

PIPE INSERTION METHOD AND APPARATUS

The invention is concerned with a method and apparatus for inserting a first pipe into a second pipe, for example to enable an existing gas pipe to be replaced or reconditioned by a new pipe.

The invention is particularly concerned with a technique known as "live insertion" whereby an existing pipe carrying a fluid, particularly gas, is replaced by a replacement pipe of smaller diameter than the existing pipe while the existing pipe is still maintaining a live flow of fluid. This technique is particularly important when the pipe serves a multi-occupancy or non-domestic structure. If for example, the pipe is serving a block of flats, then interruption of the flow will cause inconvenience to a large number of people. If the pipe is serving an industrial installation, then an industrial process which is normally continuous might have to be interrupted, if a live flow cannot be maintained.

It is already known to insert a new plastics pipe into an existing cast-iron main, for example as described in our earlier Patent Application GB 2103753A. However, a number of disadvantages are associated with existing methods, and in particular it is necessary to put a clamp onto the trailing end of the new pipe, as it is being inserted, to prevent gas from escaping along the new pipe before installation of the

new pipe is complete. It is difficult to apply a sealing clamp effectively to the new pipe, particularly as the pipe, and hence the clamp, has to move over the ground, as the pipe is being inserted.

It is therefore an object of the present invention to overcome this problem.

According to a first aspect of the invention we provide a method of inserting a first pipe into a second pipe, in which the second pipe carries fluid from a feeder pipe to an inlet pipe, the method comprising isolating the second pipe from the inlet pipe after ensuring that the inlet pipe is supplied with fluid independently of its junction with the second pipe, temporarily sealing the leading end of the first pipe, feeding the leading end of the first pipe into the second pipe and connecting the trailing end of the first pipe to the inlet pipe either before or after the first pipe is fed into the second pipe.

By temporarily sealing the leading portion of the first pipe during insertion of the first pipe fluid flow along the first pipe is prevented until the first pipe has been inserted while a flow of fluid is maintained through the second pipe.

The second pipe may comprise a gas pipe.

A by-pass may be fitted between the service pipe and the inlet pipe before the service is isolated from the inlet pipe to ensure that the inlet pipe is supplied with fluid independently of its junction with the service pipe.

In this case fluid is only permitted to enter the leading end of the first pipe after the feeding step has been completed and before the first pipe has been connected to the inlet pipe.

The first pipe may be temporarily sealed by a plug.

The plug may subsequently be removed by pushing an elongate member along the inside of the first pipe.

Alternatively, the first pipe may be temporarily sealed by a membrane.

The membrane may subsequently be ruptured by pushing an elongate member along the inside of the first pipe.

The first pipe may be inserted into the second pipe in a direction which is opposite to the direction of flow of fluid along the second pipe. However, it is also possible to insert the first pipe into the second pipe in the same direction as the flow of fluid along the second pipe.

Preferably the external diameter of the first pipe, with respect to the internal diameter of the second pipe, is chosen to provide a clearance between the pipes which is sufficient to maintain the flow of fluid along the second pipe. However, the diameter of the first pipe is often chosen such that it will supply a satisfactory flow of fluid to the premises and the clearance between the pipes may only be sufficient to maintain pressure in the space between the pipes.

There may be means to centralise the leading end of the first pipe with respect to the second pipe.

The centralising means may have fluid flow passages therethrough.

After the first pipe has been fully inserted, and the leading portion of the first pipe has been unsealed, to establish fluid flow along the first pipe, the clearance between the two pipes may be sealed.

The fluid flow passages may be such as to permit the flow therethrough of the fluid being carried by the second pipe, but be such as to prevent the flow of sealant material used to seal the clearance between the two pipes.

According to a second aspect of the invention we provide a method of inserting a first pipe into a second pipe, in which the second pipe carries fluid from a feeder pipe to an inlet

pipe, the method comprising isolating the second pipe from the inlet pipe after ensuring that the inlet pipe is supplied with fluid independently of its junction with the second pipe, temporarily blocking the bore of the first pipe, feeding the leading end of the first pipe into the second pipe and connecting the trailing end of the first pipe to the inlet pipe either before or after the first pipe is fed into the second pipe.

