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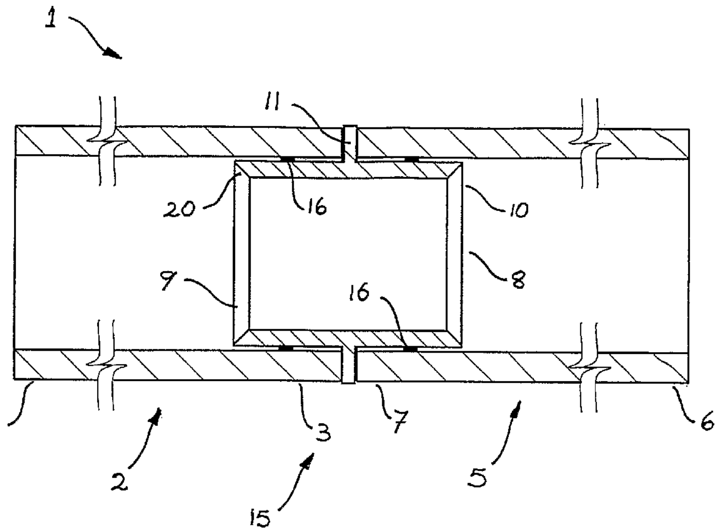
(54) **Title:** INTERNALLY COLLARED PIPE JOINING SYSTEM



(57) **Abstract:** A pipe assembly (1) includes a first pipe section (2) having a first end (3) and a second end (4), a second pipe section (5) having a first end (6) and a second end (7), and an internal collar (8) adapted for internal engagement with both the first end of the first pipe section and the second end of the second pipe section. The collar (8) thereby locates the first and second pipe sections in end-to-end relationship at a joint (14) to form a composite pipe (15). A method of forming a pipe assembly (1) including the steps of: forming a first pipe section (2) having a first end (3) and a second end (4); forming a second pipe section (5) having a first end (6) and a second end (7); and forming an internal collar (8). The method further includes the step of effecting simultaneous internal engagement of the collar with the first end of the first pipe section and the second end of the second pipe section; whereby the collar locates and retains the first and second pipe sections in end-to-end relationship to form a composite pipe.

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Internally Collared Pipe Joining System

FIELD OF THE INVENTION

The present invention relates generally to pipes and more particularly to a pipe assembly, pipe elements that make up the assembly, and an associated method of manufacturing a composite pipe.

The invention has been developed primarily for use in connection with storm water and sewerage pipes and will be described predominantly in terms of this application. It will be appreciated, however, that the invention is not limited to this particular field of use.

BACKGROUND OF THE INVENTION

The following discussion of the prior art is intended to place the invention in an appropriate technical context, and to enable the associated advantages to be more fully understood. It should be appreciated, however, that unless the context clearly dictates otherwise, references to the prior art should not be interpreted as admissions that such art forms part of common general knowledge in the field.

Composite pipes, pipelines and pipe networks are usually formed by interconnecting a multitude of discrete pipe sections. These pipe sections must be securely joined to prevent mechanical failure. The joins must also be effectively sealed to avoid leakage and excessive loss of fluid pressure along the pipe, as well as migration of fluid or soil to into the pipe from outside. Effective sealing and joint failure are not unrelated. For example, soil penetration into a pipeline as a result of ineffective sealing can lead to erosion of the underlying bedding, which in turn can lead to mechanical pipe failure as a consequence of localised stress concentration.

In known pipe systems, the sections to be connected are usually configured so that the outer diameter of each male end is smaller than the inner diameter of the corresponding female end of the adjoining section, so as to permit insertion of the male pipe end into the corresponding female pipe end. This provides a basic mechanical connection, typically referred to as a “socket and spigot”, or "bell and spigot" joint, which must then be secured and sealed.

One common form of pipe seal is takes the form of an O-ring. This type of seal comprises an annular ring, normally of circular cross-sectional profile, formed from an elastomeric material such as rubber. It is typically retained within a circumferential retention groove formed around one end of a pipe section, normally the male end. The O-ring is sized to protrude radially beyond the surface of the pipe end surrounding the groove, so that upon insertion into a corresponding female end of an adjoining pipe section, the O-ring is resiliently compressed into the radial clearance space defined between the male and female pipe ends. In some instances, a circumferential shoulder or groove is also formed around the inner periphery of the female pipe end to facilitate captive retention of the O-ring in the optimal position and to resist withdrawal of the adjoining pipe sections, following installation. Other forms of compression seal having more flattened or special-purpose profiles are also known, but operate essentially on the same basic principles. Further known types of seals rely on differential pressure between the interior and exterior of the pipe to induce expansion pressure, as a substitute or a supplement to the pressure provided in response to resilient seal compression.

One known way of achieving the differential diameters between the male and female pipe ends involves the formation of a circumferential rebate around the outer wall of one pipe section and a corresponding rebate around the inner wall of a complementary pipe section, with the pipe sections otherwise having the same nominal internal diameters, and the same nominal but larger external diameters. One advantage with this particular form of bell and spigot joining system is that once the pipe sections are assembled in end-to-end relationship, the effective inner and outer diameters do not vary along the length of the resultant pipeline. There are, however, a number of significant disadvantages. Firstly, with common storm water pipe materials, a separate manufacturing process is usually required in order to form the external and internal rebates and the associated seal retention grooves on the respective male and female pipe ends. For example, in the case of fibre reinforced concrete (FRC) pipes, this is typically achieved by machining processes which add significantly to the production cost, and are further complicated by the production of significant quantities of dust. These processes also result in material wastage. Other forming processes can also be used, subject to material constraints, but almost inevitably result in additional cost and/or material wastage.

