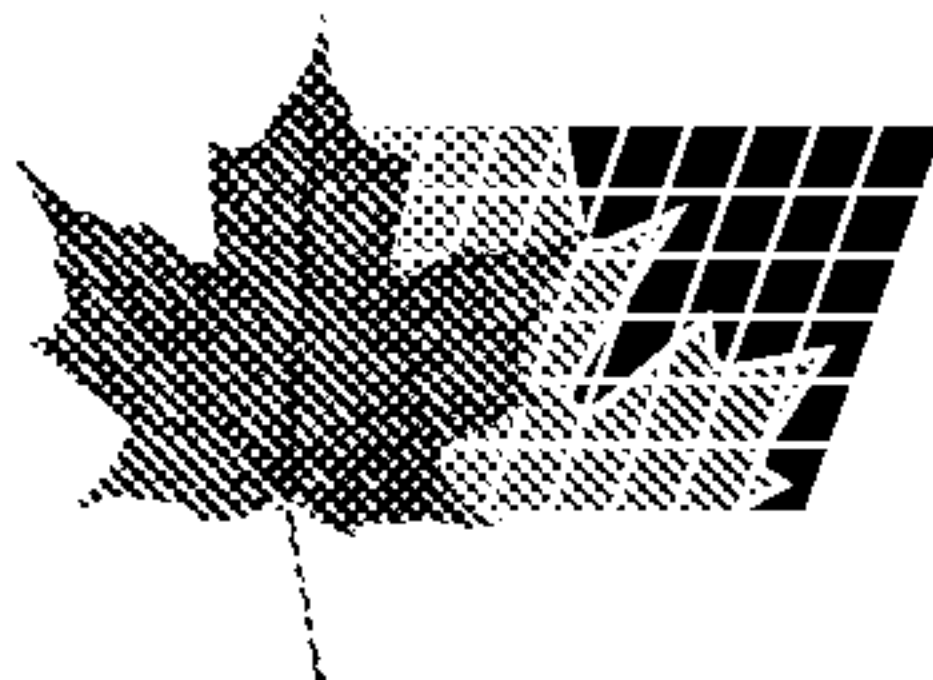




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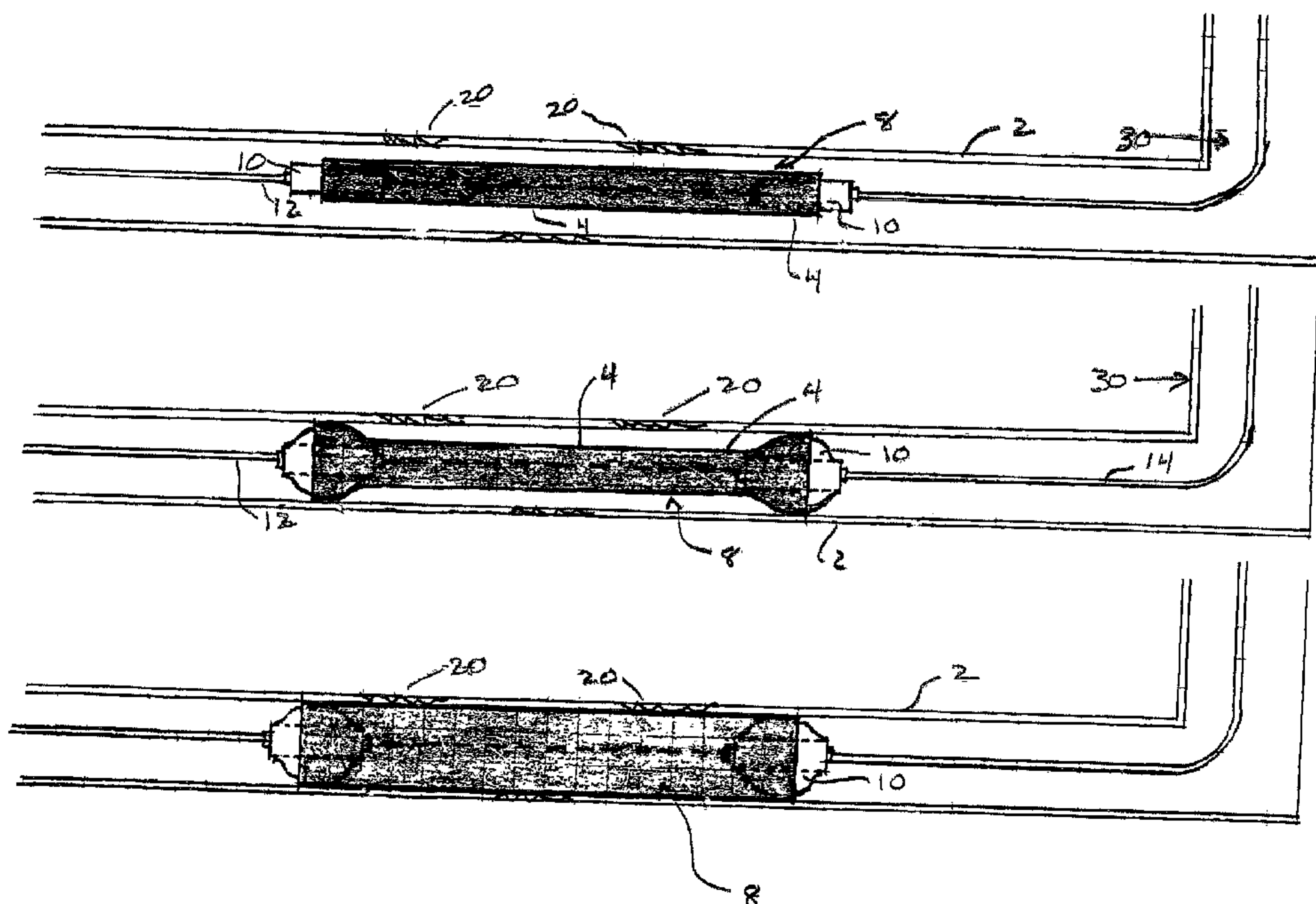
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(54) **REVETEMENT INTERIEUR POUR TUYAUTERIE ET
METHODE D'INSTALLATION CONNEXE**

(54) **PIPE LINER AND METHOD OF INSTALLATION**



(57) A method of relining sewer lines, waterlines or gas lines is disclosed which uses a segmented liner of reduced size relative to the pipe being relined, with the liner being blow molded to the shape of the pipe being relined. The liner segments are joined by conventional joining techniques, however, the preferred joint is achieved by fusion.

ABSTRACT OF THE DISCLOSURE

A method of relining sewer lines, waterlines or gas lines is disclosed which uses a segmented liner of reduced size relative to the pipe being relined, with the liner being blow molded to the shape of the pipe being relined. The liner segments are joined by conventional joining techniques, however, the preferred joint is achieved by fusion.

TITLE: PIPE LINER AND METHOD OF INSTALLATIONFIELD OF THE INVENTION

5 The present invention is directed to procedures for repairing or relining of pipelines, and in particular relining of sewer lines, water mains, gas lines and manholes.

BACKGROUND OF THE INVENTION

10 There continues to be considerable interest in systems for relining of sewer lines, which systems do not require extensive digging to allow a liner to be inserted in the sewer line. It is known to use continuous lengths of PVC or polyethylene pipe that are extruded and shortly
15 after extrusion they are deformed into a generally 'U' shape. This flattened pipe is then coiled and easily transported to the installation site. It is installed by dragging the liner in its flattened condition through the existing pipe, whereafter the liner is plugged at either
20 end and exposed to heat and pressure to force the deformed liner to return to its original circular shape. In some cases, it is then necessary to grout between the liner and the original sewer to maintain the liner in place. Note that these systems merely return the liner to its original
25 extruded shape and do not use the original pipe as a mold for controlling expansion of the liner. One of the prime advantages of the deformed liner system is that the liner is of a continuous length and has no interruptions along the length thereof and once inserted in a reduced volume
30 configuration, is returned to its extruded shape.