The bore of the first pipe is unblocked when the first pipe is being fed into the second pipe.

The bore may be temporarily blocked by temporarily squeezing the first pipe flat at a position between its ends and is unblocked by subsequently releasing the squeeze.

Clearly in this case the first pipe will be of a flexible material such as polyethylene or other plastics based material.

Preferably the external diameter of the first pipe with respect to the internal diameter of the second pipe is chosen to provide a clearance between the pipes, along which clearance during and after the feeding step the flow of fluid is prevented.

The fluid may be allowed to flow between the ends of the first pipe as soon as the bore has been unblocked.

Suitably after the first pipe has been fully inserted the clearance between the two pipes is sealed.

After the first pipe has been installed, and fluid flow has been established along the first pipe, it may be desired to fill the clearance between the two pipes with sealing material. In this case the spacer means may be such that

although it will permit a flow of the fluid being carried by the pipes, it will restrict or, preferably, prevent the flow of a more viscous sealing material, such as grout.

The spacer means may comprise at least one vane.

The, or each, vane may comprise a circular or annular member, whose axis is coincident with the longitudinal axis of the first pipe.

There may be a vane which has holes therethrough, the size of the holes being such that they permit the flow of the fluid, but prevent or restrict the flow of a more viscous sealing material, such as grout.

Alternatively, a vane may have notches or slits in its periphery.

Another form of vane may be provided with non-return valves, for example of the Schraeder type, or in the form of hinged flaps.

According to yet another embodiment, a vane may be arranged to flex in such a way as to permit fluid flow, but prevent sealant flow.

By way of example, specific embodiments of the invention will now be described, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a service pipe which is to be reconditioned, leading from a gas main to a riser, the riser supplying gas to a block of flats;

Figure 2 shows a first stage in one embodiment of a suitable reconditioning process in which a by-pass circuit is installed;

Figure 3 shows a further stage in this reconditioning process in which a section of the service pipe is removed;

Figure 4 shows a further stage in this reconditioning process in which the insertion of a new pipe inside to old pipe is commenced;

Figure 5 shows completion of the insertion of the new pipe into the old service pipe;

Figure 6 shows yet another stage in this reconditioning process in which a seal at the leading end of the new pipe is released;

Figure 7 shows yet another stage in this reconditioning process in which the trailing end of the new pipe is closed;

Figure 8 shows a still further stage in this reconditioning process, in which grout or sealant is inserted between the old service pipe and the new inner pipe;

Figure 10 is a perspective view, partly in cross-section, of a first embodiment of the leading end of the new pipe for use in the reconditioning process of Figures 2 to 9;

Figures 11 to 15 show part of five other possible embodiments of the leading end of the new pipe;

Figure 16 is a sectional side view partly in cross-section of a further embodiment of the leading end of the new pipe for use in a second version of a reconditioning process;

Figure 17 shows a further stage in another embodiment of a suitable reconditioning process (following the stages shown in Figures 1 and 2) in which a section of the service pipe has been removed and the insertion of a new pipe inside the old pipe has been commenced;

Figure 18 shows the completion of the insertion of the new pipe into the old service pipe and the re-establishment of the supply to the riser;

Figure 19 shows the stage following removal of the by-pass, and

Figure 20 shows a final stage in the reconditioning process in which grout or sealant is inserted between the old service pipe and the new inner pipe.

Figure 1 shows a gas main 10 from which runs a service pipe 11. The service pipe 11 supplies gas, via a service valve 12, to a riser 13. The riser 13, in this embodiment, supplies gas to five flats, 14 to 18.

