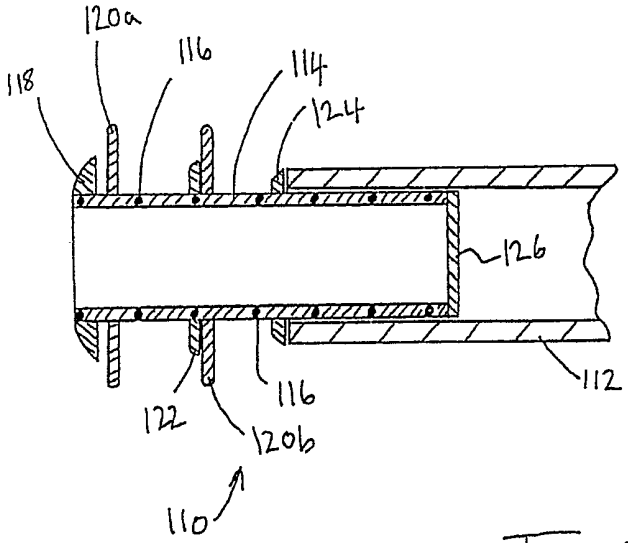

Fig. 5

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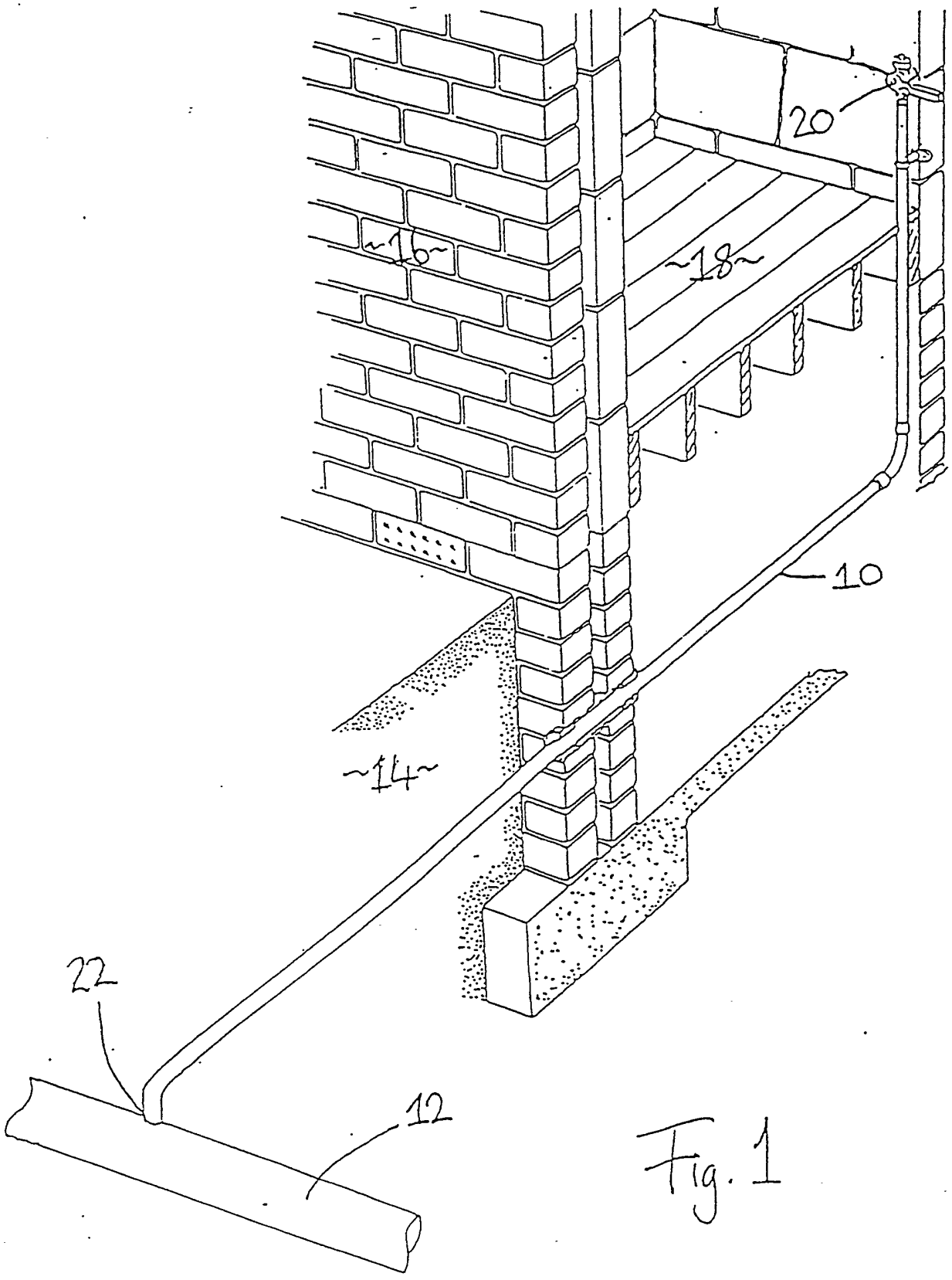