Perhaps most importantly, however, these rebates produce zones of significantly reduced wall thickness at both ends of each pipe section. Consequently, the pipe ends are potentially susceptible to failure in these weakened zones. This problem is exacerbated in a number of known pipe section designs, by the fact that sharp transitions in wall thickness between the machined ends and the main body can give rise to significant stress concentrations. Such pipes are particularly susceptible to failure in this mode during installation, when transient stress concentrations are typically at their highest levels.

In an attempt to ameliorate these disadvantages, it is also known to flare or bell the wall of one end of each pipe section to form a female end having an internal diameter marginally greater than the nominal outer diameter of the main pipe section. This technique potentially obviates the need for a separate forming or machining process, and reduces stress concentrations at the transition zones near the male and female ends. However, it gives rise to other disadvantages. Firstly, the process of flaring or belling is not without difficulties and can itself significantly increase production costs. Additionally, when laying a pipeline of this nature, it is necessary to remove additional material from the subsoil bed under each joint during the installation procedure, so as to accommodate the expanded outer diameter of the flared female end of each pipe section. This process significantly increases the time and cost of the installation procedure. Furthermore, if not done properly, for example if too much or too little bedding material is removed, additional stresses are introduced into the pipeline as a result of non-uniform bed support. In the case of buried pipelines, subsidence of the overlying earth following installation is also typically uneven, giving rise to the need for subsequent land filling by way of restoration.

As an alternative approach, it is also known to join adjacent pipe sections using an external collar adapted to surround the each pair of adjoining pipe ends, and captively retain the associated seals. This solution similarly avoids the need for significant machining of the pipe ends themselves, and also avoids the associated zones of weakness and stress concentration. However, because it results in an enlarged outer diameter of the pipeline at each joint, it suffers from essentially the same disadvantages as the pipe end flaring technique described above, in terms of the need for more complex and costly bed preparation, and the consequential problems inevitably associated with that.

A further disadvantage with this system arises because for a given nominal inner diameter, the wall thickness and hence the outer diameter will vary according to the material strength, pressure rating and other design parameters of the pipeline. Accordingly, across a range of pipes, it is necessary to provide a corresponding array of differently sized collars for each internal pipe size. In the context of large-scale production across a comprehensive product range, this adds significantly to the cost of manufacturing, as well as the cost and complexity of inventory control.

It is an object of the present invention to overcome or ameliorate one or more of these disadvantages of the prior art, or at least to provide a useful alternative.

DISCLOSURE OF THE INVENTION

Accordingly, in a first aspect, the invention provides a pipe assembly including a first pipe section having a first end and a second end, a second pipe section having a first end and a second end, and an internal collar adapted for internal engagement with both the first end of the first pipe section and the second end of the second pipe section, the internal collar thereby locating the first and second pipe sections in end-to-end relationship at a joint to form a composite pipe.

The term "composite pipe " as used herein is intended to denote a pipe assembly formed from at least two discrete pipe sections and one or more pipe joints connecting the respective pipe sections together. The term "pipe line" has essentially the same meaning, but is used herein to convey the sense of a larger number of pipe sections, in situ.

Preferably, the first and second pipe sections have substantially equal and substantially constant outer diameters, such that the external surface of the composite pipe is substantially flush across the join. In the preferred embodiment, the first and second pipe sections are substantially identical to one another. It will be appreciated, however, that this need not be the case. In other embodiment, the internal collar in the form of a transitional fitting can be used to join pipes of substantially different internal and/or external diameter or cross-sectional profile.

In one preferred embodiment, the first and second pipe sections have substantially equal and substantially constant inner diameters, such that the internal collar protrudes radially inwardly into the internal flow path in the vicinity of each join. In this embodiment, the pipe sections preferably have substantially constant inner and outer diameters throughout their lengths and in the preferred embodiment, take the form of hollow cylinders. In this embodiment, the ends of the internal collar are preferably designed for minimum impact on hydraulic performance, having regard to factors such as pressure drop, laminar and turbulence flows. In one such embodiment, the ends of the internal collar are chamfered, to minimise creation of turbulence in fluid flowing through the pipe in the vicinity of the join.

Preferably also, the collar in this embodiment includes an outwardly extending circumferential locating flange positioned approximately midway along its length to define the position of maximum axial insertion of each end of the collar into the associated pipe end. The locating flange thereby ensures that upon installation, the collar is centrally positioned with respect to the adjoining pipe sections, with an approximately equal degree of insertion into each pipe end.

In a particularly preferred embodiment, each end of each pipe section preferably includes an internal rebate defining an end section of reduced inner diameter adapted to accommodate one end of the internal collar. In this embodiment, the internal collar is configured to be nestingly located within a composite internal groove defined by a first internal rebate formed in the first end of the first pipe section and a complementary second internal rebate formed in the second end of the second pipe section. In this way, the internal collar is substantially flush with the internal bore of the composite pipe. Consequently, in this embodiment, the ends need not be chamfered to minimise turbulence within the pipe, although the collar is nevertheless designed for optimum hydraulic performance in situ. A transition zone between each rebate and the adjacent main pipe section is preferably chamfered or radiused to minimise stress concentrations. The external surface of the composite pipe is preferably again substantially flush across the join. The internal collar in this embodiment may also be provided with a circumferential locating flange, although the primary functionality of this flange may alternatively or additionally be provided by the rebates, which, if optimally positioned and shaped, ensure central location of the collar. The locating flange may optionally be formed from, or coated with, a shock absorbent material, to absorb impact and minimise the potential for damage to the associated pipe ends during installation.