The invention is concerned with the reconditioning of the service pipe 11. The pipe 11 may for example be a steel pipe which has started to leak. Reconditioning is carried out by removing a short length of the old pipe 11, enabling a new flexible plastics pipe to be fed into the old pipe and form a new connection between the main 10 and the riser 13. The invention exists in carrying out this reconditioning while maintaining a live service gas supply to the riser 13.

In one embodiment of the invention, in the first stage; clamps 19 and 20 are fitted upstream and downstream of the service valve 12 using proprietary wrap-around clamps. Drillings are then made through the clamps and into the pipe 11 and a by-pass pipe 21 is fitted together with a pressure gauge 22 to monitor whether or not flow is being properly maintained.

Once the by-pass circuit has been established, the service valve 12 is closed, a section 23 of the old pipe is removed

and the exposed part of the old pipe is capped at 24, as illustrated in Figure 8.

The new flexible pipe 25, for example made from polyethylene, is fitted to a nose cone 26, for example by fusing, the nose cone being shown in more detail in Figure 10. It comprises a tubular portion 27, one end of which is temporarily closed by a plug 28. The tubular portion 27 also has a plurality of centralising vanes 29 to 33. Each vane has a series of small apertures 34 therein, circumferentially spaced apart around the vane.

Returning now to Figure 4, the leading end of the pipe 25 is arranged within an insertion gland fitting 35. This gland fitting 35 is attached adjacent to the valve 12 and the valve 12 is then opened. The pipe 25 can then be pushed along inside the old pipe 11 towards the main 10.

It is an important aspect of this embodiment of the invention that the leading end of the pipe 35 is temporarily sealed by the plug 28, so that gas cannot enter the pipe 25 until it is removed.

Once the leading end of the pipe 25 has moved past the rider 19, it is still possible for gas to flow from the main 10 to the riser 13 because the gas can pass through the apertures 34 in the vanes 29 to 33 and then travel along the annular space between the old pipe and the new pipe.

Referring now to Figure 5, insertion of the new pipe 25 terminates when the leading end of the pipe comes into contact with a service tee 36 on the main 10. The pipe 25 is then cut free from the coil of pipe (not shown) from which it has been drawn, and a small insertion gland 37 is fitted to the trailing end of the pipe.

As shown in Figure 6, a rod 38 is then inserted through the gland 37 and is pushed along the new pipe to pop out the plug 28, thus permitting gas to enter the new pipe. The rod 38 is then almost fully withdrawn, the new pipe is sealed at the rear end by squeezing it off at 39, (see Figure 7) and the rod 38 can then finally be withdrawn.

The gland 37 can now be removed, and a connection made between the trailing end of the new pipe and the previously capped end 24 of the old pipe via the valve 40.

At this point the annular passage between the two pipes is still live.

As shown from a comparison of Figures 7 and 8, the by-pass line 21 and pressure gauge 22 are removed and the entry hole into the old pipe from the clamp 20 being sealed. The clamp 19 is retained for use as an injection port, as shown in Figure 9. Sealant material is pumped through the clamp 19 to fill and seal the annular passage between the two pipes, as shown at 41 in Figure 9.

Finally, the old service valve 12, whose function has been taken over by valve 40, is disabled and made inoperative, to avoid any risk of the old valve 12 being shut down on the new polyethylene pipe.

The design of the nose cone 26, and particularly the vanes 29 to 30, is important. It must be possible for gas to flow freely through the vanes, to maintain the live service, but it is preferred that the vanes should be such that the sealant material 41 cannot flow through the vanes. This has the dual purpose of ensuring that sealant does not leak into the main 10, before the sealant has had a chance to set, and also ensuring that the annular passage between the two pipes can be completely filled with sealant material under pressure, before the sealant sets.

In the first embodiment shown in Figure 10, the size of the holes 34 are chosen such that they are large enough to permit the flow of gas, but small enough to restrict or prevent the flow of viscous sealant material.

Other possible embodiments of vane are shown in Figures 11 to 15. Although only single vanes are shown in Figures 13 to 15, to illustrate the important feature of each embodiment, it will be appreciated that in practice a plurality of vanes may be used, for example 5 vanes are shown in Figure 10.

