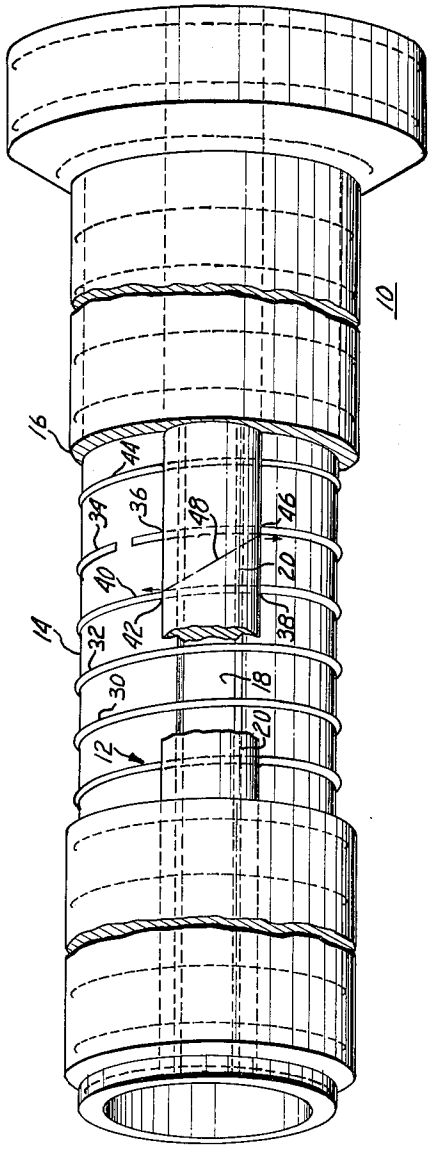
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PRESTRESSED PIPE

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INVENTOR.
JAMES T. KENNEY

BY
Christie, Parker & Hale
ATTORNEYS

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PRESTRESSED PIPE

James T. Kenney, Arcadia, Calif., assignor, by mesne assignments, to Idevel Corp., Pasadena, Calif., a corporation of California

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This invention relates to pipe structures and more specifically to prestressed concrete pipe structures.

Concrete pipes are laid end to end and abut one another to form conduits through which oil, gas, water and the like are caused to flow. Concrete pipe is usually made in sections of such a size as to facilitate manufacturing, transportation, handling and installation. It is common practice to form the pipe sections with a spigot end and a bell-shaped end, the latter being referred to as the bell end. The pipe sections are laid end to end with the spigot end of one pipe engaging the bell end of a companion pipe. It is customary to employ an O-ring seated between the two engaging ends of companion sections in order to insure a fluid tight seal.

When fluids are caused to flow through the conduit, pressures are established against the inner surface of the pipe sections which may be relatively high, say on the order of 150 to 300 pounds per square inch. Internal fluid pressures establish forces radially outward. If the forces thus established exceed the ability of the pipe to withstand them, the result is a rupture or a break in the pipe with a consequent loss of fluid pressure at such points. It has been the practice in the past to prestress the pipe sections. Prestressing as herein used refers to the use of a wrapping such as wire or other material which is wound around the outside of a pipe structure, tensioned to a desired amount and secured in place on the pipe for the purpose of maintaining the pipe in compression. The wrapping material is usually covered with a protective coating such as gunite which serves to preserve the wrapping material, usually metallic, from corrosion. Essentially the protective coating serves to keep moisture away from the metallic wrapping material.

Damage to the protective coating may occur in transporting and installing the pipe as well as during intermediate stages of handling. Even if installed without damage, the protective coating is eroded away with the passage of time, and as a result of one or more of these factors, some of the metallic wrapping may be exposed to moisture. This in turn leads to corrosion of the metallic wrapping material and ultimately to a loss of tension as by stretching or even parting of the wrapping material. Since the pipe sections are usually wrapped from end to end by a continuous piece of material which is tensioned and secured to the pipe at each end, it is readily seen that if the wrapping is parted or otherwise loses its tension at one point, the entire pipe section loses its prestressed condition. In other words, if one or more prestressed turns are broken or otherwise detensioned, the tension is lost throughout the entire length of the associated pipe section. Accordingly, where the prestressed wrapping fails, the entire pipe section is weakened and must be replaced if relatively high fluid pressure is to be withstood.

In order to overcome the foregoing disadvantages, a pipe structure is provided according to this invention which permits one or more turns of prestressed wrapping to become defective, as by parting or otherwise losing its tension, without changing the prestressed condition of the remainder of the associated pipe section. According to a preferred arrangement, metallic wrapping is employed from end to end on a concrete pipe structure, tensioned to the desired amount and secured