Fig. 1

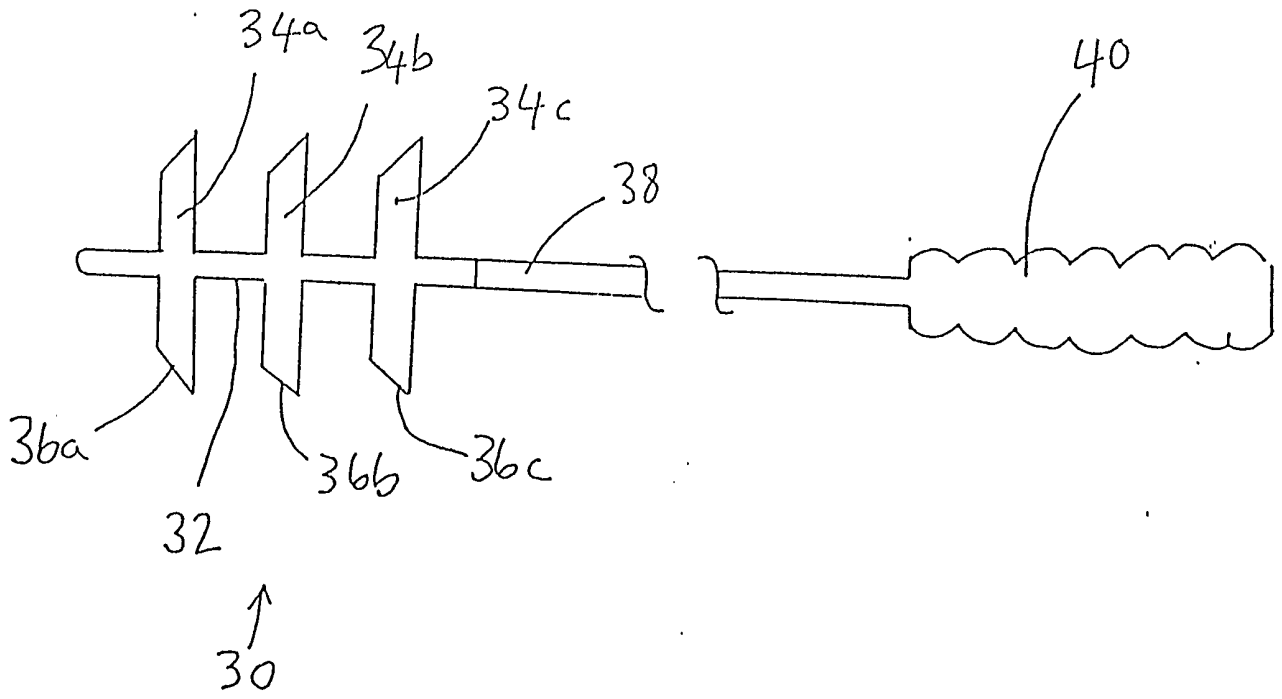


Fig. 2

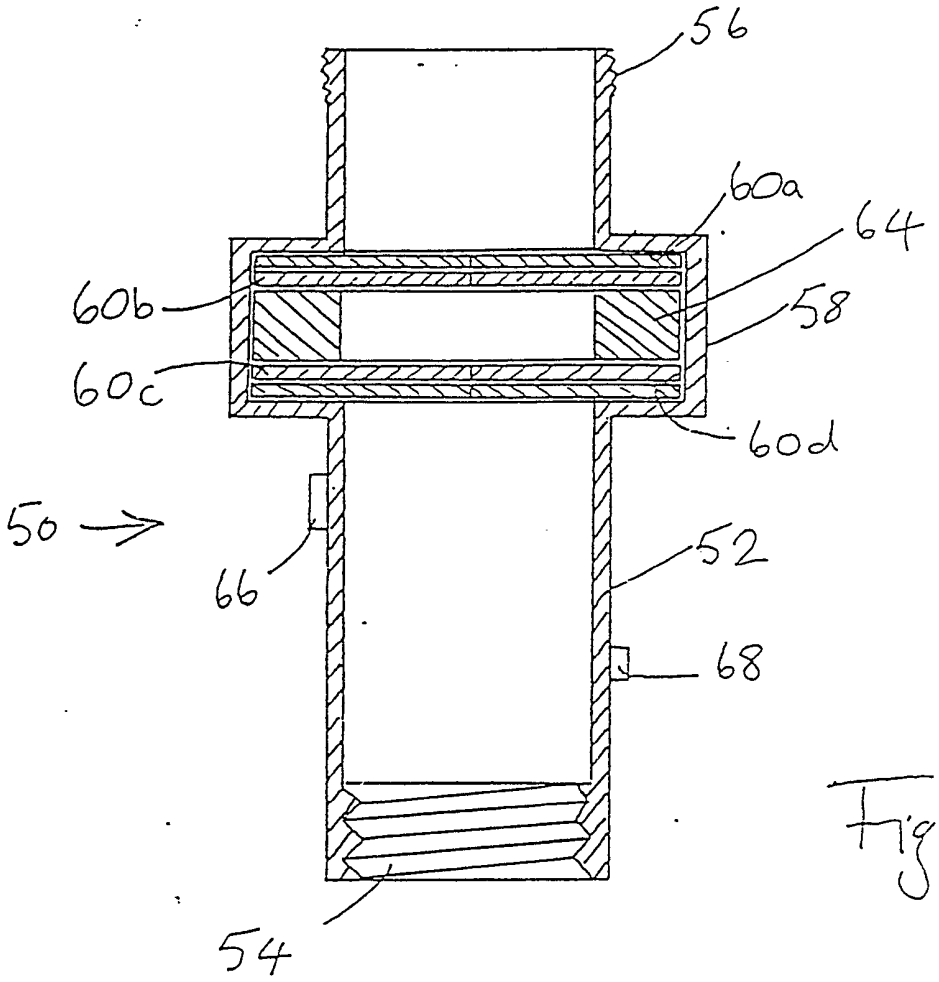


Fig. 3a

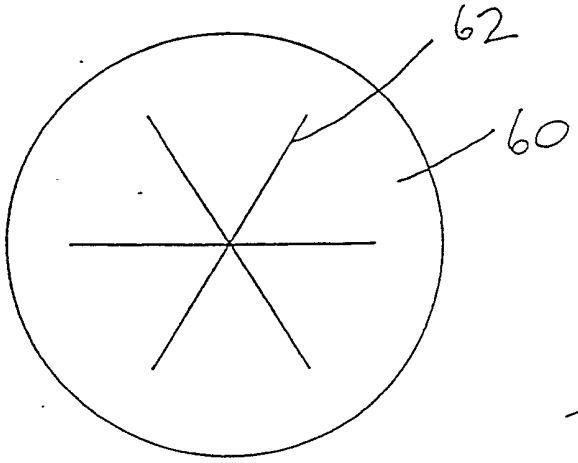