In Figure 11, each vane has a plurality of v-shaped notches 42, spaced around the periphery of the vane, to replace the apertures 34 of the first embodiment.

In the Figure 12 embodiment, each vane is provided with a plurality of circumferentially spaced slits 43.

In the Figure 13 embodiment, each vane is provided with apertures which are covered by hinged flaps 44, acting as one-way valves which permit flow of gas in one direction, but prevent flow of sealant in the opposite direction.

In the Figure 14 embodiment, each vane is provided with tubular passages 45 containing non-return valves, for example of the Schraeder type.

In the final embodiment shown in Figure 15, each vane has a central relatively rigid portion 46 surrounded by a more flexible or softer rim 47 which can flex in one direction sufficiently to allow the passage of gas, but cannot flex sufficient in the other direction to allow the passage of the more viscous sealing material.

Not all the vanes on one nose cone need be of the same type. The nose cone may be of semi rigid plastics, rubber or polymeric material. The nose cone is described as being fused to the new pipe in the above embodiments, yet it may be fitted

by other means, for example using adhesive or mechanical means, or a combination of these techniques.

The invention is not restricted to the features of the above-described embodiments. For instance, instead of using the pop out plug 28, a membrane-type seal may be provided, which can be punctured by the rod 38.

The insertion gland 26 may be of the type which can be permanently left in place, or subsequently removed, to suit particular circumstances.

The nose cones and vanes may be manufactured in a range of sizes to suit different sizes of old pipe and new pipe. Cones may for example be manufactured to suit existing service pipes having internal diameters of 1.5" (38mm), 2" (50mm) and 3" (76mm). However, the principle of operation is still the same, and only involves scaling up or scaling down of the design shown.

In another embodiment of the method, instead of the nose cones described above in relation to Figures 10 to 14, a nose cone similar to that shown and described in UK Published Patent Application No. 2227071A can be used but without a membrane or pop out plug so as to permit fluid to enter the replacement pipe and having vanes which unlike those in Figures 10 to 14 but like those in the above published application are impermeable to fluid flow and form a barrier to flow within

the clearance between the replacement and service pipes. A typical example 50 is shown in Figure 16.

In this version of the method, the nose cone 50 is fused to the end of the replacement pipe 25, the distance from the gland 35 to the feeder main 10 having been previously determined by inserting a rod through gland 35 and measuring the length of rod between the main 10 and gland 35. The replacement pipe 25 is then cut to size i.e. cut so that its length corresponds to the distance between the feeder main 10 and the isolated junction with the inlet pipe 13 and is then squeezed off by rolls 39 (Figure 7) at a point near the leading end of the replacement pipe 25 to prevent the escape of gas from the trailing end. The leading end is then inserted into the gland 35 but not beyond rider 19 so that gas continues to flow to the inlet pipe 13 by way of the riders 19 and 20. Valves 12 and 40 are now opened.

The trailing end of the replacement pipe 25 is then connected to the isolated end 24 of the inlet pipe 13 using a known type connector with the valve 40 in a manner similar to that shown in Figure 8 and previously described. The squeeze off is removed to now permit gas to reach the trailing end of the replacement pipe 25 via the open-bored nose cone (not shown) and the leading end of the replacement pipe 25 is pushed through the gland 35 and service valve 12 into the existing pipe 11 in a manner similar to that shown in Figures 4 and 5 and along the existing pipe 11 until service tee 36 adjacent

feeder main 10 is reached. The rider 21 and gauge 22 can now be removed and wrap-around clamp 20 now plugged. Grout sealant is then inserted through the clamp 19 to fill the space between the replacement and existing service pipes 25 and 11 in the manner previously described, the vanes of the nose cone serving as a barrier to the flow of sealant beyond the leading end of the replacement pipe.

If desired the replacement pipe can be connected to the inlet pipe junction before the leading end of the replacement pipe is fed into the gland 35, in which case it would not be necessary to squeeze off the replacement pipe.