Preferably, the pipe assembly includes a circumferential seal positioned radially between each end of the internal collar and the surrounding end of the associated pipe section, to seal the composite pipe at the join.

The composite pipe preferably includes a plurality of the first and second pipe sections, ideally being substantially identical in shape and configuration, and a corresponding plurality of internal collars and seals joining the respective pipe sections together, to form a pipeline.

Preferably, the collars are sized relative to the pipe sections to provide a predetermined radial clearance sufficient in conjunction with seal compression to accommodate a limited degree of rotation between adjoining pipe sections about any axis normal to the longitudinal pipe axis, thereby to enable progressive changes of direction in the pipeline without the need for supplementary bends, fittings or connecting elements. It should be appreciated, however, that in other embodiments, if such pipe rotation is not required and subject to the sealing arrangement employed, this radial clearance may be substantially reduced, or eliminated altogether.

In a second aspect, the invention provides an internal collar for use with a pipe assembly including a first pipe section having a first end and a second end and a second pipe section having a first end and a second end, the collar being configured for internal engagement with both the first end of the first pipe section and the second end of the second pipe section, the collar thereby in use locating the first and second pipe sections in end-to-end relationship to form a composite pipe.

In a third aspect, the invention provides a first pipe section having a first end and a second end, for use in a pipe assembly, the pipe assembly further including a second pipe section having a first end and a second end and an internal collar, the first end of the first pipe section being internally configured for connection to the second end of the second pipe section by simultaneous internal engagement of the collar with the with the first end of the first pipe section and the second end of the second pipe section, the collar thereby in use locating the first and second pipe sections in end-to-end relationship to form a composite pipe. Preferably, the second pipe section is substantially identical to the first pipe section.

In a fourth aspect, the invention provides a method of forming a composite pipe, said method including the steps of:-

forming a first pipe section having a first end and a second end;

forming a second pipe section having a first end and a second end;

forming an internal collar; and

effecting simultaneous internal engagement of the collar with the first end of the first pipe section and the second end of the second pipe section;

whereby the internal collar locates and retains the first and second pipe sections in end-to-end relationship to form a composite pipe.

Advantageously, the assembly and method of the invention can be used in connection with pipe fittings to enable pipes of different diameters to be joined together, or to enable pipes to be joined to ancillary components such as valves, manholes, pumped flanges, and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a cross-sectional side elevation showing a pipe assembly according to a first embodiment of the invention;

Figure 2 is a cross-sectional side elevation showing the internal collar from the pipe assembly of figure 1;

Figure 3 is an end view of the collar shown in figure 2;

Figure 4 is an enlarged cross-sectional detail showing a pipe assembly according to a second embodiment of the invention, in which the locating rib is omitted from the collar;

Figure 5 is an enlarged cross-sectional detail showing a pipe assembly according to a third embodiment of the invention, in which the collar is located by internal rebates in the respective pipe ends;

Figure 6 is an enlarged cross-sectional detail showing a pipe assembly according to a fourth embodiment of the invention, which is similar to the embodiment shown in figure 5 but wherein the collar additionally incorporates a central locating rib;

Figure 7 is an enlarged cross-sectional detail showing a pipe assembly according to a fifth embodiment of the invention, in which the collar and associated rebates incorporate chamfered edges; and

Figure 8 is an enlarged cutaway view showing a pipe assembly according to a variation on the third embodiment of the invention.

PREFERRED EMBODIMENT OF THE INVENTION

Referring initially to figures 1 to 3, the invention provides a pipe assembly 1 including a first pipe section 2 having a first end 3 and a second end 4, and a second pipe section 5 having a first end 6 and a second end 7. In the embodiment illustrated, the first and second pipe sections are substantially identical, although this need not be the case. The assembly further includes a collar 8, having a first end 9, a second end 10, and a circumferential locating flange 11 extending radially outwardly from a central section of the collar.

As best seen in figure 1, the first end 9 of the collar is adapted for internal engagement with the first end 3 of the first pipe section 2, while the second end 10 of the collar is adapted for simultaneous internal engagement with the second end 7 of the second pipe section 5. By means of this engagement, the collar locates and retains the first and second pipe sections in end-to-end relationship at a joint 14, to form a composite pipe 15. The adjoining pipe ends abut the intermediate locating flange 11, to prevent over-insertion and to ensure that the collar is centrally positioned across the join in the assembled configuration.

Annular seals 16 are positioned in the radial clearance spaces defined between the respective ends of the internal collars and the corresponding pipe ends. These seals undergo radial compression upon assembly in the manner of an O-ring, V-ring or K-ring seal, to ensure effective sealing of the composite pipe at the join. These seals, following resilient compression upon installation, also transmit a radially directed force from each end of the collar to the surrounding internal walls of the respective pipe sections, so as to positively locate and removably secure the pipe sections to the respective ends of the collar. If no seals are used, the collar and pipe ends may be configured for interference fit, to provide similar location and retention functionality. In some embodiments of the invention, these seals are retained within circumferential seal retention grooves (not shown) formed in each end of the collar, each pipe end, or both. These grooves help to prevent the respective seals from rolling or folding out of optimal alignment as each end of the collar is slid axially into the corresponding pipe end during the installation procedure. In some applications, it may also be possible to use a curable adhesive or sealant to join the collar to the respective pipe ends, as an alternative to a conventional compression seal.

Advantageously, because the pipe sections have substantially equal and constant outer diameters, the external surface of the composite pipe is substantially flush across the join. Multiple pipe sections can thus be joined end-to-end with a corresponding series of internal collars to form a pipeline having a substantially smooth outer surface of effectively constant outer diameter. This greatly facilitates the process of bed preparation, minimises localised stress concentrations at the joins due to uneven bed support, reduces the risk of uneven subsidence of overlying landfill, and enables the pipe to be used in pipe jacking installations.