Fig. 3b

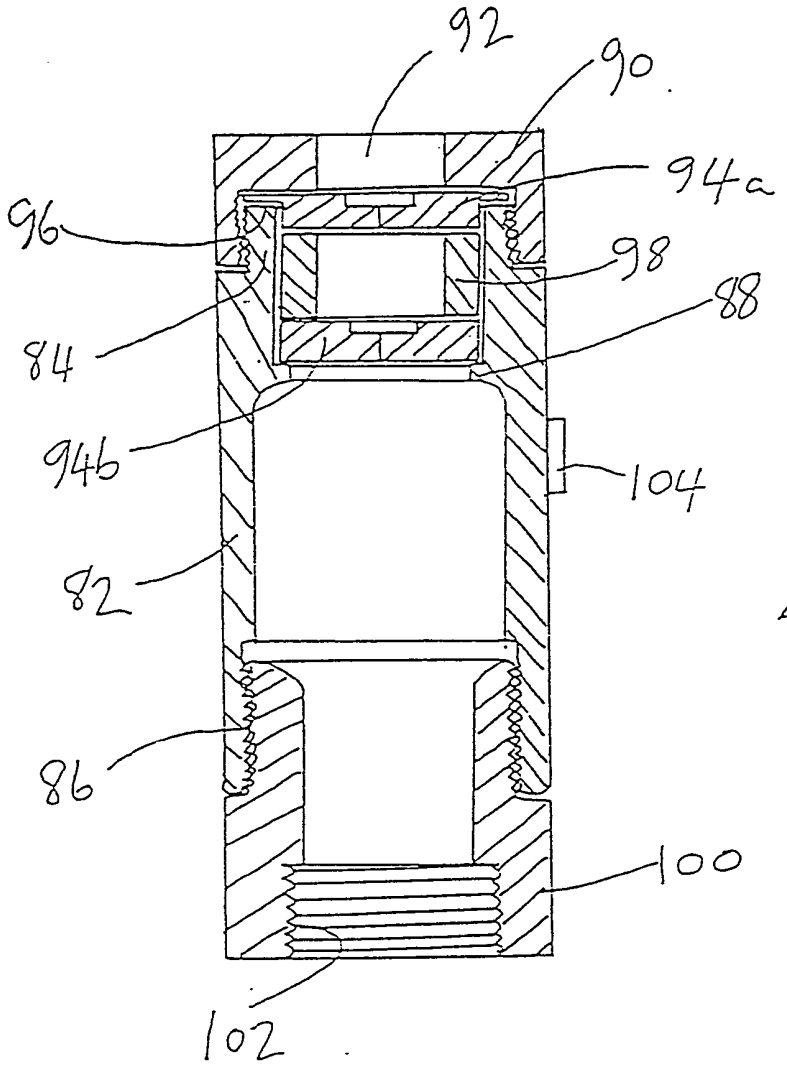


Fig. 4

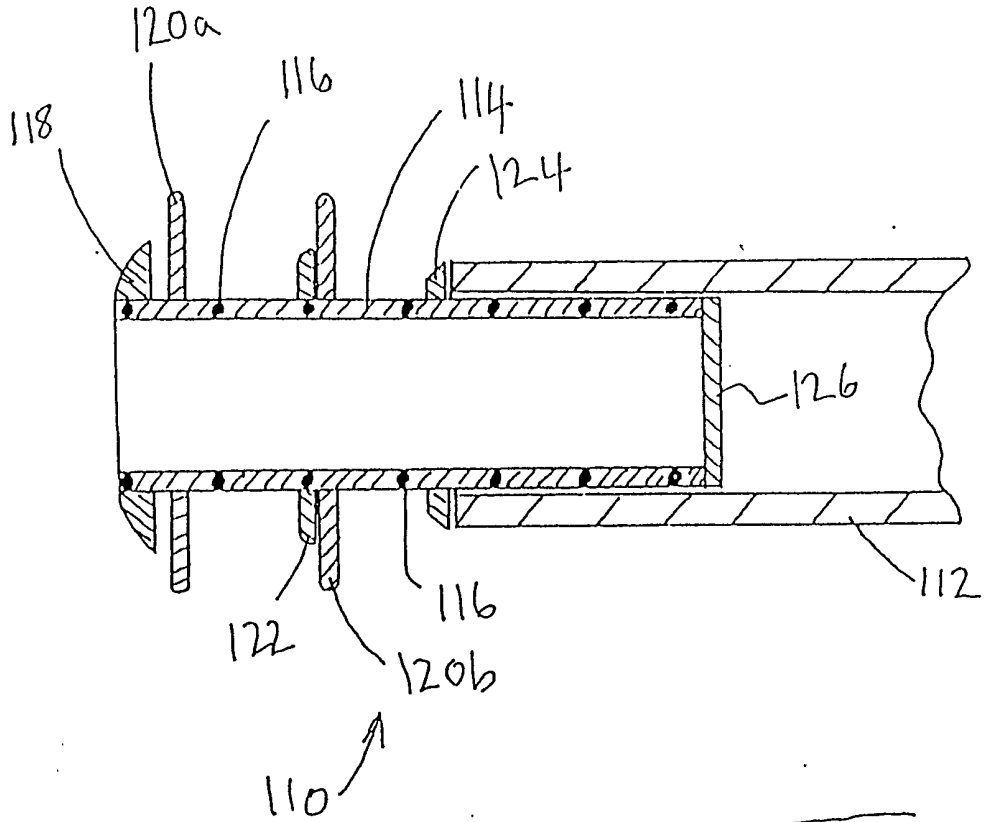


Fig. 5