The sealing material 41 may be of any desired type, to suit the operational requirements, and it may for example be possible to use grout, anaerobic sealing material, or synthetic materials such as epoxy resin.

In yet another embodiment of the method using the nose cone 50, the first stages are as shown in and described in relation to Figures 1 to 2. The distance between the feeder main 10 and the riser 13 is measured to compute the amount of replacement pipe 25 needed and a short length is added on for excess. The required length of replacement pipe 25 is then cut off (from say a reel) and the trailing end of the replacement pipe 25 is connected to the valve 40 (which is not yet connected to the clamp 20). The replacement pipe 25 is then fitted into the insertion gland fitting 35 (which is not

yet connected to the valve 12) and the nose cone 50 is fused onto the leading end of the replacement pipe 25. Next the valve 12 is closed and a section of old service pipe between valve 12 and clamp 20 is removed using standard/proprietary methods with the by-pass 21 maintaining the gas supply. The situation is shown in Figure 3.

Next the gland 35 now containing the nose cone 50 is connected to the valve 20 and the valve 40 is connected to the riser 13 at clamp 20 as shown in Figure 17.

The valve 12 is now opened and gas can now travel from the feeder main 10 along the replacement pipe 25 to the riser 13 (Figure 17).

Next, the leading end of the replacement pipe 25 is pushed along the existing service pipe 11 until it reaches the service tee at feeder main 10 (Figure 18).

The by-pass 21 is now removed and clamps 19 and 20 plugged (Figure 19).

Grout 41 or a similar sealant material is now pumped into the gland 35 into the annular space between the existing pipe 11 and the replacement pipe 25 by way of the valve 12 and the clamp 19 so as to provide a seal between the nose cone 50 and the gland 35 (Figure 20).

The old service valve 12 can now be made inoperative.

The gland 35 can be of the type which is either:-

- (a) in two splittable parts so that it can be removed from valve 12 and from the replacement service pipe 25. In this case, a temporary split fitting with elastomeric seal is attached to valve 12, or
- (b) a combination gland and end seal fitting constructed of an elastomeric material or a metal/elastomeric seal which can be left in place as a permanent seal.

The method and apparatus described may be used to recondition not only steel pipes, but any other form of pipe, for example cast iron pipes.

Should it be necessary to avoid gas leakage, temporary seals may be employed in the old pipe, for example by making a small drilling in the pipe, inserting an inflatable balloon seal, and then inflating the seal to close the pipe temporarily. Such seals can readily be deflated and withdrawn after use, the small insertion drilling then being closed. Alternatively, a series of flanges designed to tightly fit the inside of the old pipe can be inserted through a cut end of the pipe or drilling in the wall to temporarily effect the sealing of the pipe.

The method and apparatus according to the invention are particularly useful where the pipe to be reconditioned services a large number of occupants, for example in a block of flats, or services an industrial unit. Where a large number of occupants is involved, it is obviously particularly desirable to maintain a live service, thus avoiding inconvenience to a large number of people. Equally, it may be important to maintain a live service to an industrial facility, which may be operating a continuous process.

The method and apparatus described above may be used in a variety of applications, and could be useful where any fluid flow service is to be maintained, including liquid flows as opposed to gas flows. With regard to gas supplies, the method and apparatus may have useful application on a number of different types of pipe or combination of pipes, including feeder mains, street mains, service pipes and riser pipes.

In the embodiments of the invention described above, the feeding is conducted by way of the existing service valve 12. However, the feeding step could equally well be performed at any position outside the building where a service valve is not present or at a position on the horizontal or vertical part of the existing service pipe or riser inside the building. The replacement pipe 25 may also be fed into the existing service pipe through a so-called side entry clamp or fitting to avoid cutting the existing service pipe until necessary.

