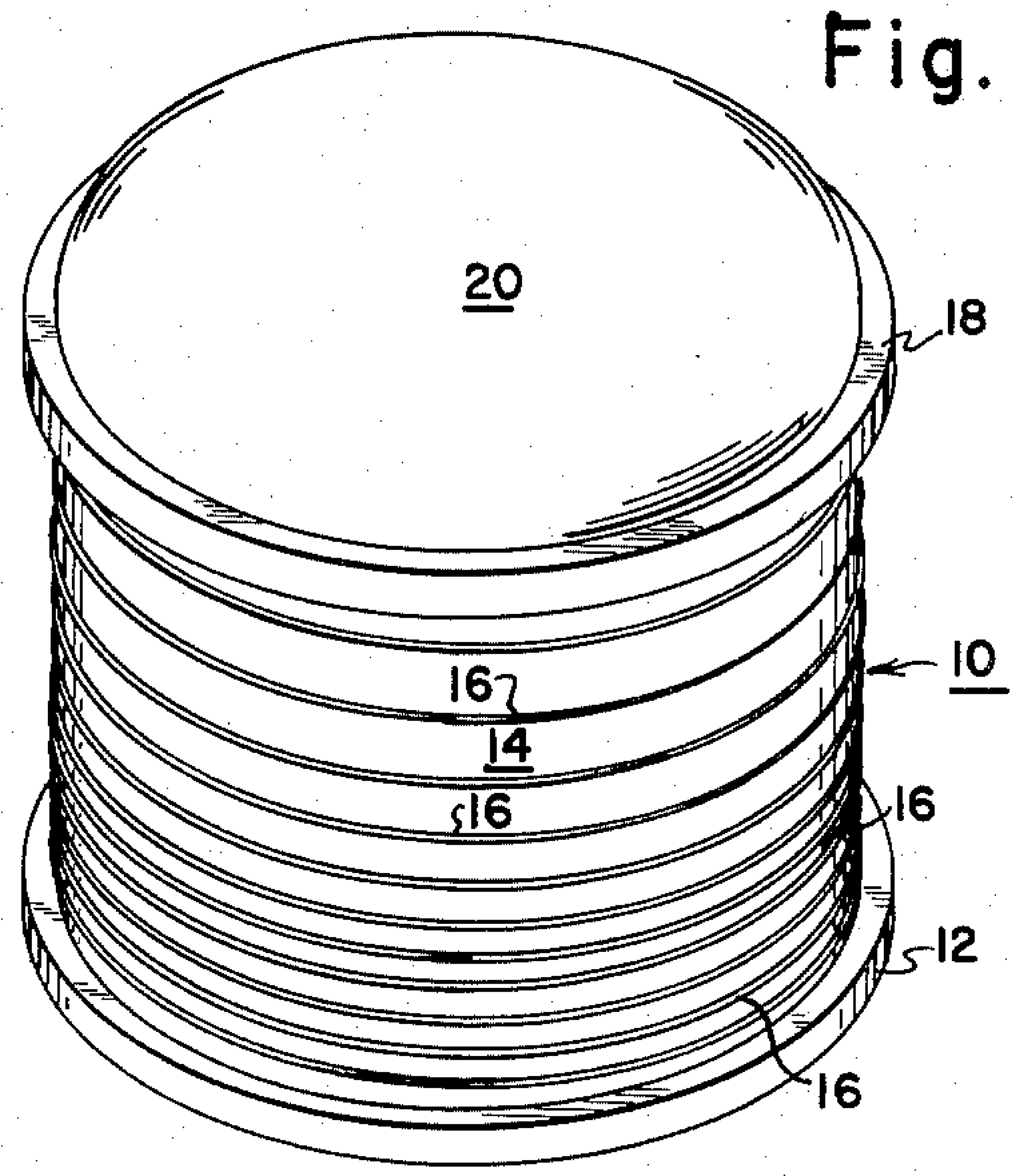
March 22, 1966 L. MAGERS, JR 3,241,278

PRESTRESSED