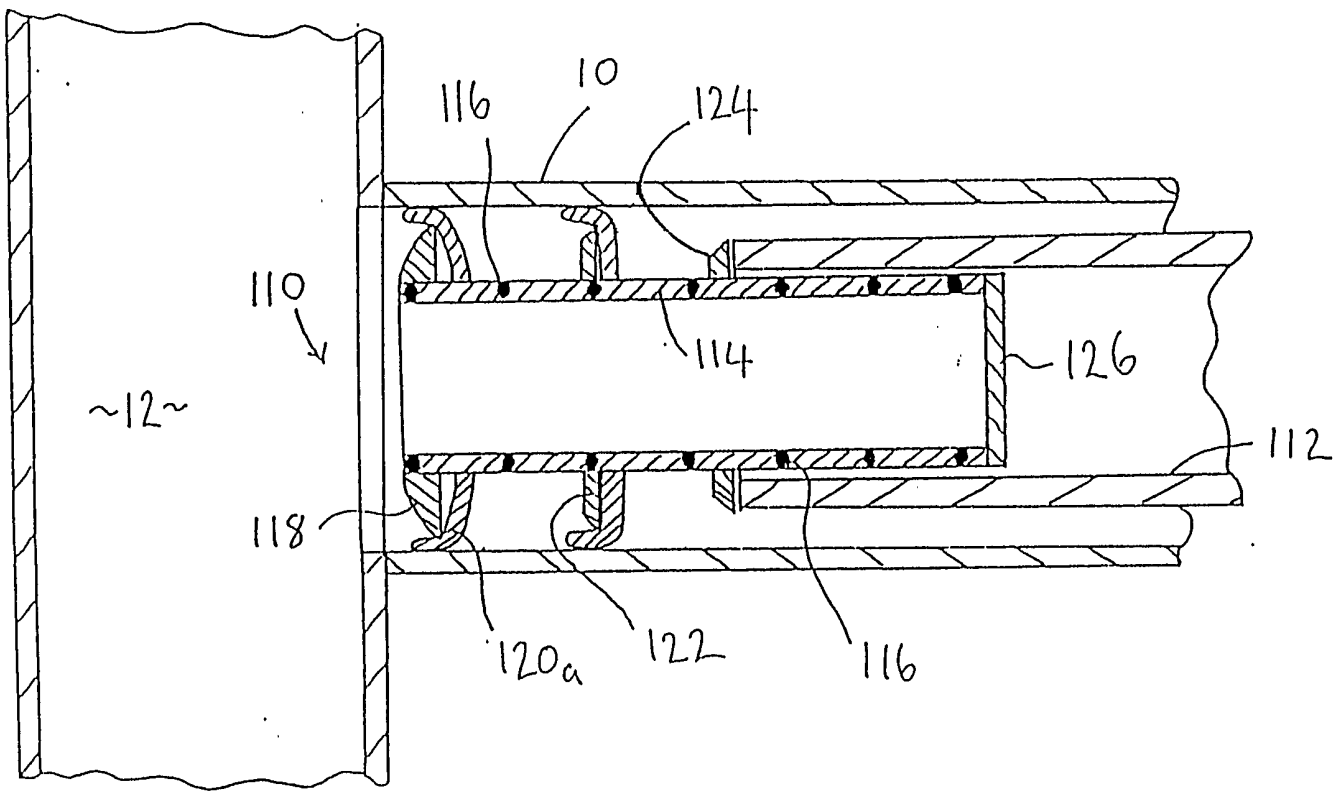


Fig. 6

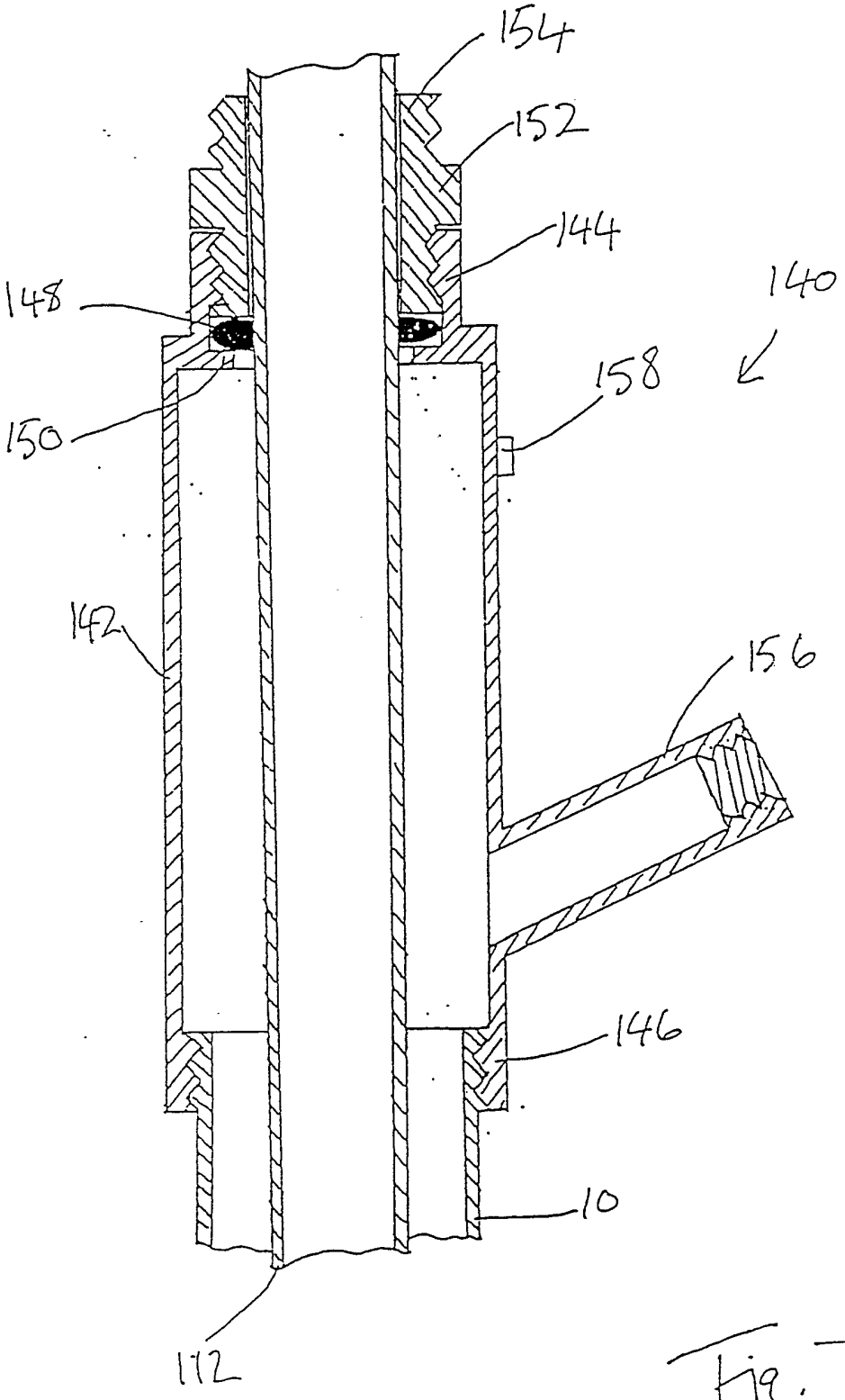
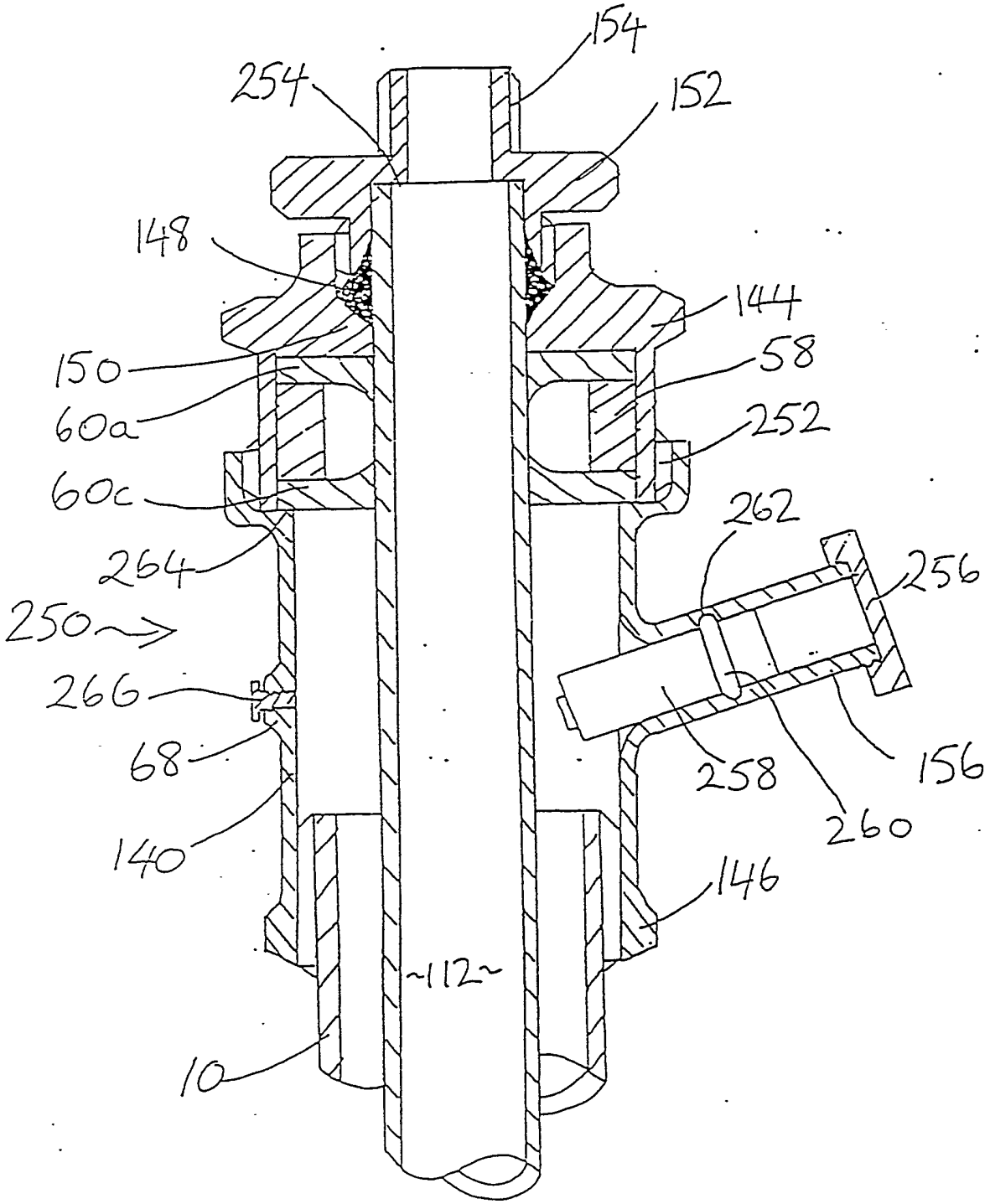