Although these "no-dig" systems have enjoyed some success, they can be difficult to install and the deformed liner, particularly in large diameters, is somewhat difficult to handle. With cooler temperatures, the liner
35 becomes stiff and in some cases, it is necessary to preheat the liner to add flexibility for handling of the liner. Another problem is the grouting of the liner in the

existing sewer, which is time consuming and the liner obviously restricts the maximum original capacity of the sewer, as the liner is of reduced diameter. Furthermore, the insertion can be different, even in the deformed shape.

5

SUMMARY OF THE INVENTION

The present invention recognizes that certain thermoplastic pipe, in particular PVC pipe, when heated and exposed to pressure, can be blow molded inside an existing
10 pipe to effect relining thereof. Furthermore, the present invention has found that it is possible to have joints between pipe segments and subject the joined pipes to the required heat and pressure with the resultant combination being blow molded against the existing pipe to be relined
15 with the integrity of the joints being maintained. The pipe segments can be of traditional sections, easily installed due to the reduced diameter and merely appropriately sized once properly located.

The present invention further recognizes that, in
20 many cases, it is not necessary to reline and entire length of pipe, as the pipe may only be damaged in a certain limited segment. With the present invention, it is possible to line only that portion which is damaged or a certain limited portion to effectively provide a spot
25 repair along a length of pipe.

With the present invention, it is possible to have limited access to the existing pipe and insert smaller diameter liners into the pipe and form fusion joints, solvent joints or other joints to the pipe segments as they
30 are being inserted into the existing pipe. The diameter of the liner can be significantly less than the diameter of the pipe being relined whereby the liner is easily inserted in the pipe. Once the length of pipe liner has been inserted in the existing pipe, the liner can be plugged at
35 either end and exposed to steam under pressure to heat the liner along the length thereof and apply pressure thereby urging it out into contact with the interior walls of the

surrounding existing pipe. After the liner has fully expanded to conform to the interior surface of the existing pipe, it can be cooled and then the plugs removed. The resulting liner conforms to the walls of the existing pipe and it has been found that the joints formed between the pipe segments also expand and do not exhibit any problems due to the expansion thereof within the pipe.

With the present method and system, it is possible to use short pipe segments, form suitable fusion, solvent or other joints between segments and insert the joint segments along a length of pipe. Once the appropriate length has been inserted in the pipe, it is then possible to effectively blow mold the liner to force it to conform to the existing pipe. This method can be used where the manhole provides the necessary access to a sewer line.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 is a schematic view showing a number of joined pipe segments inserted into an existing sewer pipe between two manholes;

Figure 2 is a view similar to Figure 1 with the pipe liner expanded to conform to the interior walls of the sewer pipe;

Figure 3 is a schematic view showing repair of a portion of a sewer liner with the smaller diameter pipe liner loosely located in the area of the repair;

Figure 4 is a schematic view similar to Figure 3 where the pipe liner has started to undergo expansion; and

Figure 5 shows the pipe liner expanded and conforming to the walls of the damaged sewer pipe.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and apparatus is shown in the figures where an existing sewer pipe 2 is being relined with short

pipe segments 4 joined with fusion joints 6, resulting in a joined pipe liner 8.

5 In contrast to existing technology, the pipe liner 8 is made up of joined pipe segments 4 and can have a host of joints 6. Furthermore, the pipe liner 8 is inserted as a conventional pipe (i.e. generally circular in cross section) having a significantly reduced diameter relative to the diameter of the existing sewer. For example, if the existing sewer was an 8 inch sewer, the short pipe segments 10 could be of a six inch diameter. One of the advantages of forming the pipe liner by means of short pipe segments 4 is that it can be formed at the base of a manhole such that a dug trench is not necessary. The system is also used where a dug trench is used to provide access to an end of a sewer 15 line and longer lengths of pipe segments can be used. The pipe segments can be joined using existing thermal or solvent technology and, in most cases, an overlapping mechanical joint can even be used. No winding of pipe is required, as joins are easily made.

