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PRESTRESSED CONCRETE STRUCTURES

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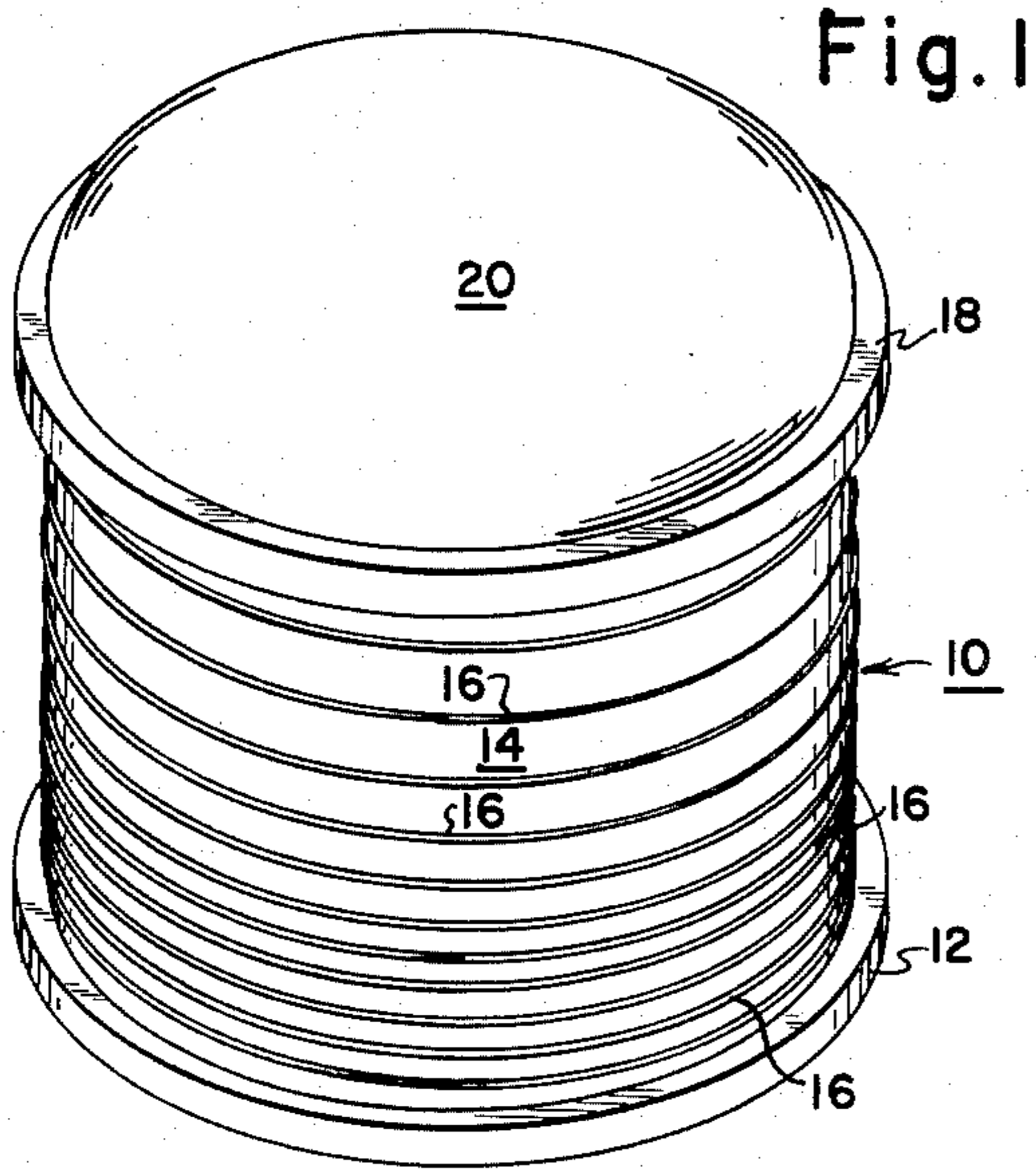