Fig. 7

Fig. 8


154
254
152
148
144
150
58
60a
252
60c
262
264
256
250
266
68
258
156
260
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146
112
10

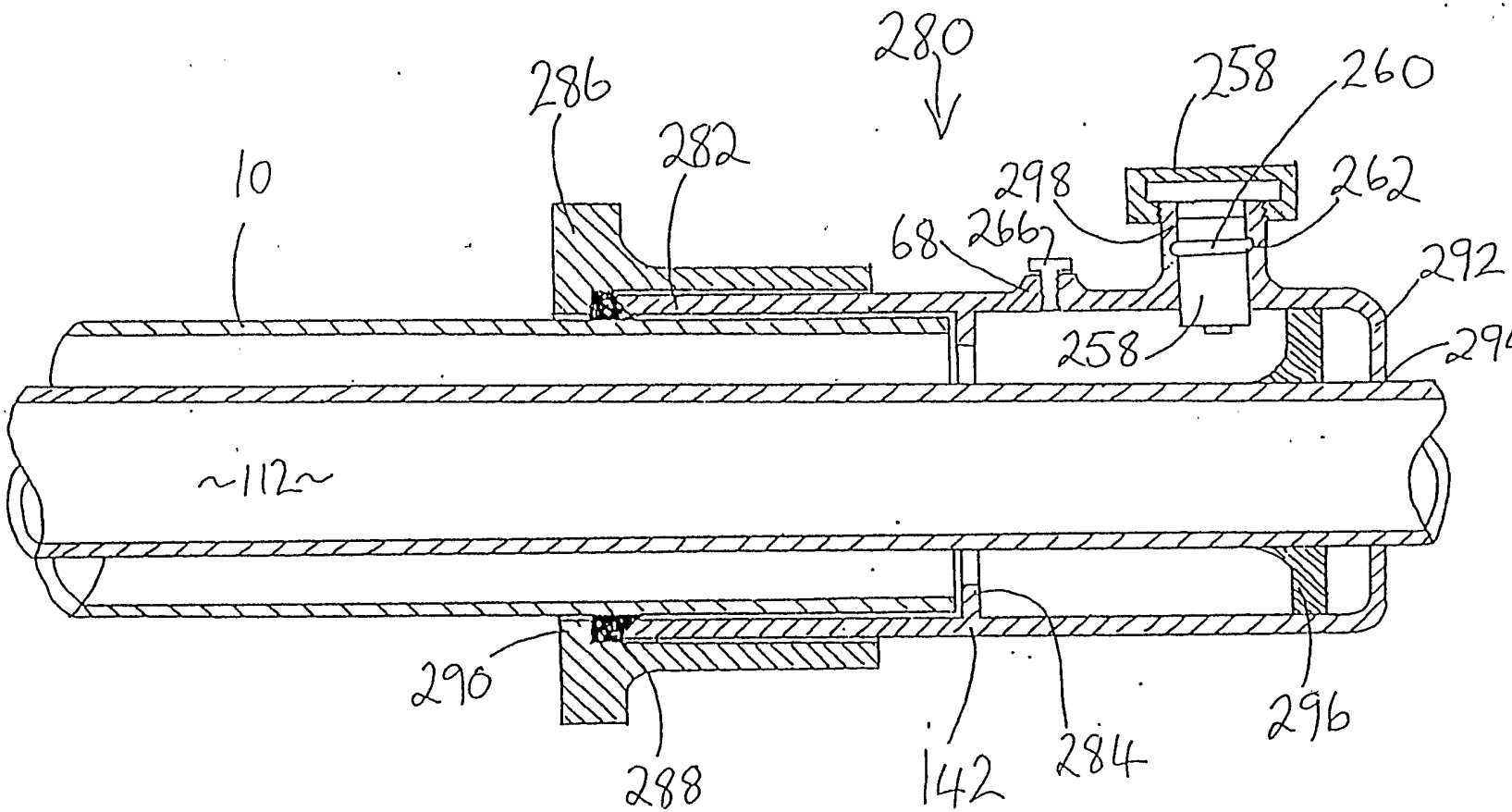
280
286
282
258
260
10
298
262
68
266
292
258
~112~
290
296
288
142
284

Fig. 9

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A SEAL FOR A PIPE

The invention relates to a seal for a pipe, to stop the flow of fluid through the pipe. It finds particular application in a method and apparatus for relining a pipe such as a domestic gas service pipe, with a new pipe, such as a polyethylene pipe. Such method and apparatus is the subject of UK Patent Application No. 9003723.5 from which this application has been divided.

It is often necessary to replace original pipe with new pipe, because of corrosion and other deterioration of the original pipe. In cases in which the original pipe is buried, removal and replacement is expensive, time consuming and inconvenient, since it necessitates digging up the entire length of original pipe, and interruption of the supply.

To reduce the cost and inconvenience of pipe replacement, techniques have been developed to reline existing pipe in situ. A liner pipe, such as a flexible polyethylene pipe, is inserted into a free end of the original pipe, and fed, if necessary with the aid of a pipe jack, along the original pipe.

In many cases, such as that of a domestic gas supply, this operation, although simpler than pipe replacement, is still complex, since it involves digging, cutting the pipe to be relined to isolate it from the main supply and capping of the cut end.

A typical gas supply is shown in Figure 1. A service pipe 10 is connected at one end to a buried gas main 12, passes through the ground 14, and the wall 16 and the floor 18, of the house and is connected to a tap 20. In Figure 1, the upstream side of the tap is shown unconnected. Normally, it will be connected to a domestic gas meter.

In order to reline the service pipe using current techniques, it must be cut close to its junction 22 with the main 12. This necessitates digging to uncover the junction, and closing off the main supply whilst the service pipe 10 is cut and the main capped. The tap 20 is then removed, the polyethylene liner pipe inserted into the service pipe and the tap

reconnected. The main supply must again be closed off whilst the service pipe 10 is reconnected to the main 12, The operation is time consuming and inconvenient.