on the pipe, as by connecting back on itself at the ends. A locking groove is disposed in the concrete pipe below the metallic wrapping and extends longitudinally of the pipe throughout the length of the metallic wrapping. This groove may extend in a straight line on one side of the pipe or it may be skewed so as to extend spirally along and around the pipe. The locking groove is filled with a suitable material such as a lead-tin alloy or an epoxy resin. This material fills the groove and extends beyond or above the groove a sufficient distance to envelope or engulf the metallic wrapping in the vicinity of the locking groove. This material acts as a filler which tightly grips the wrapping, and being seated in the groove beneath the wrapping, it is wedged or held in the groove and restrained from movement. Thus it holds the individual turns of the wrapping material in position. The gripping action of the filler material is sufficiently strong to keep the turns from slipping therethrough under the forces of tension employed in the prestressing operation. Essentially the filler serves as a mechanism to secure each turn of the wrapping material to the pipe section. With this construction a defect in one strand will not result in adjacent strands losing their tension. Instead the adjacent strands are held tightly in position by the filler material and the locking groove, and only the loss in strength from one strand of the wrapping is lost. Accordingly, it is not necessary to replace the pipe section as was earlier the case. Because the wrapping material may be of rather small diameter of wire, many turns of such wire may be employed on a pipe section, and the loss in tension of one or more turns does not usually weaken the pipe sufficiently to render it defective. In fact, numerous turns of wrapping material, especially when widely separated, may become defective without destroying the minimum prestress requirement of a pipe section.

These and other features of this invention may be more fully appreciated when considered in the light of the following specification and drawing which is a perspective view, partly broken away.

The pipe section **10** in the drawing is made of a good grade of concrete so as to provide strength and high resistance to wear and corrosion. In order to provide additional strength, prestressing techniques are employed. When fluids under pressure are caused to flow through the pipe **10**, they establish forces radially which counteract the forces of compression established by the prestressing. Thus prestressing tends to increase the fluid pressure which a concrete pipe section may handle without rupturing. The concrete pipe section **10** is prestressed by a metallic wire **12** that extends from end to end of the pipe section **10**. The wire **12** is disposed over a concrete liner **14**, and a protective coating **16** serves to prevent erosion of the wire by keeping out moisture. A locking groove **18** extends throughout the length of the wire wrapping. Although this groove may extend spirally along the length of the pipe, it is illustrated for convenience as extending in a straight line along the pipe. A filler material **20**, preferably epoxy, is disposed in the locking groove as shown and envelops the turns of the wire **12** in the region of the groove. The groove is made deep enough to prevent the filler material **20** from slipping around the liner **14**. The turns of wrapping hold the filler in the groove and further insure against the filler slipping around the liner. The groove is made wide enough to give the filler material adequate strength to prevent rupturing by forces in shear established on the filler when one or more of the turns of the wire **12** are parted or otherwise lose their tension. The thickness of the concrete pipe liner **14** must be sufficient to provide the minimum strength required with the weakening effect of the locking groove **18** taken into account. In order to minimize the thickness

requirements of the liner 14, the depth of the locking groove 18 is made as small as possible consistent with the demand of maintaining the filler 20 against slipping around the liner.

The filler 20 is broken away in order to show how the turns of wire engage the concrete liner 14. Note that turns 30 and 32 lie tightly against this liner after the wire 12 is prestressed. The filler is installed after the wrapping is tensioned. In order to illustrate the operation of the locking groove 18 and the filler 20, assume that the turn 34 is parted after the pipe section 10 is constructed. Consequently, no force is exerted on the filler 20 by the turn 34 at the points 36 and 38. However, the turn 40 exerts a force at the point 42 in the direction indicated by the arrow there, and the turn 44 exerts a force at the point 46 in the direction indicated by the arrow there. Consequently the forces at points 42 and 46 are established in opposite directions and tend to shear the filler 20 along the line 48. The strength of the filler 20 must be such as to withstand this force in shear. Hence the cross-sectional area of the filler 20 along the line 48 must be of a minimum area which varies with and is determined by the magnitude of the forces acting at points 42 and 46 and the strength in shear of this material. Even though the turn 34 loses its tension, the adjacent turns 40 and 44 as well as all remaining turns retain their tension. Although the turns of the metallic wrapping 12 are shown widely displaced from each other for convenience, it is to be understood that the turns may be very closely wound. The pitch of the turns will vary in every construction according to the amount of prestressing desired. The less the pitch the greater is the prestressing obtained.

Accordingly, there is provided a prestressed concrete pipe structure wherein numerous turns may become defective or detensioned without destroying the minimum prestressed condition of a pipe structure necessary for fluid tight integrity in a conduit. Numerous modifications will readily suggest themselves to those skilled in the art in view of the foregoing description concerning the cross-sectional contour and course of the locking groove, various other types of materials which may be employed as a filler in a concrete pipe structure and numerous equivalents for securing each turn of wrapping material to a pipe structure.

What is claimed is:

1. A concrete structure including a hollow concrete liner, a continuous metal strip under tension wrapped around the liner and extending from end to end of the liner, the liner having a groove extending lengthwise thereof and transversely of the wrapping strip, a cement material disposed in the groove and engulfing the metal strip along a narrow band where the turns of wire bridge the groove, the cement material having a bonding strength to the metal which is greater than the tension in the metal strip whereby successive turns of the metal strip are locked to each other to prevent loss of tension with a break in any turn of the metal strip.

2. Apparatus as defined in claim 1 wherein the cement mentioned is an epoxy resin.

3. Apparatus as defined in claim 1 wherein the cement is a lead-tin alloy.

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