20 Once the pipe liner 8 is in place (merely by pushing or pulling it through the existing sewer, which is easily accomplished due to the reduced diameter of the liner relative to the existing sewer), inflatable plugs 10 are inserted either end. These inflatable plugs 25 essentially close the pipe liner and allow the pressurizing of the pipe liner by introducing steam or other hot fluids into the pipe liner. The pipe liner becomes hotter and starts to expand, and it is essentially a blow molding process, forcing the liner into contact with the existing 30 sewer. Any irregularities in the sewer merely limit the blow molding process somewhat sooner or slightly later. It has been found that the pipe liner can easily be blown out to the diameter of the existing sewer, and thus, provides a snug fit with the interior walls of the existing sewer. 35 After the blow molding process, the plugs can be deflated and removed from the pipe. As can be appreciated, the inflatable plugs 10 have an inlet line 12 associated at one

end and an exhaust 14 at the other end. Typically, steam under pressure is introduced into the pipe liner and after the liner has expanded to contact the interior walls of the existing sewer, cooling fluids can be introduced to
5 effectively set the liner.

It has been found that the joints expand much in the manner of the pipe segments and no problems are experienced in these areas.

The expanded liner is shown in Figure 2.

10 It is believed the pressurizing and expanding of the liner is simplified due to the circular cross section, which tends to expand the liner uniformly. Furthermore, the liner is not initially in a prestressed state, as would be the case with liners initially deformed into a 'U'
15 shape.

Although the system has been shown in Figures 1 and 2 for relining a pipe segment between two manholes 30 with access provided by the manholes, the pipe segments could be longer and access to one end of the pipe could be through a
20 trench. Again, the pipe segments would be joined to form a continuous liner and the joining can be by means of the various joints described. The actual pipe segments are preferably of a PVC material, but other suitable materials can be used. There are modified PVC materials with
25 expansion additives and these materials can be used.

Figures 3, 4 and 5 show a further application where only a limited portion of the sewer needs to be relined. There is a damaged area 20 between two manholes and a segmented liner is positioned to repair the damaged area.
30 Again, the liner is inflated and subjected to heat to effectively blow mold out or expand out and be limited by the existing walls of the sewer.

The actual thickness of the PVC liner can be selected to accommodate the needed expansion to fill the
35 interior. In many cases, conventional PVC pipe is sufficient.

To ensure that the inflatable plugs remain in the same spacial relationship, the plugs are chained together and thus, cannot separate. Once the plugs are deflated, they can pass through the pipe liner, either in the
5 original or in the expanded condition, whereafter the chain can be removed, if desired, or merely the whole assembly can be withdrawn from one end of the liner.

A further advantage of the present system is that the blow molding process can be used to achieve different
10 diameters of the final lined pipe. For example, at an end of a waterline, a sleeve can be used to form an extension equal to the outer diameter of the waterline. The liner, when expanded, contacts the inner walls of the pipe, but at the sleeve the liner continues to expand until restricted
15 by the sleeve with a smooth transition in the liner therebetween. The sleeve can then be removed and the liner trimmed. In this way, the ends of the liner can be shaped to fit with valves or other connectors, etc.

The method and apparatus can also be used for
20 lining manholes. In this case, a large diameter liner is used which is preferably capped at one end. For example, a 24 inch liner can be located in a 48 inch manhole. The liner is then plugged at the upper end and expanded. The liner is blow molded out against the interior walls of the
25 manhole. Any lines coming into the manhole are easily identified and the liner is cut to allow entry of these lines. With this system, the liner and the cap expand.