A technique for relining pipes, such as gas pipes, which does not involve digging or cutting of pipes and which minimises the risk of leakage is described in UK Patent Application No. 9003723.5.

The seal of the present invention is particularly suited for use in this technique. In this technique it is necessary to seal off from the gas main, at the same time, both the open end of the liner pipe in the service pipe and the annular space between the service pipe and liner pipe, but subsequently to open the liner pipe to the gas main to allow the passage of gas through the liner pipe.

According to the invention, there is provided a double seal adapted to be borne on an end of a liner pipe to seal the end of the liner pipe and to seal the annular space between the liner pipe and a service pipe into which the liner pipe and the double seal are inserted comprising:

a tube, the downstream portion of which is adapted to fit tightly into the liner pipe and seal to it;

around the upstream end of the tube, a first shoulder ring dimensioned to be a push fit in the service pipe;

a first resilient flange extending around the tube downstream of the first shoulder ring and adjacent thereto, the diameter of the first flange being greater than that of the first shoulder ring, so that when the double seal is in a pipe and is retracted, the first flange is urged over the first shoulder ring to seal against the internal wall of the pipe; and

a plug sealing across the bore of the tube which can be pushed out by a rod introduced into the liner pipe.

Preferably, a second shoulder ring and flange are provided downstream of the first flange.

Also preferably, the first shoulder ring is of substantially unresilient material and flares outwards in the downstream direction, to provide a nose cone for the double seal, to ensure that it does not snag on obstacles in the pipe.

The tube may be a helical spring in a sleeve of, for example, rubber. This gives the sealing body flexibility to travel in curved pipes and resilience to assist in its retention by the liner pipe into which the downstream end is inserted.

A frangible seal is provided across the bore of the tube, so that when the double seal, in the end of the liner pipe, is inserted into the service pipe, the upstream end of the liner pipe is sealed.

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

Figure 1 shows a typical domestic gas supply;

Figure 2 shows a side elevation of a preferred plug for use in a method of relining a service pipe;

Figure 3a shows a cross-section through a gland for use in a method of relining a service pipe;

Figure 3b shows a plan view of a seal of the gland of Figure 3a;

Figure 4 shows a cross-section through a gland for use in a method of relining a service pipe;

Figure 5 shows a preferred double seal according to the invention;

Figure 6 shows, in cross-section, the double seal of Figure 5 sealing a pipe;

Figure 7 shows a preferred sealant head for connection with the gland of Figure 3a in a method of relining a service pipe;

Figure 8 shows a first combined gland/sealant head for use in a method of relining a service pipe;

Figure 9 shows a second combined gland/sealant head for use in a method of relining a service pipe;

The plug 30 of Figure 2 is a single piece of rubber comprising a spine 32 having upstream 34a, middle 34b and downstream 34c circular flanges extending therefrom. The peripheral regions 36a, b, c of the flanges are bevelled, the upstream face of each flange being of smaller diameter than the downstream face. Such a plug is the subject of copending UK Patent Application No. 9306523.3 which is divided from UK Patent Application No. 9003723.5

Figure 2 shows the upstream end of the plug 30 attached, by means of cooperating screw threads, to a flexible rod 38 having at its free end a handle 40.

The flanges 34a, b, c are so dimensioned that they can be introduced into a service pipe 10 through a tap 20 (see Figure 1). They firstly pass through a gland on the outlet of the tap, which is then opened to allow the plug 30 into the service pipe. The flanges 34a, b, c then seal against the inner wall of the service

pipe, so that the tap can be removed.

The first embodiment 50 of a gland in Figure 3a comprises a circular cylindrical steel body 52 with internal threads 54 at its lower end for connection to the threaded end of a service pipe 10 (see Figure 1) and external threads 56 at its upper end. The body 52 has a wide portion 58 about a third of the way down, for reception of circular star seals 60a, b, c, d of rubber. A star seal 60 is shown in Figure 3b. It comprises a circular disc of rubber which has six radial slits 62 in it extending toward, but stopping short of, its edge. Normally, the edges of the slits 62 close to provide a gas tight seal. However, pipes and other equipment can be pushed through the seal 60, deflecting the sectors defined by the slits 62, which then return to the sealing condition. The sectors will seal against a relatively narrow rod passing through the seal.

The star seals 60a, b, c, d are arranged in the wide portion 58 of the gland 50 in two pairs 60a, b and 60c, d. The pairs of seals are separated by a plastic spacer ring 64.

The gland 50 is provided, upstream of the seals 60a, b, c, d, with a pressure relief valve 66 and a water gauge connection 68, both of which communicate with the interior of the gland 50.

The second embodiment 80 of the gland shown in Figure 4 comprises a circular cylindrical body 82 having a rebated externally threaded neck 84 at its upper end and a wide internally threaded recess 86 at its lower end. An annular flange 88 runs around the inside wall of the body 82 about a third of the way down it. Such glands 50 and 80 are the subject of copending UK Patent Application No. 9306525.8 which is divided from UK Patent Application No. 9003723.5.

A cap 90 having a central passage 92 screws onto the neck 84 of the body 82, A first star seal 94a is trapped between the inner face of the cap 90 and the upper face 96 of the body 82. A second star seal 94b rests on the flange 88 in the body 82. A spacer ring 98 maintains the separation of the star seals 94a, b. The two seals 94a, b and the spacer ring 98 may be provided as a single element.

A cylindrical adaptor 100 screws into the recess 86 at the lower end of the body 82 of the gland 80. The inner wall of the adaptor 100 is threaded at its lower end 102 to receive a tap. By employing an adaptor 100 having a suitable dimension at its lower end 102 the gland 80 can be affixed to taps of different diameters.

The body 82 of the gland 80 is provided below the seals 94a,

b, with a water gauge connection 104, which communicates with the interior of the gland.

The double seal 110 of Figure 5 is shown inserted into a polyethylene liner pipe 112. The double seal comprises a rubber tube 114, of a diameter to fit snugly in the bore of the liner pipe 112, and which is reinforced by a steel helical spring 116. The spring assists in retaining the downstream end of the tube 114 in the liner pipe 112. It also renders the tube rigid enough to pass over obstacles in the service pipe into which the double seal is inserted whilst maintaining it flexible enough to follow curves in the service pipe.

The upstream end of the tube 114 has an annular nose cone 118 of hard plastic around it. This nose cone, which flares outwardly in the downstream direction, enables the double seal 110 to enter a service pipe easily, and to overcome snags in the pipe.