In this first embodiment of the invention, the collar protrudes radially inwardly into the pipe flow path in the vicinity of each join, which obviates the need for internal rebates or recesses in the pipe ends to accommodate the collar. Weakening of the pipe ends is therefore avoided and the production process substantially simplified because the pipe sections have essentially constant wall thickness. One possible downside with this arrangement is the introduction of turbulence into the fluid flowing through the pipe as a result of intrusion of the collar into the flow path. The ends of the collar are therefore ideally formed with chamfers 20 so that the impact on flow rate and pressure drop across the pipeline is minimised. Surprisingly, preliminary analyses indicate that the adverse impact on flow rate and pressure loss across the pipeline due to the intermittent reduction in cross-sectional flow area caused by the collars is significantly less than initially anticipated. Another difficulty that was anticipated as a potential problem with this embodiment of the invention related to the possibility of "pooling" of liquid within the pipeline, behind the collars, at low flow rates. Again, however, preliminary analyses indicate that this potential problem is less significant than initially anticipated.

The collar is sized relative to the pipe sections to provide a predetermined radial clearance, sufficient in conjunction with seal compression, to accommodate a limited degree of rotation between each adjoining pair of pipe sections, about any axis normal to the longitudinal pipe axis. Advantageously, this longitudinal rotation enables progressive changes of direction in the pipeline without the need for supplementary connecting components such as junction boxes or elbow joints. In certain applications, and subject to other design constraints, the use of double seals or gaskets may also be employed to enhance rotation.

The collar may be formed from concrete, clay, fibre reinforced plastic (FRP), fibre reinforced concrete (FRC), metal, or any other suitable material, depending upon the nature of the fluid intended to be carried in the pipe, the pressure rating of the pipe, the material composition of the pipe sections, and other relevant design parameters. Generally, it is desirable to select a material with comparable or complementary properties such as deflection, load-bearing capacity, rate of thermal expansion and the like, as the associated pipe material.

The pipe is designed primarily as a storm water or pressure pipe and is provided in a range of sizes suitable for that purpose. The preferred range of internal pipe diameters 12, 15, 18, 24, 30, 36 and 48 inch. For each internal diameter, a range of wall thicknesses or "classes", and hence external diameters, is ideally provided. The optimum wall thickness or class will depend upon the desired pressure rating, burial depth and other relevant design criteria. By way of example only, for a 15 inch FRC pipe, the preferred wall thicknesses for the five standard classes would ideally range from 20 mm to 40 mm. For a 36 inch FRC pipe, the preferred wall thicknesses for the five standard classes would ideally range from 48 mm to 95 mm. More generally, the internal diameter is preferably in the range of 10 to 50 inches and the wall thickness is preferably in the range of 10 mm to 100 mm. However, it will be appreciated that the precise sizing can be tailored to set specific design requirements and will be depended in part upon the strength and grade of the materials used and other design factors.

Figure 4, wherein corresponding features are denoted by corresponding reference numerals, shows a second embodiment of the invention, in which the locating flange is omitted from the collar. Advantageously, this arrangement allows the pipe ends of adjoining sections to abut end-to-end. Ideally, this embodiment of the invention incorporates sealing retention grooves of the type previously described (again not shown), to facilitate centring of the collar between the surrounding pipe ends.

Figure 5 shows a third embodiment of the invention, in which the collar is located by internal rebates 21, in the respective pipe ends. Each rebate 21 defines a section of reduced inner diameter in the associated pipe end, sized to accommodate a corresponding end of the internal collar 8. The collar is thereby configured to be nestingly located within a composite internal groove defined by the contiguous rebates in the adjacent ends of adjoining pipe sections. Because this composite groove effectively performs the axial locating function, this embodiment of the invention does not require a central locating flange. It will also be appreciated that because the collar is substantially flush with the internal bore of the composite pipe, the ends of the collar need not be chamfered to minimise turbulence within the pipe. This embodiment of the invention is therefore particularly appropriate for use in pipeline applications requiring a constant internal cross-sectional profile, or in other words a smooth bore, whereby the collars do not protrude into the flow path or otherwise compromise the flow characteristics of the pipe. Preferably, in this embodiment, the overall length of the collar is marginally less than the sum of the lengths of the rebates in the adjoining pipe ends. This avoids the possibility of the shoulders applying significant compressive load on the collar, which in certain circumstances can compromise sealing performance. Ideally, the collar in this embodiment should be able to "float" within the surrounding rebates, subjected only to radial pressure from the seals themselves.

Figure 6 shows a fourth embodiment of the invention, which is similar to that shown in figure 5 but wherein the collar additionally incorporates a central locating flange. This flange operates in substantially the same manner as described in relation to the first embodiment of the invention, to centre the collar between the pipe sections and to prevent over-insertion into one pipe end or the other. In this case, the arrangement as illustrated similarly maintains a substantially constant internal cross-sectional flow area within the pipeline.

Figure 7 shows a fifth embodiment of the invention, which is essentially a variation on the version illustrated in figure 6. In this case, however, the closed ends of the rebates incorporate respective chamfers 25 in the transition zones between the rebates and the adjacent main pipe sections. The ends of the collar incorporate complementary chamfers 26. These chamfers help to minimise stress concentrations in the transition zones, and thereby significantly reduce the probability of failure during installation, and in response to seal compression. It will be appreciated, however, that other stress minimising transitional geometries, such as radii, may alternatively be used. It will be noted that in this embodiment, the collar is provided with a circumferential locating flange 11 of the type previously described. It will be appreciated that in this instance, the primary functionality of the flange would to some extent be provided by the rebates, which are generally shaped and positioned to ensure central location of the collar with respect to the surrounding pipe ends. Again, however, each end of the collar is ideally slightly shorter than the surrounding rebate, so that the shoulders are not able to apply substantial axial loads to the collar.