CONCRETE STRUCTURES

Filed March 28, 1961

Fig. 1



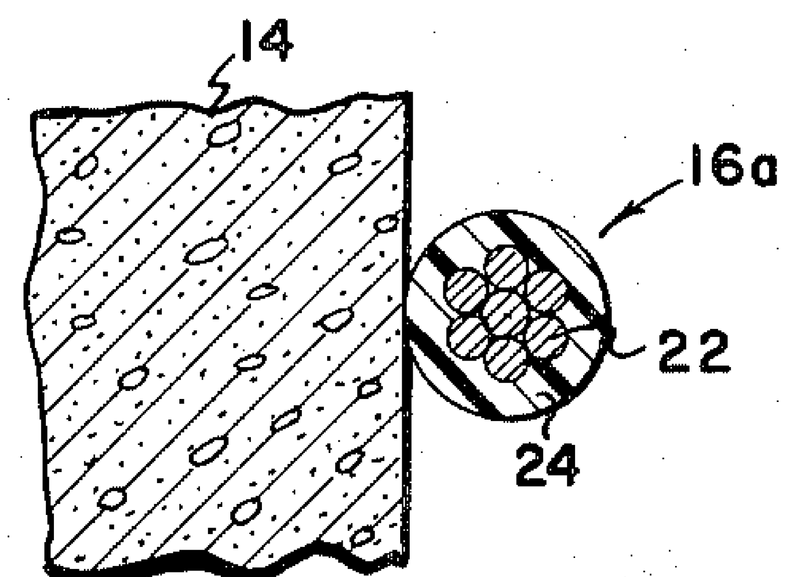