The actual material of the liner can be any suitable blow moldable material and PVC or PVC with
30 expansion additives have proven acceptable. The particular application, i.e. sewer, waterline, gas line or other fluid carrying line, may require care in selecting the most appropriate material of the liner. Any suitable joining method can be used for the particular application. For
35 example sewer lines can use many types of joints, whereas for pressurized waterlines, fusion joints are better.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of relining a length of pipe requiring rehabilitation, comprising joining a plurality of thermoplastic pipe segments to form an appropriate length of relining pipe and inserting said length of relining pipe in said pipe to be rehabilitated with said relining pipe being of a diameter significantly less than the diameter of said pipe to be rehabilitated allowing the relining pipe to be easily inserted and positioned in said pipe to be rehabilitated, sealing the ends of said relining pipe, heating said relining pipe under pressure to effectively soften said relining pipe, and blow mold said relining pipe against the interior walls of said pipe requiring rehabilitation, causing non recoverable deformation and said relining pipe, and cooling said relining pipe, whereby the relining pipe increases in shape to reline the existing pipe including any joints in said relining pipe.
2. A method as claimed in claim 1 wherein said pipe segments are of a PVC material.
3. A method as claimed in claim 1 wherein said pipe segments are of a PVC material and have a large open longitudinally extending cavity in the length thereof.
4. A method as claimed in claim 3 wherein said pipe segments are joined using a fusion joint technique.
5. A method as claimed in claim 3 wherein said pipe segments are joined using a solvent joint technique.
6. A method as claimed in claim 3 wherein said pipe segments are joined using overlapping locking mechanical joints formed as part of the pipe segments.
7. A method as claimed in claim 1 whereby said method is used to reline part of a water main.

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8. A method as claimed in claim 3 wherein said method is used to reline part of a sewer line.
9. A method as claimed in claim 4 wherein said method is used to reline part of a gas line.
10. A method as claimed in claim 1 wherein said pipe segments are standard PVC pipe segments.
11. A relined length of pipe comprising an outer pipe section and an inner pipe section of a thermoplastic material which is suitable for blow molding, said inner pipe section comprising a plurality of pipe sections joined together by means of a fusion or solvent joint, and wherein said pipe sections are of a distorted shape which conform to the interior walls of the outer pipe including any irregularities therein, and said pipe sections inherently maintaining the distorted shape.
12. A relined length of pipe as claimed in claim 11 wherein said outer pipe is a sewer pipe and said inner pipe segment is located in a damaged section of outer pipe located between two manholes and only forms part of the sewer pipe extending between said manholes.
13. A method of forming a pipe within an existing pipe of a given inside diameter comprising the steps of providing PVC pipe segments having an outside diameter sized to allow loose insertion into the existing pipe, joining a multiplicity of said pipe segments forming a series thereof and inserting the joined pipe segments into said existing pipe such that the joined pipe segments define a desired length of pipe loosely received within the existing pipe as said given inside diameter is much greater than said outside diameter of said pipe segments, sealing opposite ends of said joined pipe segments and heating said joined pipe segments under pressure to cause said pipe segments to soften and expand said pipe segments and joints therebetween outwardly until restricted by said existing pipe with the integrity of said joints being maintained, cooling said joined pipe segments and removing the seals from said opposite ends to expose a new pipe with an outside surface thereof in contact with said inside diameter of said existing pipe with said new pipe inherently maintaining its expanded size.

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14. A method as claimed in claim 13 wherein said existing pipe has a diameter at least of eight inches.
15. A method as claimed in claim 13 wherein said existing pipe is a sewer manhole and said pipe segments are of a diameter of about 24 inches prior to expanding in the existing manhole.
16. A method as claimed in claim 13 wherein said pipe segments are joined using a fusion joint technique.
17. A method as claimed in claim 13 wherein said pipe segments are joined using a solvent joint technique.
18. A method as claimed in claim 13 wherein said pipe segments are joined using overlapping locking mechanical joints formed as part of the pipe segments.
19. A method as claimed in claim 13 whereby said method is used to reline part of a pipeline.
20. A method as claimed in claim 13 wherein said method is used to reline part of a sewer line.
21. A method as claimed in claim 13 wherein said method is used to reline a manhole.
22. A method as claimed in claim 13 wherein said joined pipe segments are heated to a temperature between 60° and 70° C as part of the expanding step.
23. A relined length of pipe as claimed in claim 11 wherein said relining pipe extends between two manholes.
24. A relined length of pipe as claimed in claim 11 or claim 23 wherein said pipe is of a diameter of about 8 inches or greater.

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25. A relined length of pipe as claimed in claim 24 wherein said inner pipe section is of a PVC material.