Figure 8 shows a variation on the third embodiment of the invention, with the collar engaged with the first pipe section, but prior to engagement with the second pipe section. This embodiment shows radiused, rather than chamfered, transition zones between the rebates and the corresponding main pipe sections. It also shows an alternative sealing arrangement in which a pair of annular seals are located and captively retained within respective circumferential grooves recessed into the outer periphery of the collar, at its respective ends. The seals and associated grooves are shaped to minimise the insertion force required upon installation, to optimise seal positioning, and to resist inadvertent pull-out after assembly.

The invention in its various embodiments has been found to possess a number of significant and unexpected advantages. Firstly, the strength of the composite pipe at the joins has been found to be significantly increased relative to comparable forms of spigot and socket jointed pipes, even in those embodiments incorporating rebated ends of reduced wall thickness. Secondly, by obviating the need for flaring or belling the pipe ends, the outer diameter of the resultant pipeline is substantially constant. Consequently, no special bed preparation is required in order to accommodate expansion of the outer diameter of the pipe at the joins. This significantly facilitates the installation procedure and avoids the problem of additional stress and possible failure in the pipeline, as well as uneven subsidence of overlying soil, as a result of non-uniform bed support. Additionally, because a common collar size can be used, subject to design constraints, for each internal diameter of pipe, irrespective of wall thickness, the cost of production and the cost and complexity of inventory control are significantly reduced across a range of pipe sizes and pressure ratings. It has also been found, unexpectedly, that under similar load conditions, internal collars are subject to less sheer stress than comparable external collars. Furthermore, it has been found, surprisingly, that internal collars offer a greater degree of joint rotation and therefore better facilitate the incorporation of bends in composite pipelines, in comparison to external collars of comparable size and load-bearing capacity. In all these respects, the invention represents an unexpected, yet practical and commercially significant improvement, over the prior art.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

CLAIMS

1. A pipe assembly including a first pipe section having a first end and a second end, a second pipe section having a first end and a second end, and an internal collar adapted for internal engagement with both the first end of the first pipe section and the second end of the second pipe section, the internal collar thereby locating the first and second pipe sections in end-to-end relationship at a joint to form a composite pipe.

2. A pipe assembly according to claim 1, wherein the first and the second pipe sections have substantially equal and substantially constant outer diameters, such that the external surface of the composite pipe is substantially flush across the joint.

3. A pipe assembly according to any one of the preceding claims, wherein the first and the second pipe sections are substantially identical to one another.

4. A pipe assembly according to claim 1 or claim 2, wherein the first and the second pipe sections are different in diameter or cross-sectional profile, and the internal collar also functions as a transitional element.

5. A pipe assembly according to any one of the preceding claims, wherein the first and the second pipe sections have substantially equal and substantially constant inner diameters, such that the internal collar protrudes radially inwardly into an internal flow path near the joint.

6. A pipe assembly according to claim 5, wherein the pipe sections have substantially constant inner and outer diameters throughout their respective lengths.

7. A pipe assembly according to claim 5 or claim 6, wherein the ends of the internal collar are chamfered, to minimise creation of turbulence in fluid flowing through the pipe near the joint.

8. A pipe assembly according to any one of the preceding claims, wherein the collar includes an outwardly extending circumferential locating flange to define a position of maximum axial insertion of each end of the collar into the respective pipe end.

9. A pipe assembly according to claim 8, wherein the locating flange is positioned approximately midway along the length of the collar, thereby to ensure that upon installation the collar is positioned generally centrally with respect to the adjoining pipe sections, with approximately equal degrees of insertion into the respective pipe ends.

10. A pipe assembly according to claim 8 or claim 9, wherein the locating flange is formed from, or coated with, a shock absorbent material.

11. A pipe assembly according to claim 1, wherein at least one of the ends of at least one of the pipe sections includes an internal rebate defining an end section of reduced inner diameter, adapted to accommodate one end of the internal collar.

12. A pipe assembly according to claim 11, wherein each of the ends of each of the pipe sections includes a corresponding internal rebate defining a respective end section of reduced inner diameter adapted to accommodate one end of the internal collar.

13. A pipe assembly according to claim 12, wherein the internal collar is configured to be nestingly located within a composite internal groove defined by a first internal rebate formed in the first end of the first pipe section and a complementary second internal rebate formed in the second end of the second pipe section.

14. A pipe assembly according to claim 13, wherein the internal collar is substantially flush with an internal bore of the composite pipe.

15. A pipe assembly according to any one of claims 11 to 14, wherein a transition zone between each of the rebates and an adjacent main pipe section is chamfered or radiused to minimise stress concentration.

16. A pipe assembly according to any one of the preceding claims, wherein an external surface of the composite pipe is substantially flush across the joint.

17. A pipe assembly according to any one of the preceding claims, including a circumferential seal positioned radially between each end of the ends of the internal collar and the surrounding end of the corresponding pipe section, to seal the composite pipe at the joint.

18. A pipe assembly according to claim 17, wherein said seals are compression seals, configured upon installation to transmit a radially directed force from each end of the collar to the surrounding internal walls of the respective pipe sections, so as to positively locate and removably secure the pipe sections to the respective ends of the collar.

19. A pipe assembly according to claim 18, wherein said compression seal is selected from the group comprising an O-ring, a V-ring and a K-ring seal.