Fig. 2

Fig. 3

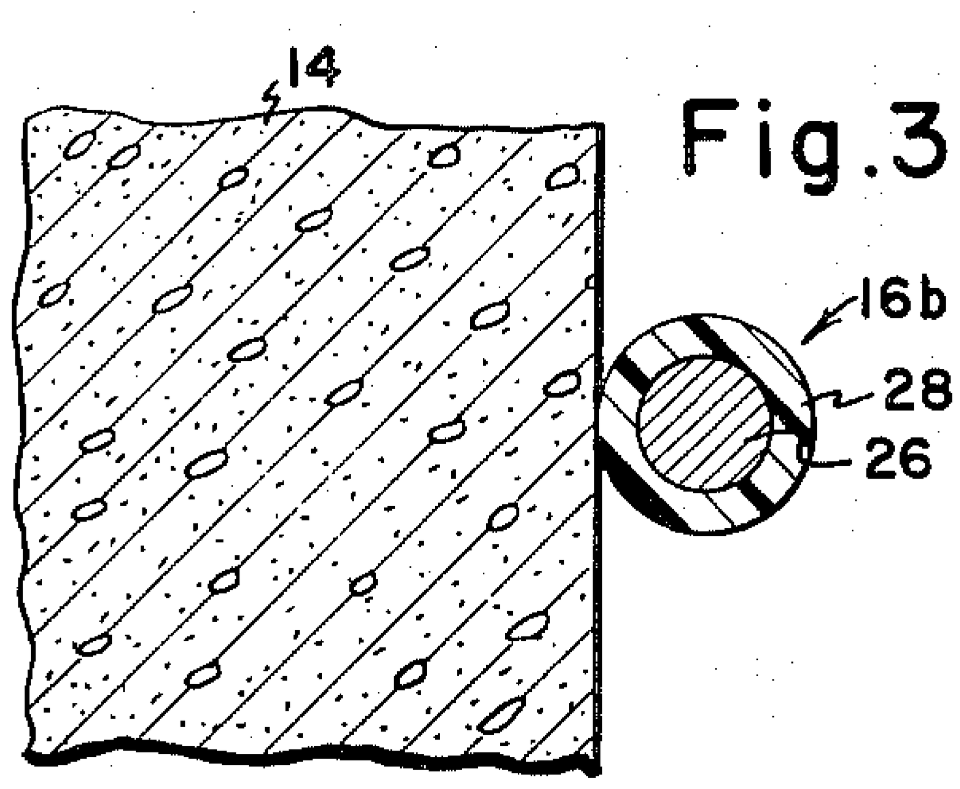
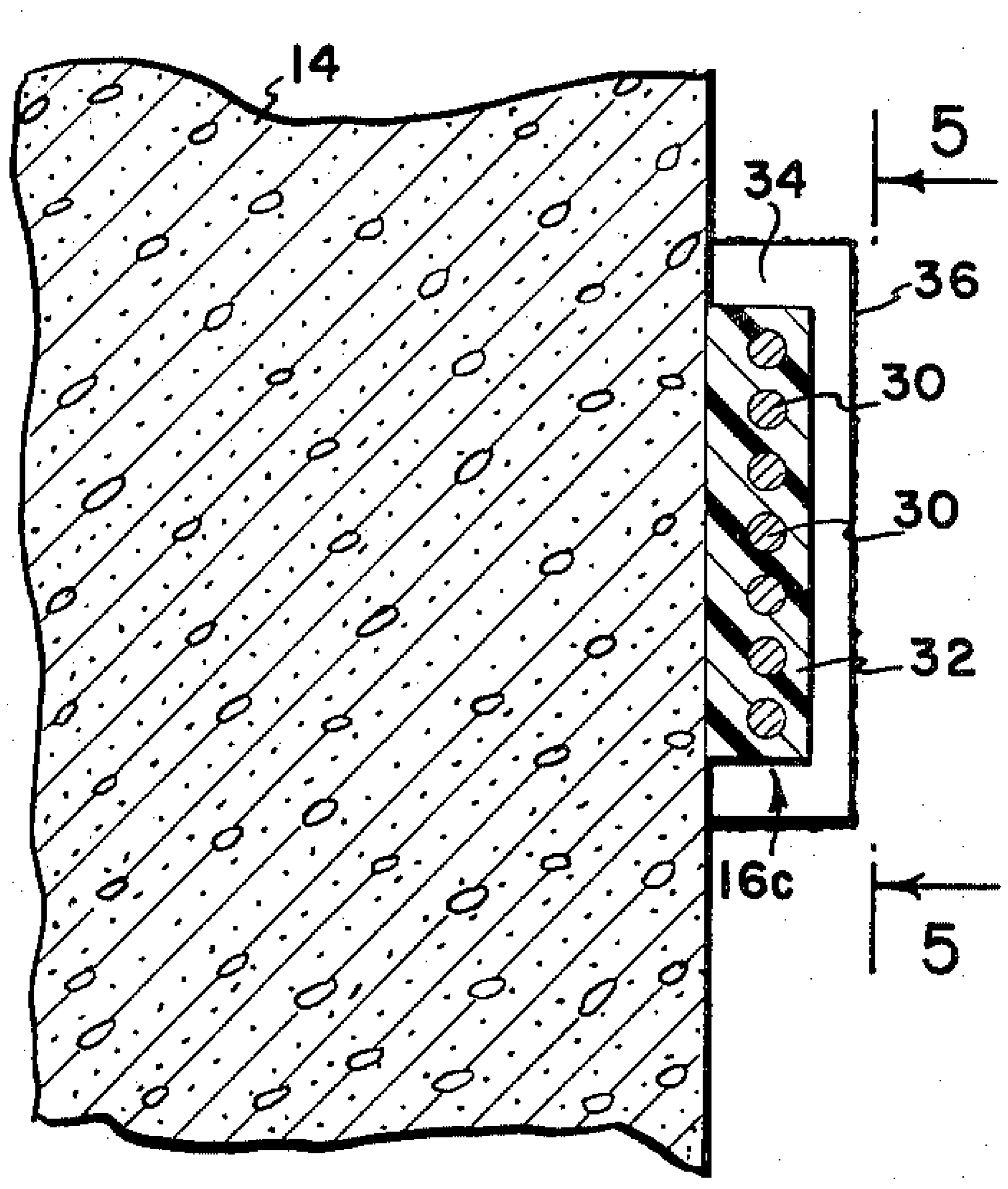