**CLAIMS**

1. A method of inserting a first pipe into a second pipe, in which the second pipe carries fluid from a feeder pipe to an inlet pipe, the method comprising isolating the second pipe from the inlet pipe after ensuring that the inlet pipe is supplied with fluid independently of its junction with the second pipe, temporarily sealing the leading end of the first pipe, feeding the leading end of the first pipe into the second pipe and connecting the trailing end of the first pipe to the inlet pipe either before or after the first pipe is fed into the second pipe.
2. A method as claimed in claim 1, in which fluid is only permitted to enter the leading end of the first pipe after the feeding step has been completed and before the first pipe has been connected to the inlet pipe.
3. A method as claimed in claim 1 or claim 2, in which the first pipe is temporarily sealed by a plug.
4. A method as claimed in claim 3, in which the plug is subsequently removed by pushing an elongate member along the inside of the first pipe.
5. A method as claimed claim 1 or claim 2, in which the first pipe is temporarily sealed by a membrane.



6. A method as claimed in claim 5, in which the membrane is subsequently ruptured by pushing an elongate member along the inside of the first pipe.
7. A method as claimed in any one of the preceding claims, in which the external diameter of the first pipe, with respect to the internal diameter of the second pipe, is chosen to provide a clearance between the pipes which is sufficient to maintain the flow of fluid along the second pipe.
8. A method as claimed in claim 7, in which means are provided to centralise the leading end of the first pipe with respect to the second pipe.
9. A method as claimed in claim 8, in which the centralising means has fluid flow passages therethrough.
10. A method as claimed in any of claims 3 to 9, in which, after the first pipe has been fully inserted, and the leading portion of the first pipe has been unsealed, to establish fluid flow along the first pipe, the clearance between the two pipes is sealed.
11. A method as claimed in claim 10, as dependent on claim 9, in which the fluid flow passages are such as to permit the flow therethrough of the fluid being carried by the second pipe, but are such as to prevent the flow of



sealant material used to seal the clearance between the two pipes.

12. A method of inserting a first pipe into a second pipe, in which the second pipe carries fluid from a feeder pipe to an inlet pipe, the method comprising isolating the second pipe from the inlet pipe after ensuring that the inlet pipe is supplied with fluid independently of its junction with the second pipe, temporarily blocking the bore of the first pipe, feeding the leading end of the first pipe into the second pipe and connecting the trailing end of the first pipe to the inlet pipe either before or after the first pipe is fed into the second pipe.
13. A method as claimed in claim 12 in which the bore is unblocked after the first pipe has been fed into the second pipe.
14. A method as claimed in claim 12 or claim 13, in which the bore is blocked by a valve fitted to the trailing end of the first pipe, the valve being closed to block the bore and opened to unblock the bore.
15. A method as claimed in claim 12 or claim 13, in which the bore is blocked by temporarily squeezing the first pipe flat at a position between its ends and is unblocked by subsequently releasing the squeeze.



16. A method as claimed in claim 1 or claims 11 or 12, in which the external diameter of the first pipe with respect to the internal diameter of the second pipe is chosen to provide a clearance between the pipes, along which clearance during and after the feeding step the flow of fluid is prevented.
17. A method as claimed in any of claims 12 to 16 in which fluid is allowed to flow between the ends of the second pipe as soon as the bore has been unblocked.
18. A method as claimed in claim 16 or claim 17 in which after the first pipe has been fully inserted the clearance between the two pipes is sealed.
19. A method as claimed in any of the preceding claims in which a by-pass is fitted between the service pipe and the inlet pipe before the service pipe is isolated from the inlet pipe to ensure that the inlet pipe is supplied with fluid independently of its junction with the service pipe.
20. A method as claimed in any of the preceding claims, in which the second pipe comprises an existing service pipe, and the first pipe is a replacement pipe.
21. A method as claimed in any of the preceding claims, in which the second pipe is a gas pipe.



22. A method as claimed in any one of the preceding claims, in which the first pipe is inserted into the second pipe in a direction which is opposite to the direction of flow of fluid along the second pipe.
23. A method of inserting a first pipe into a second pipe, substantially as described herein, with reference to the accompanying drawings.