Fig. 1

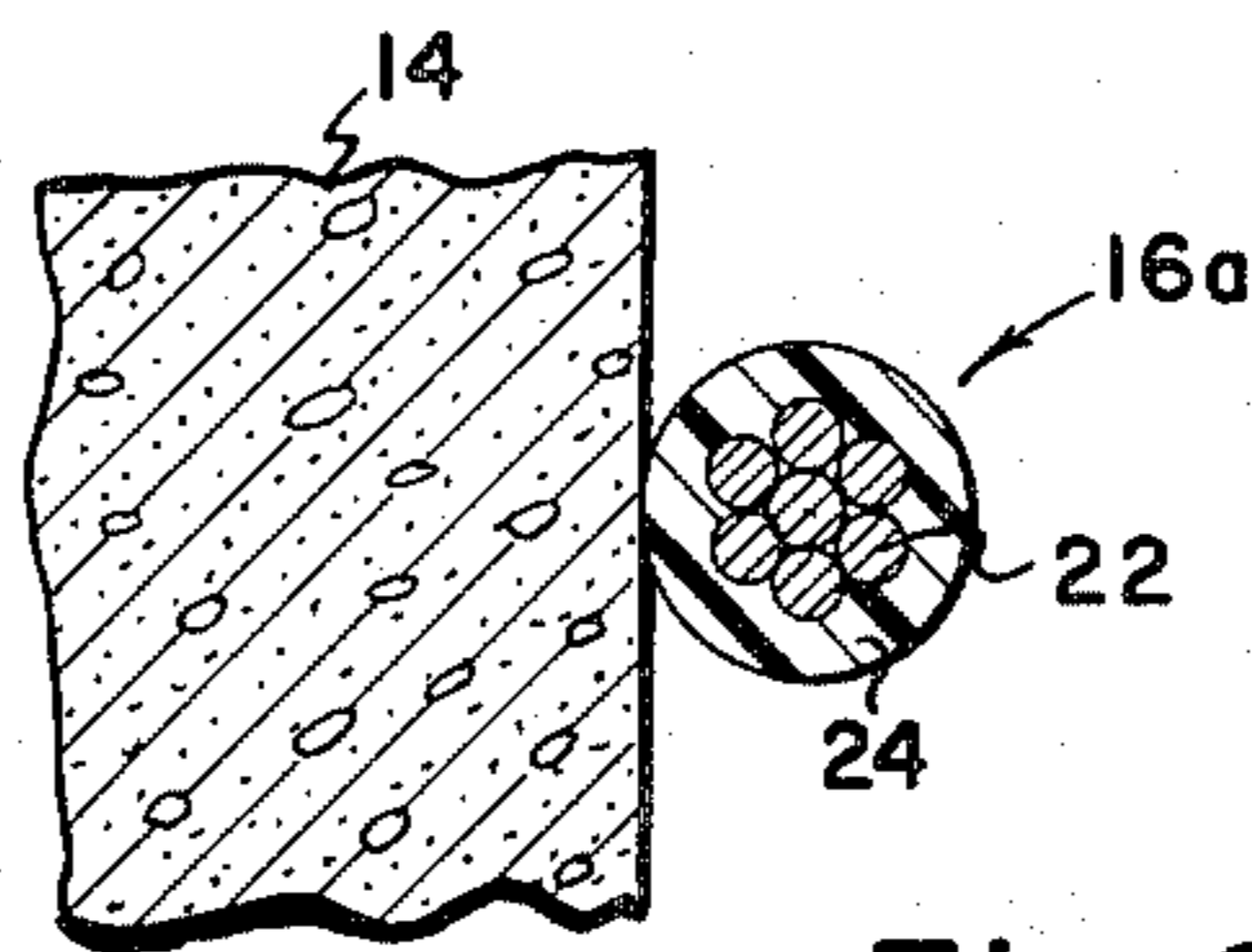


Fig. 2

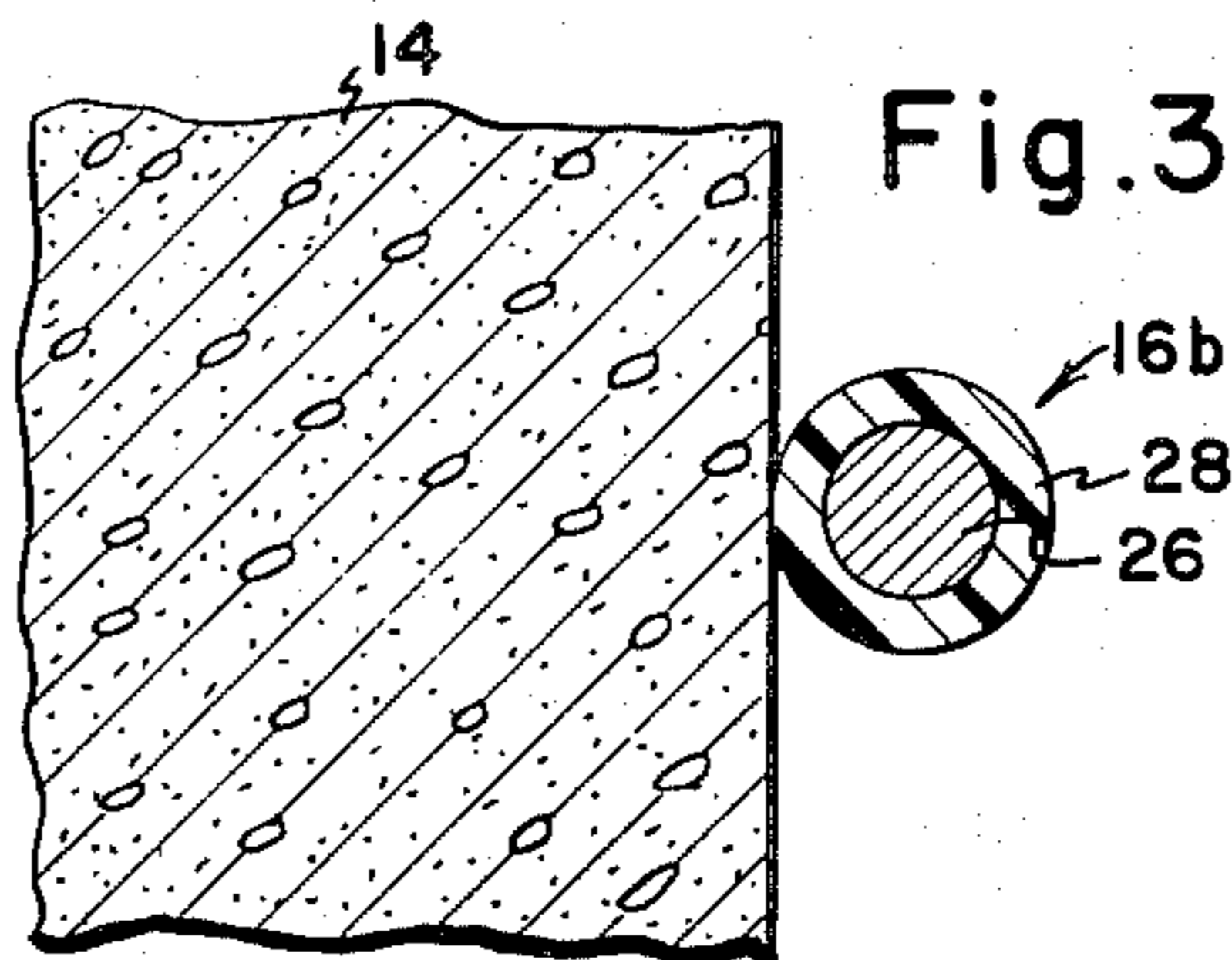


Fig. 3

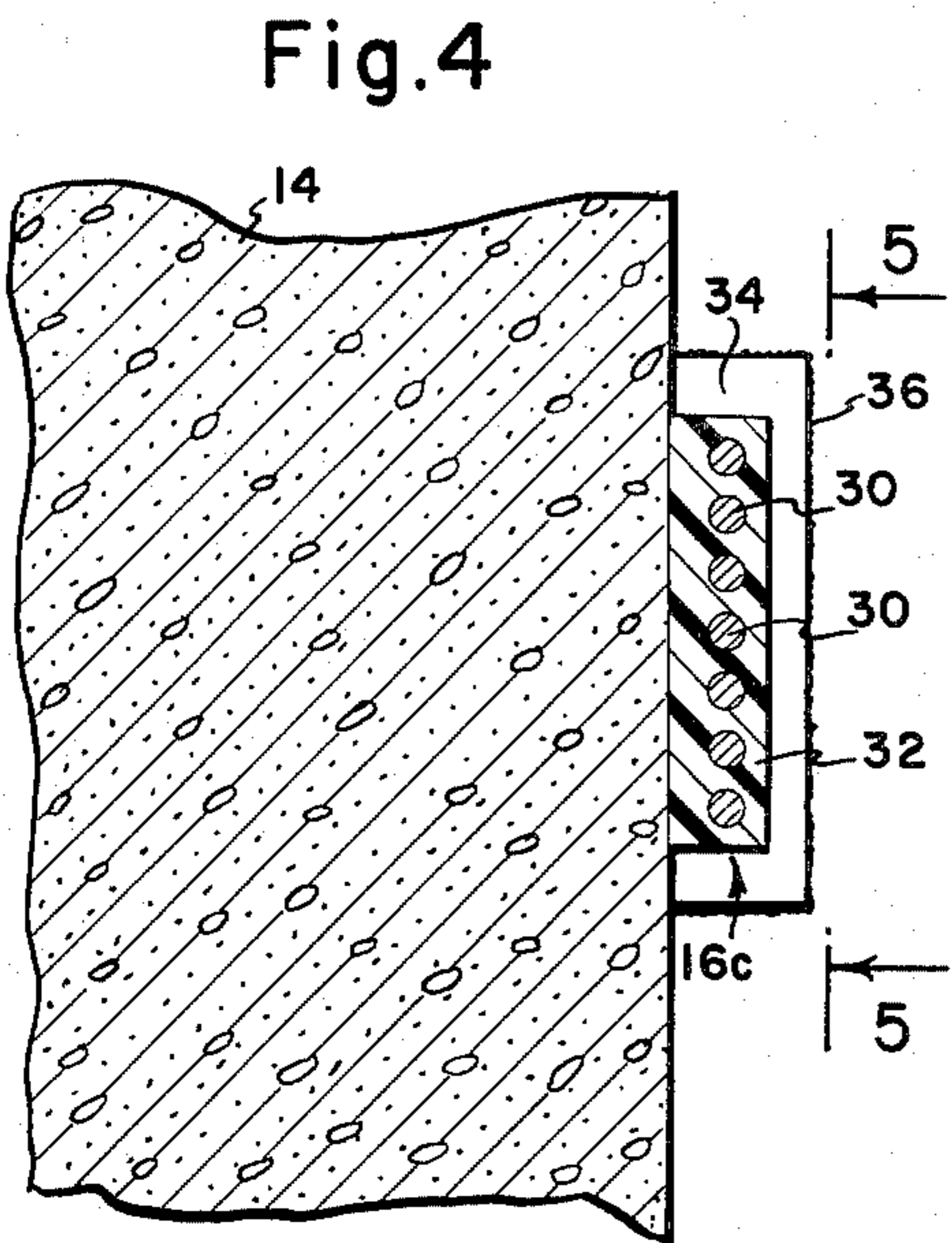


Fig. 4

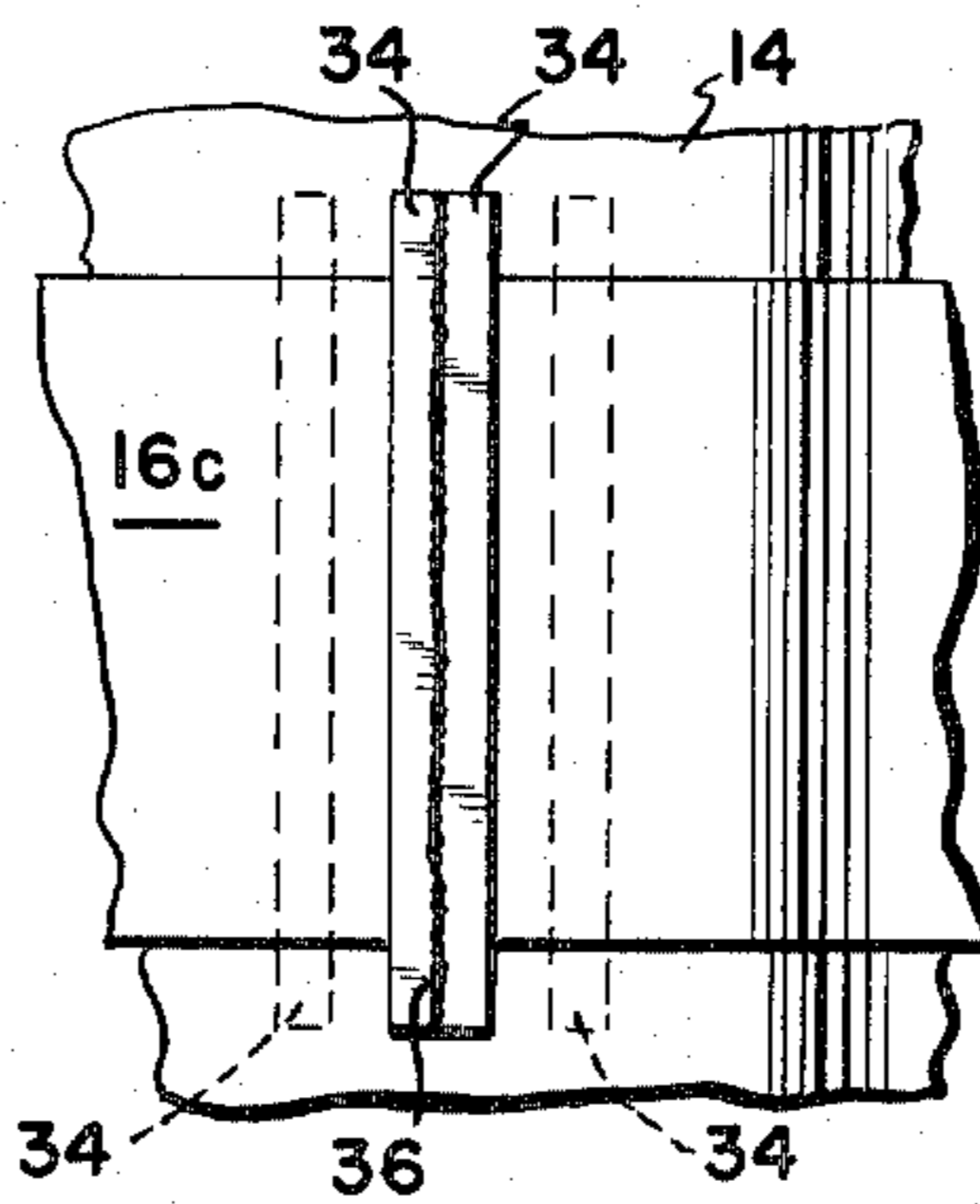


Fig. 5

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PRESTRESSED CONCRETE STRUCTURES

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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 advan-

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tage 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 16a 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 co-

polymers thereof such as polyvinyl chloride-acetate copolymers.

In FIGURE 3 a solid rod or heavy wire 26 serves as the core for the tendon 16b. 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 16c. In using tendon 16c, the wires 30 and coating 32 are prefabricated and cut to a predetermined length before being applied to the tank. To apply the tendon 16c 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 16c is shown. Attached to each end of the tendon 16c is a flange 34 to which the wires 30 are anchored. When the untensioned tendon 16c 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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