The nose cone 118 also acts as a shoulder for a first annular sealing flange 120a of rubber around the tube 114, immediately downstream of the nose cone and of greater diameter than the nose cone. A second annular rubber sealing flange 120b is provided around the tube 114 downstream of the first flange, and an annular rubber shoulder of smaller diameter 122 is provided around the tube 114 immediately upstream of the second flange 120b. An annular pipe stop 124 of rubber is provided around the tube 114 downstream of the second flange 120b, against which the liner pipe 112 abuts when the double seal body 110 is inserted in the liner pipe.

In a preferred embodiment of the double seal according to the invention, the tube 114 may be sealed with a plug, preferably across its upstream end. Most preferably, such a seal is employed in a double seal having at least one, preferably two, air bleed holes are provided through the wall of the tube 114 intermediate the pipe stop 124 and the second, downstream, sealing flange 120b. The function of these additional features is discussed below.

The sealant head 140 of Figure 7, which is shown screwed onto the open end of a gas service pipe 10 lined with a liner pipe 112, comprises a cylindrical body 142 surmounted by a narrower neck section 144. The bottom end 146 of the head 140 is open and threaded on its internal surface, to screw onto the service pipe 10.

The liner pipe 112 extends through the body 142, and the neck 144 is sealed around the liner pipe 112 by an olive 148 around the liner pipe which rests on a flange 150 inside the neck 144. The

olive 148 seals against the inside surface of the neck 144 by means of a cap 152 with a central passage, for the liner pipe 112, which screws into the neck 144 of the head 140 and presses onto the olive 148. An externally threaded collar 154 extends around the top of the cap 152 for attachment to a tap.

A hollow side arm 156 for the introduction of sealant extends up and away from the lower end portion of the body 142 of the head 140, and communicates therewith. The free end of the arm 156 is internally threaded to receive either a sealant hose or a plug. The side arm 156 may be provided with a one-way valve, such as a spring loaded ball valve, or a top-hat valve, to prevent sealant from spilling out of the arm when the sealant hose is disconnected from it after use. The body 142 is vented by vent 158.

The first combined gland/sealant head 250, shown in Figure 8, may be used in place of both the gland 50 of Figure 3 and the sealant head 140 of Figure 7. Like reference numerals to those employed in Figures 3 and 7 are used in Figure 8 to indicate like parts. Such a sealant head 140 and combined gland/sealant head 250 are the subject of copending UK Patent Application No. 9306527.4 which is divided from UK Patent Application No. 9003723.5.

The gland/sealant head 250, which is shown screwed onto the open end of gas service pipe 10 lined with a liner pipe 112, comprises a cylindrical body 142 surmounted by a separate neck portion 144. The neck portion screws into the mouth 252 of the body 142, which is wider than the body. The bottom end 146 of the gland/head 250 is open and internally threaded to screw onto a service pipe.

When the gland/head 250 is in place and the liner pipe 112 has been introduced into the service pipe 10 as described below, the liner 112 passes through the body 142 and the neck 144 is sealed around the liner pipe by an olive 148 which rests on a flange 150 inside the neck 144. The olive 148 is sealed against the inside surface of the neck 144 by means of a cap 152 having a central passage which screws into the top of the neck 144 and can press the olive 148. The free end of the cap 152 has an external thread 154 for attachment to a tap. The bore of the central passage of the cap 152 is just wide enough at its lower end to accommodate the liner pipe 112, but is narrowed by a pipe stop 254 which the liner pipe 112 abuts.

A hollow side arm 156 for the introduction of sealant extends up and away from the lower end of the body 142 of the gland/head

250, and communicates therewith. The free end of the arm 156 is externally threaded to receive either the hose of a sealant pump or a cap 256. The side arm 156 contains a one-way top-head valve 258, to prevent sealant from spilling out of the arm when the pump hose is disconnected. A retaining ring 260 around the valve 258 is held in a groove 262 around the internal wall of the arm 156 to hold the valve in place.

The neck 144 of the gland/head 280 contains two star seals 60a, c, separated by a spacer ring 58. The lower star seal 60c rests on the shoulder 264 formed by the widening of the body 142 to form the mount 252. The flange 150 of the neck 144 bears upon the upper star seal 60a.

A water gauge connection 68 closed by a screw 26 when not in use is provided in the wall of the body 142 of the gland/head 250.

It will be apparent that the gland/sealant head 250 can perform the functions of both the gland 50 of Figure 3 and the sealant head 140 of Figure 7.

The second combined gland/sealant head 280, shown in Figure 9, functions in a similar manner to the first combined gland/head 250 of Figure 8, and like reference numerals indicate like parts.

The combined gland/head 280, which is shown fitted to a free end of a service pipe 10, comprises a cylindrical body 142 having an open upstream end 282 which fits over the service pipe 10 as far as an internal pipe stop flange 284 in the body 142 allows. The open end 282 is externally threaded, for engagement with a back nut 286 which fits over the service pipe 10 upstream of the gland/head 280. An olive 288 is compressed between the shoulder 290 of the back nut 286 and the end body 142.

The downstream end of the body 142 of the gland/head 280 is closed by a downstream end wall 292, having an opening 294 for passage of the liner pipe 112. A star seal 296 across the body 142 closes the opening 294.

Immediately upstream of the star seal 296 a side arm 298 opens perpendicularly from the body 142. The free end of the arm 298 is externally thread to receive either the hose of a sealant pump or a cap 256. The side arm 298 has a one-way top-hat valve 258 in it to prevent sealant spilling out of the arm, The valve 258 has a retaining ring 260 around it, held in a groove 262 around the internal wall of the side arm 298. A water gauge connection 68 closed by a screw 266 when not in use is provided in the wall of the body 142 of the gland/head 280.

The plug 30, first 50 and second 80 glands the double seal 110 and the sealant head 140 together form a kit for relining a gas service pipe 10 between a gas main 12 and a tap 20. The first combined gland/sealant head 250 can replace the first gland 50 and the sealant head 140. The kit is used as follows.

The closed tap 20 is disconnected from the meter.

The gland 80 according to the second embodiment shown in Figure 4 is prepared as follows.

The rod 38 of the plug 30 (see Figure 2) is inserted into the body 82 of the gland 80 through the central passage 92 in the cap 90 of the gland and the two star seals 94a, b. The adaptor 100 of the gland 80 is unscrewed from the body. The rod 38 is screwed onto the downstream end of the plug 30, which is then pulled, by the rod, into the body 82 of the gland 80. The adaptor 100 is rejoined to the body 82.

The prepared gland 80 is screwed onto the free, downstream, side of the tap 20, which is thus sealed. The tap 20 is opened, and the plug 30 is pushed through the tap 20 and into the service pipe 10 by the rod 38. The flanges 34a, b, c on the spine 32 of the plug 30, which are of slightly greater diameter than the internal diameter of the service pipe 10, deform against the internal walls of the service pipe 10 to make a gas tight seal.

The rod 38 is unscrewed from the plug 30 and withdrawn through the tap 20 and the gland 80. A water gauge connected to the water gauge corrector 104 on the gland 80 confirms that the seal has been made. The tap 20, with the gland 80, is unscrewed from the end of the service pipe 10.