Fig. 4



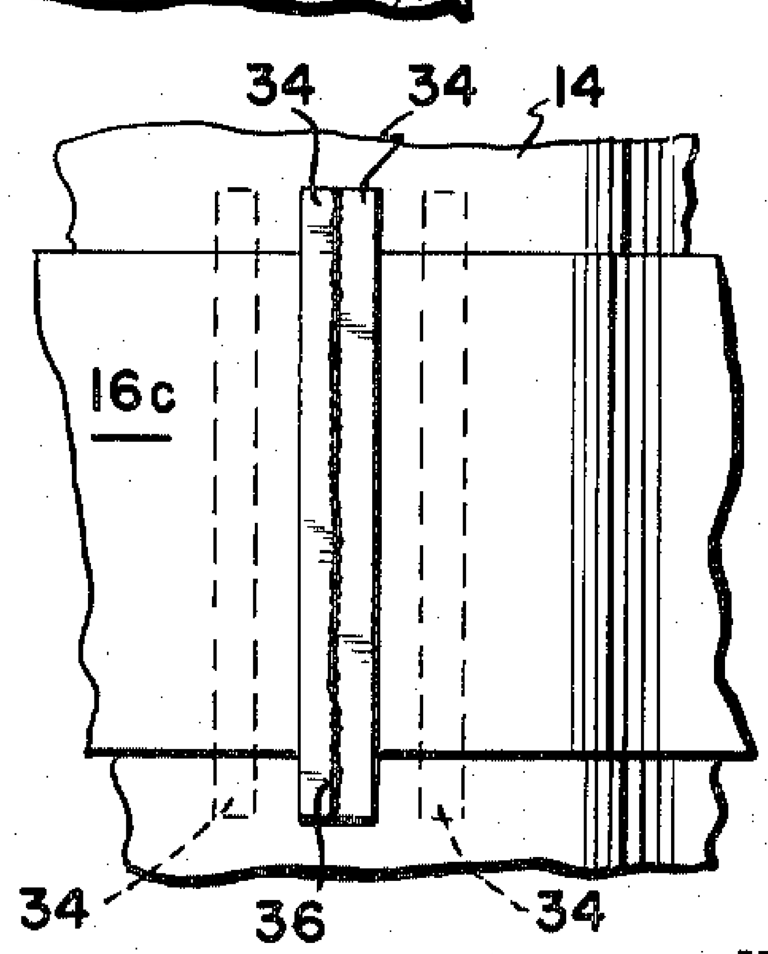


Fig. 5

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PRESTRESSED CONCRETE STRUCTURES

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4 Claims. (Cl. 52—224)

This invention relates to improved prestressed concrete structures and, in particular, to the protection of the tendons used to prestress the structures.

Prestressed concrete structures are widely used for many purposes including storage tanks, silos, reinforcing rings for dome top roofs, and other substantially cylindrical structures. Cylindrical prestressed concrete structures are generally constructed by first erecting an annular concrete core wall or ring which may or may not be reinforced. In the case of a wall, a suitable foundation is constructed before the wall is erected. When a dome ring is to be constructed the supporting wall for the ring must also be first erected.

About the core wall or ring a series of convolutions of prestressing tendons are positioned. These tendons are tensioned and elongated a controlled amount so that the concrete wall or ring is radially compressed and has a resultant post-tension stress developed therein. Since the wall is subjected to radial compressive forces, it is necessary that the wall be of sufficient thickness to withstand the stress.