20. A pipe assembly according to any one of the preceding claims, wherein the composite pipe includes a plurality of the first and the second pipe sections, and a

corresponding plurality of the internal collars joining the respective pipe sections together in situ, to form a pipeline.

21. A pipe assembly according to any one of the preceding claims, wherein the collars are sized relative to the pipe sections to provide a predetermined radial clearance sufficient to accommodate a limited degree of rotation between adjoining pipe sections about any axis normal to a longitudinal pipe axis.

22. A pipe assembly according to any one of the preceding claims, adapted for use as a storm water or pressure pipe, and having an internal diameter of at least 12 inches.

23. A pipe assembly according to claim 22, being formed substantially from FRC, having an internal diameter of between 10 and 50 inches, and having a wall thickness of between 10 mm and 100 mm.

24. An internal collar for use with a pipe assembly as defined in any one of the preceding claims, said collar being configured for simultaneous internal engagement with both the first end of the first pipe section and the second end of the second pipe section, thereby in use locating the first and second pipe sections in end-to-end relationship to form the composite pipe.

25. A first pipe section for use in a pipe assembly as defined in any one of claims 1 to 23, the first end of the first pipe section being internally configured for connection, in use, to the second end of the second pipe section by simultaneous internal engagement of the collar with the with the first end of the first pipe section and the second end of the second pipe section, the collar thereby in use locating the first and second pipe sections in end-to-end relationship to form a composite pipe.

26. A method of forming a pipe assembly as defined in any one of claims 1 to 23, said method including the steps of:-

providing a first pipe section having a first end and a second end;

providing a second pipe section having a first end and a second end;

providing an internal collar; and

effecting simultaneous internal engagement of the collar with the first end of the first pipe section and the second end of the second pipe section;

whereby the internal collar locates and retains the first and second pipe sections in end-to-end relationship to form a composite pipe.