The gland 50 according to the first embodiment shown in Figure 3a or the first combined gland/sealant head 250 of the preferred embodiment shown in Figure 8 is screwed onto the end of the service pipe 10. If the combined gland/sealant head is used, its cap 152 is not fitted. The rod 38 of the plug 30 is inserted into the service pipe through the star seals 60a, b, c, d of the gland 50, or the star seals 60a, c of the gland/sealant head 250, and attached to the plug 30. The plug 30 is withdrawn from the service pipe 10 through the gland.

The double seal 110 is inserted into the polyethylene liner pipe 112 (see Figure 5), and fed into the service pipe 10 through the star seals. The sealing flanges 120a, b seal against the inner wall of the service pipe 10. A water gauge is connected to the water gauge connector 68.

The liner pipe 112 and double seal 110 are pushed down the service pipe 10, if necessary with the aid of a pipe jack. When the double seal 110 passes from the service pipe 10 into the gas main 12, the seal between the liner pipe 112 and the service pipe 10 is broken, and gas passes into the annular space between the pipes 10, 112, which is registered on the water gauge.

The double seal 110 is then withdrawn into the mouth of the service pipe 10 by pulling on the liner pipe 112. It seals against the inner walls of the service pipe as described in relation to Figure 6. This is confirmed by the reading on the water gauge.

If the gland 50 has been used, the body 142, olive 148 and cap 152 of the sealant head 140 (see Figure 7) are passed over the liner pipe 112. The body 142 is screwed onto the end of the service pipe 10. The neck 144 of the sealant head 140 is sealed to the liner pipe 112 by screwing in the cap 152 which deforms the olive 148 against the flange 150 in the neck 144 of the head 140.

If the combined gland/sealant head 250 has been used, the olive 148 is passed over the liner pipe 112, which is trimmed to length. The cap 152 is then screwed into the neck 144 of the combined gland/head 250, deforming the olive 148 to seal against the cap 152 and the liner pipe 112.

The free end of a hose connected at one end to a supply of sealant is screwed into the side arm 156 of the sealant head 140 or gland/head 250. Sealant is introduced into the head, and flows down into the annular space between the service pipe 10 and the liner pipe 112, as far as the downstream flange 124 of the double seal 110. The sealant fills up this annular space, and then the annular space between the liner pipe 112 and the body 142 of the head 140 or combined gland/head 250. When sealant appears at the vent 158 in the head body, the operator knows that the sealant has filled both annular spaces. The hose is then removed from the side arm 156, which is plugged with a threaded plug. The one-way valve in the side arm 156, if provided, prevents sealant from spilling out of the arm.

The sealant used a method of relining or blocking a service pipe will fill the annular spaces without voids, giving a permanent gas tight seal.

The liner pipe 112 may now be cut flush with the top of the cap 152 of the sealant head 140 if this has been used. The tap 20 and the gland 80 are then fitted to the cap 152, by means of the threads on the collar 154 of the cap cooperating with the threads

on the upstream side of the tap.

A seal breaking tool, in the form of a flexible rod is introduced into the liner pipe 112 through the gland 80 and the open tap 20. It is inserted down the liner pipe 112 to the plug sealing the tube 114 of the double seal 110, and caused to push the plug into the main 12. This allows gas from the main 12 to pass up the tube 114 of the double seal 110 and into the liner pipe 112.

The seal breaking tool is withdrawn from the liner pipe 112 through the tap 20 and the gland 80. The tap 20 is closed and the gland 80 removed. The tap can be reconnected to the meter.

If air bleed holes through the tube 114 intermediate the pipe stop 124 and the second flange 120b of the double are present, the method is varied as follows.

Before sealant is introduced into the annular space between the liner pipe 112 and the service pipe 10, the downstream seal of the double seal is broken by a seal breaking tool. As sealant is introduced into the annular space, air can pass out of the space into the tube 114 of the double seal, and so be vented to atmosphere. This further ensures that no voids are formed in the sealant in the annular space. The air bleed holes are sealed by the sealant.

The tap 20 and the gland 80 are then fitted as described above, and the connection to the main 12 made by pushing the plug into the main 12 using a seal breaking tool such as a simple flexible rod.

It will be seen that the method, apparatus and sealant described allows a pipe to be relined easily and safely, with no need for the pipe to be exposed, and with no danger of leakage.

It may be desired to reline a service pipe not provided with a tap or a threaded free end, for example if access to a gas tap is impracticable, and the service pipe is excavated and cut. In this case, the second combined gland/sealant head 280 is employed, as follows.

The back nut 286 and the olive 288 are fitted over the cut end of the service pipe 10, and the body 142 of the gland/head 280 fitted over the service pipe up to the pipe stop 284. The gland/head 280 is sealed to the service pipe 10 by screwing the back nut 286 onto the upstream end 282 of the body 142, compressing the olive 288. The star seal 296 across the body 142 prevents gas escaping through the opening 294 in the downstream end wall 292 of

the gland/head. The liner pipe 112 carrying a double seal 114 at its upstream end is fed through the opening 294 and the star seal 296 into the service pipe, by a pipe jack. When the liner pipe is in position, as indicated by a water gauge connected to the connector 68 on the body 142 of the gland/head 280, sealant is introduced through the side arm 298 as described above for the first combined gland/head 250.

The seal across the upstream end of the liner pipe 112 is broken as described above.

The liner pipe is squeezed off to prevent gas escape while the other part of the service pipe is lined with liner pipe. Another gland/head 280 is fitted to the end of that part of the service pipe, and the annulus filled with sealant through the side arm 298. The two pipes are connected by conventional electrofusion techniques, and the squeeze off removed, to restore the gas supply to the tap.

CLAIMS

1. A double seal adapted to be borne on an end of a liner pipe to seal the end of the liner pipe and to seal the annular space between the liner pipe and a service pipe into which the liner pipe and the double seal are inserted comprising:

a tube, the downstream portion of which is adapted to fit tightly into the liner pipe and seal to it;

around the upstream end of the tube, a first shoulder ring dimensioned to be a push fit in the service pipe;

a first resilient flange extending around the tube downstream of the first shoulder ring and adjacent thereto, the diameter of the first flange being greater than that of the first shoulder ring, so that when the double seal is in a pipe and is retracted, the first flange is urged over the first shoulder ring to seal against the internal wall of the pipe; and

a plug sealing across the bore of the tube which can be pushed out by a rod introduced into the liner pipe.

2. A double seal according to claim 1, further comprising a second shoulder ring and flange around the tube downstream of the first flange.

3. A double seal according to claim 1 or 2, in which the first shoulder ring is of substantially unresilient material and flares outwards in the downstream direction.

4. A double seal according to any of claims 1 to 3, in which the frangible seal is of metal foil or a plastics sheet, and can be broken by a rod introduced down the liner pipe.

5. A double seal substantially as herein described with reference to Figures 5 and 6 of the accompanying drawings.