The tendons are generally formed from high tensile strength steel wires, rods, cable, or strand.

Such steel tendons are easily subjected to corrosion unless adequate measures are taken to protect them. Heretofore, the standard method of protection has been to coat the tendons with a material of cementitious nature, usually mortar. The mortar coating is applied over the tendons by means of a mechanical spraying apparatus or by building a form about the tendons and pouring mortar into the form.

One of the problems with mortar coatings has been the problem of cracks and leaks developing in these coatings. When this occurs, moisture enters into the cracks and corrodes the steel tendons. Also, in the case of tanks, cracks sometimes occur in the concrete core wall. Such cracks permit liquid such as water to leak out and seep between the wall and the mortar coating causing corrosion of the tendons. This internal leaking creates a serious problem due to the fact that the leak may occur in one portion of the wall and travel a substantial distance around the tank before seeping out through the coating.

Such leaks are not only difficult to locate but highly costly to repair. This creates a serious maintenance problem and heretofore it has deferred some potential users of prestressed concrete tanks from using such constructions.

In the present invention it is contemplated that a cementitious coating of the entire tank may be eliminated if desired. To accomplish this, the tendon is advantageously enveloped with a protective wrapping or sheath during the prestressing operation when the tendon is applied to the tank or, if desired, before it is applied. By so protecting the tendons with a fatigue and abrasive resistant material, such as polyvinyl chloride, the tendons are protected from atmospheric attack or humidity conditions. Further, the tendons are easily inspected and if cuts or tears occur in the coating, repairs may be quickly and easily accomplished. If desired, the coating material may be transparent or at least translucent, so that any discoloration of the tendon by corrosion may be easily noted and repairs made before the structural strength of the tendon is impaired.

A prestressed tank with coated tendons has an advantage of being more economical to construct than the prior art structures, as well as being easier and more economical to maintain. In addition, if a leak occurs in the concrete core wall, it may be easily located, and quickly repaired without the necessity of removing large portions of a mortar coating.

In the accompanying drawings and in the specification several embodiments of the present invention are shown. It is to be understood that these embodiments are for the purpose of illustration and they are not to be construed as limiting the present invention, but rather they are for the purpose of disclosing the invention to those skilled in the art so that it may be practiced in various embodiments, each within the spirit and scope of the invention as claimed herein.

In the drawings:

FIGURE 1 is a perspective view of a prestressed concrete tank constructed in accordance with the present invention;

FIGURE 2 is a fragmentary sectional view of a core wall of the tank showing a coated prestressed strand element tensioned against the wall;

FIGURE 3 is a fragmentary sectional view of the core wall of the tank showing a coated prestressed solid tendon against the core wall;

FIGURE 4 is a fragmentary sectional view of the core wall showing a tendon band of several wires encapsulated in a protective film positioned against the core wall; and

FIGURE 5 is a fragmentary view of the core wall and tendon band of FIGURE 4 in the direction of lines 5—5 of FIGURE 4.

Referring to the drawings and to FIGURE 1 in particular, a tank **10** is shown which is comprised of a footing **12**, a concrete annular core wall **14**, prestressing tendons **16** encircling the wall and a dome ring **18** which supports a dome shaped roof **20**. The tank **10** is erected by first constructing the footing **12**. The concrete core wall **14** is then placed and when it has set the wall is prestressed by wrapping it with a series of convolutions of high tensile strength tendons **16**, such as steel wires, rods, cable or strand. Means and methods for wrapping the tendons **16** about the tank wall in order to prestress them are well known in the art. Such automatic prestressing apparatus and a method of using it is shown in U.S. Patent No. 2,364,696. Another method of tensioning the tendons about the tank wall is shown in the copending application, Serial No. 60,682, filed October 5, 1960, now Patent No. 3,123,942, and assigned to the same assignee as the present application.