Figure 1

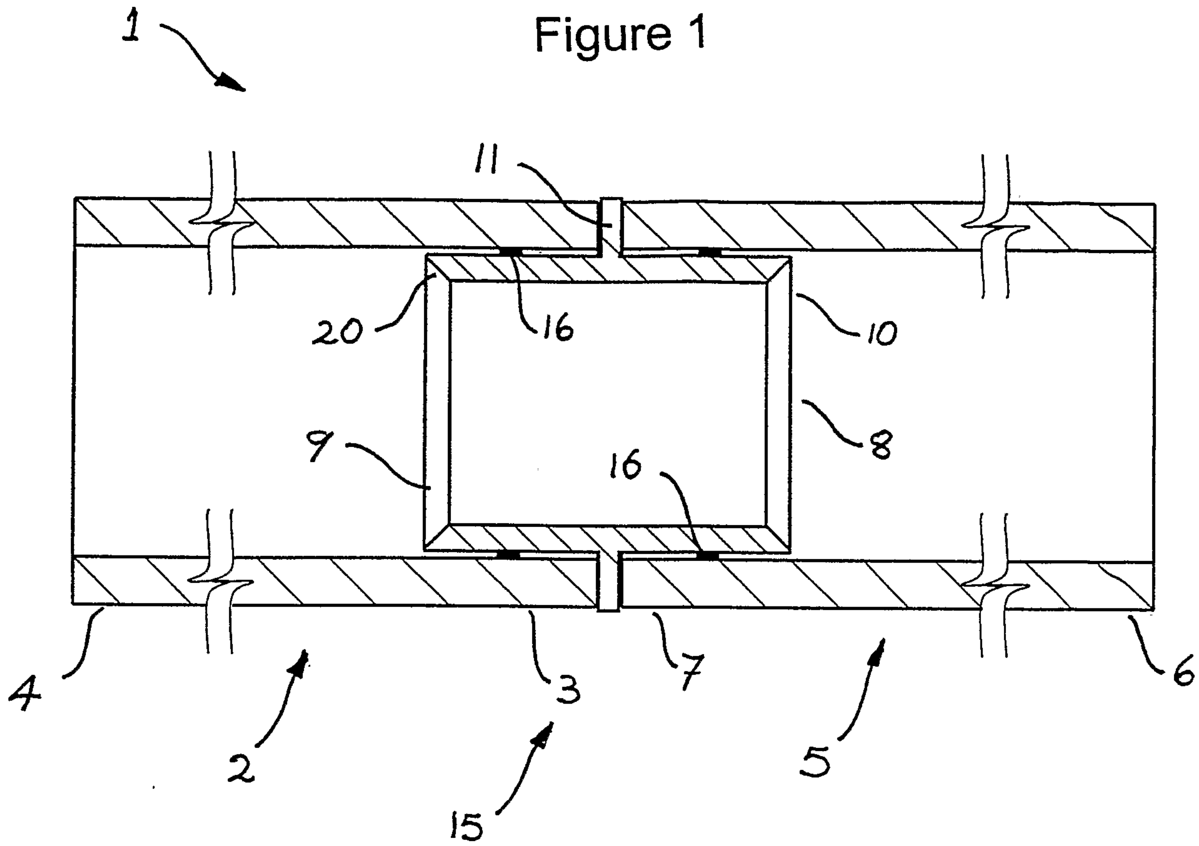


Figure 2

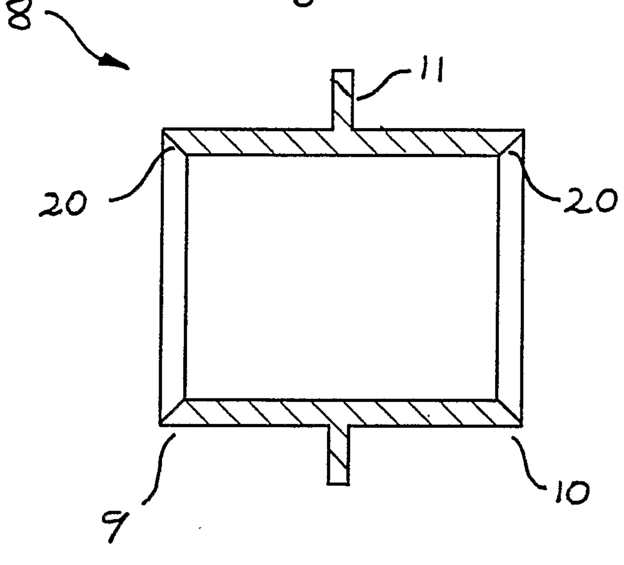


Figure 3

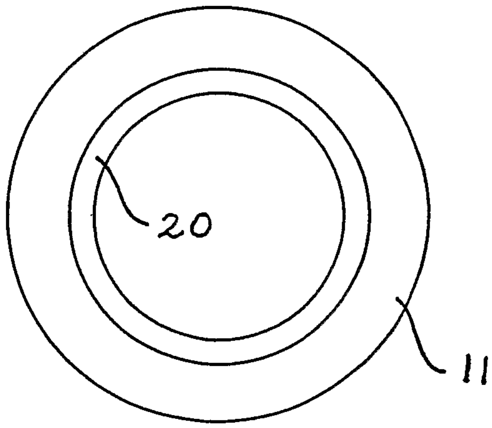


Figure 4

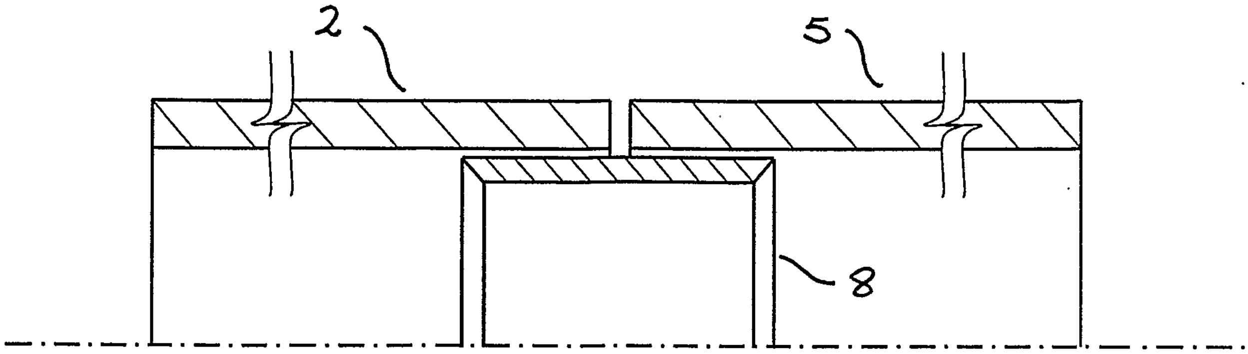


Figure 5

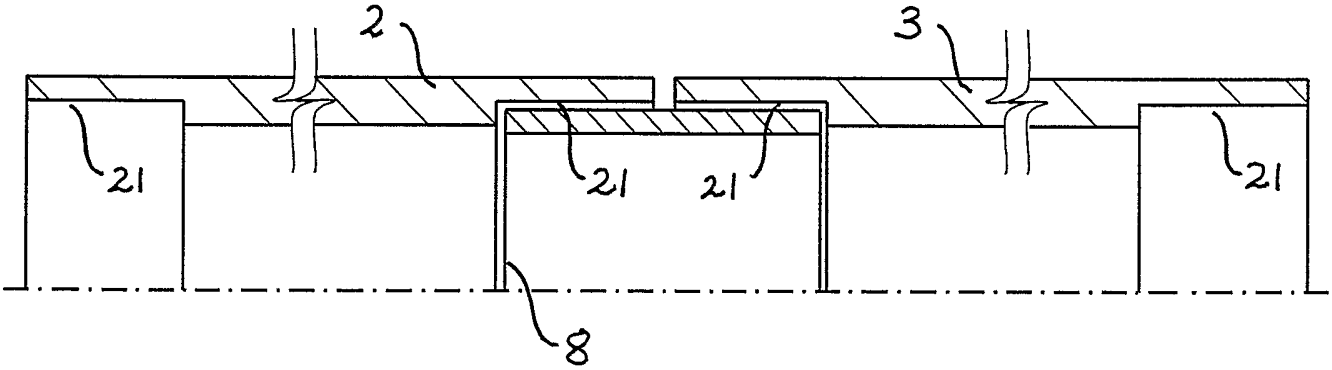


Figure 6

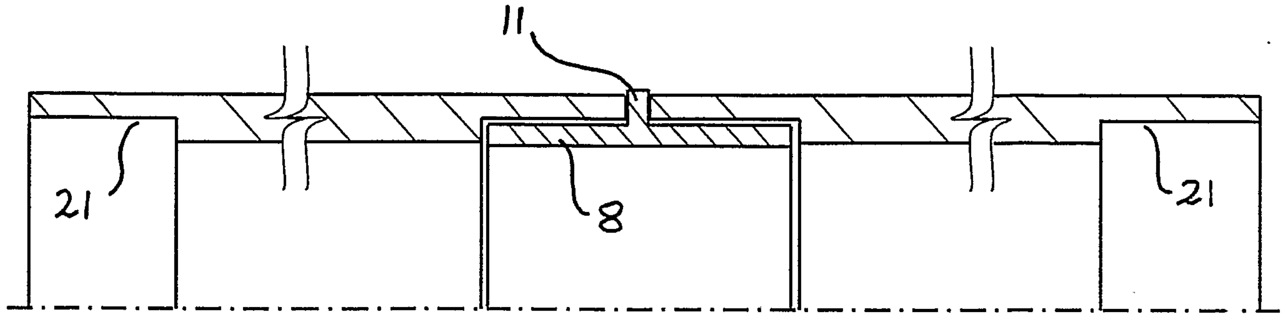
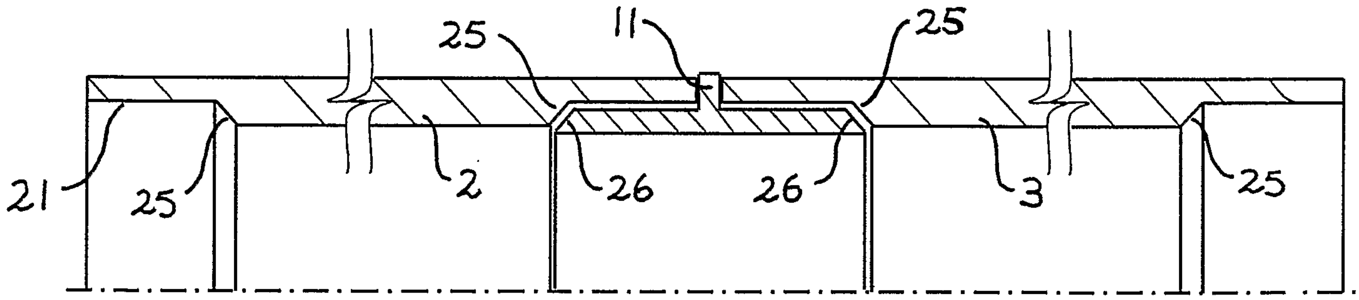


Figure 7



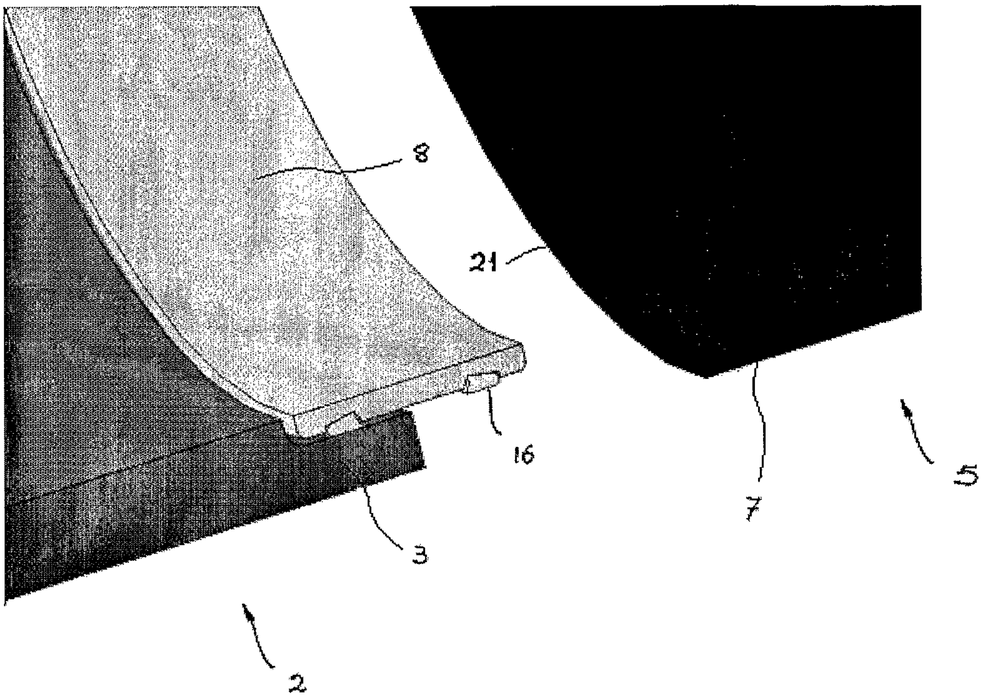


Figure 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2003/001689

A.	**CLASSIFICATION OF SUBJECT MATTER**
Int. Cl. 7:	F16L 21/00, 21/02, 25/12, 31/00, 33/00, 33/30, 37/02, 49/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI: IPC Marks F16L 21/00, 21/02, 25/12, 31/00, 33/00, 33/30, 37/02, 49/02 + Keywords ("end to end', butt, abut, flush, internal, inside, internal collar)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1762766A (GARAY), 10 June 1930 Figures	1-26
X	US 6663145 B1 (LYALL III et al), 16 December 2003 Figures	1-26
A	GB 2129082 A (THE HEPWORTH IRON COMPANY LTD (UK)), 10 May 1984	1-26

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 16 January 2004	Date of mailing of the international search report 23 JANUARY 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **G.B. NATH** Telephone No : (02) 6283 2126

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US5255945 A (TOON), 26 October 1993 Figures	1-26
A	US 4277091 A (HUNTER), 7 July 1981 Figures	1-26

INTERNATIONAL SEARCH REPORT	International application No. PCT/AU2003/001689

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5255945	CA	2083937				
US	4277091	AR	228133	CA	1135746	CA	1140183
		CA	1140184	CA	1140185	FR	2454575
		GB	2047835	GB	2117854	JP	55152990
		DE	3014128				
GB	2129082		NONE				
US	1762766A		NONE				
US	6663145		NONE				

END OF ANNEX