With the annular wall **14** in place the dome roof **20**, may be erected and prestressed by means of the dome ring **18**. The dome ring **18** is an extension of the wall **14** and is generally characterized by a construction which is comprised of a number of tendons wrapped about the upper portion of the wall **14** so that the roof **20** is prestressed and placed under tension.

As shown in FIGURE 1, no protective coating is required to be placed over the entire tank wall **14**. The necessity for such a coating is eliminated by use of a protective sheathing of suitable plastic material which is formed about the steel core of the tendon **16** and protects it from corrosion.

In FIGURES 2, 3, and 4, several embodiments of coated tendons are shown.

In FIGURE 2, a coated tendon **16*a*** is shown which is comprised of a strand steel core **22**, about which is placed a suitable coating **24**. The coating **24** is advantageously made of a scuff and abrasive resistant flexible plastic which is fatigue resistant and substantially unaffected by atmospheric attack or humidity conditions. A suitable plastic material is plasticized polyvinyl chloride or copolymers thereof such as polyvinyl chloride-acetate copolymers.

In FIGURE 3 a solid rod or heavy wire **26** serves as the core for the tendon **16*b***. A similar plastic coating **28** is placed about the core **26** and protects it from corrosion.

In FIGURE 4 several fine wires **30** are encapsulated in a plastic sheet **32** to form a band-like tendon **16*c***. In using tendon **16*c***, the wires **30** and coating **32** are prefabricated and cut to a predetermined length before being applied to the tank. To apply the tendon **16*c*** the plastic and wire belt combination is wrapped around the tank and the ends drawn together by suitable means such as jacks, torque wrenches, etc.

In FIGURE 5 a joint formed in a belt combination tendon **16*c*** is shown. Attached to each end of the tendon **16*c*** is a flange **34** to which the wires **30** are anchored. When the untensioned tendon **16*c*** is first placed about the tank the flanges **34** are spaced apart a substantial distance. By jacking the flanges together and welding them in place at **36**, a predetermined elongation of the wires **30** is achieved, with the corresponding tensile strength also being developed therein. If the plastic coating **32** is not sufficiently stretchable to be elongated to the same extent as the steel wires **30** a filler patch of plastic material may be applied between the flanges **34** and the end of the plastic material so that the entire length of the wires **30** will be coated.

In prestressing the tendons **16** a permanent elongation is obtained and a tensile stress developed in the steel core in the order of about 120,000 p.s.i. While the tensile stress developed in the steel core is quite high, the radial force developed by the tendon against the concrete wall is quite low. This radial force is not sufficient to extrude the plastic coating of the tendon to a point where the core is uncoated.

The present invention provides a tank construction which is economical to build and easy to maintain.

I claim:

1. A substantially corrosion resistant cylindrical concrete structure comprising an annular wall of substantial thickness and sufficient to withstand forces applied thereto, a series of convolutions of high tensile strength tendons wrapped about the outer face of the wall under substantial tension, said tendons being elongated a desired amount whereby the concrete wall is prestressed and circumferentially compressed by the radial pressure exerted by the tensioned tendons, and a preformed, flexible and scuff and abrasive resistant plastic coating completely enveloping each tendon and applied thereon before said tendons are wrapped and tensioned about the wall, a portion of said coating being positioned between the outer face of the wall and the tendon, said plastic having sufficient resistance to extrusion to resist the radial force developed by the tendon whereby the tendon remains enveloped in the plastic coating under said radial force.

2. A substantially cylindrical concrete structure as defined in claim **1** wherein said tendon has a solid core of high tensile strength steel.

3. A substantially cylindrical concrete structure as defined in claim **1** wherein said tendon has a strand core of high tensile strength steel.

4. A substantial cylindrical corrosion resistant concrete structure as defined in claim **1** wherein each of said tendons has a core of high tensile strength steel and said steel has a tensile stress developed therein in the order of about at least 120,000 p.s.i.

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