April 7, 1970 M. J. DYKMANS 3,504,474

STACKED RADIAL WINDING

Filed April 2, 1968

FIG. 10.

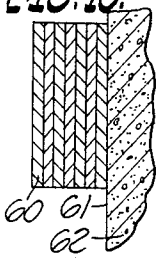


FIG. 11.

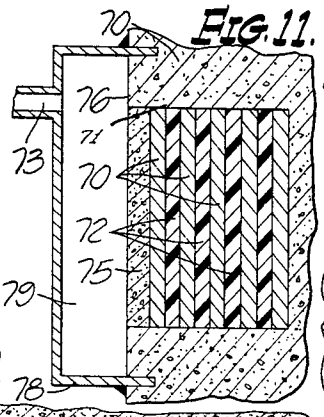


FIG. 1.

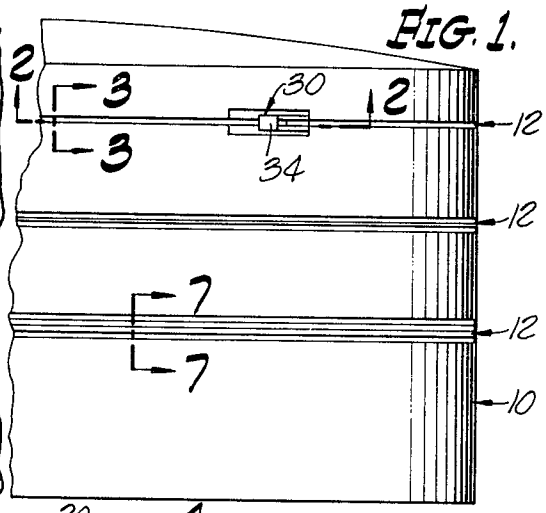
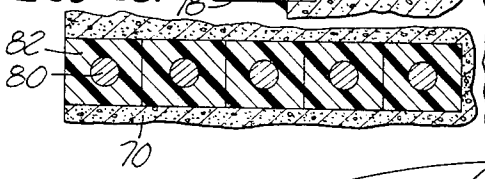


FIG. 12.



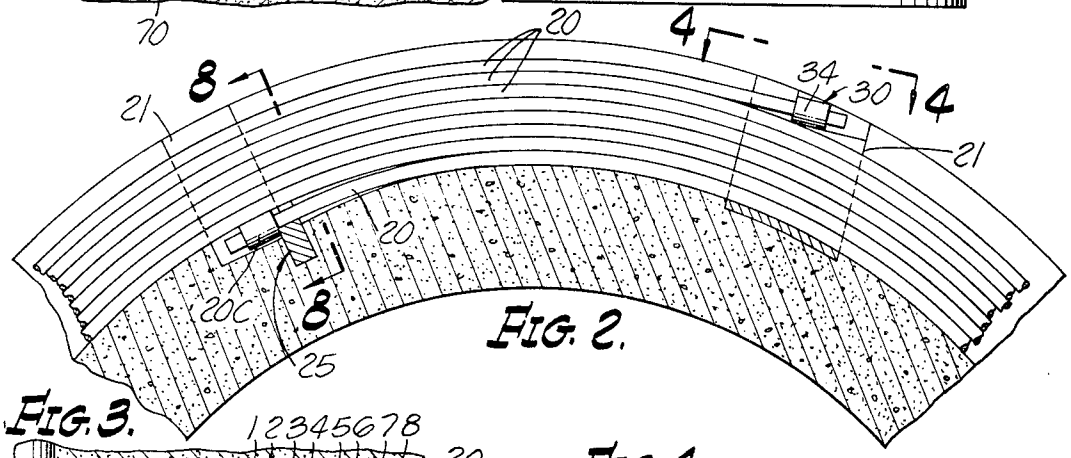


FIG. 2.

FIG. 3.

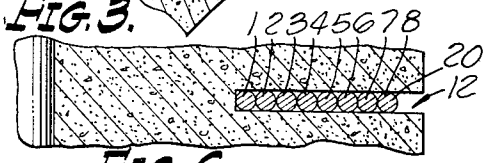


FIG. 4.

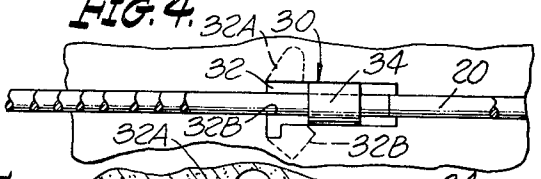


FIG. 6.

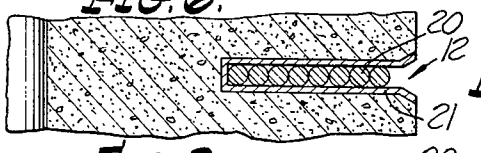


FIG. 5.

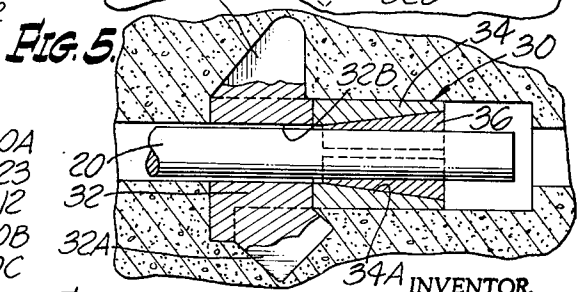


FIG. 7.

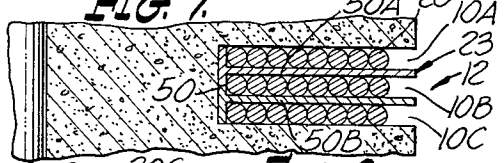


FIG. 8.

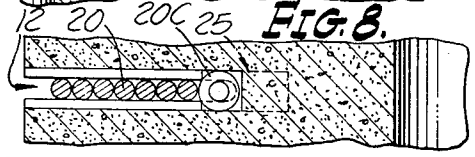
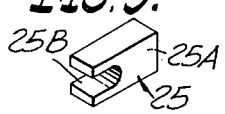


FIG. 9.



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STACKED RADIAL WINDING

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U.S. Cl. 52—741 2 Claims

ABSTRACT OF THE DISCLOSURE

In prestressing structures of concrete, metal or other materials an elongated element such as wire, strip or the like is wound either within a slot or on the outer surface of the structure such that there is a radial stacking of convolutions of such element. In one arrangement a slot is formed in the concrete having a thickness commensurate with the diameter of wire which is then wrapped to fill the slot and obtain a high concentration of forces in a narrow band. Successive individual slots are so filled by wire wrapping in sections such that one section may be removed without disturbing other sections. The elongated element may be wound such that successive radially disposed layers or convolutions are applied with increasing tension. For minimizing corrosion possibilties the elongated element such as piano wire may be embedded in an epoxy or fibreglass.

The present invention relates to means and techniques useful in the prestressing of structures.

A general object of the present invention is to provide improved means and techniques whereby a high concentration of forces may be obtained in a narrow band in a simple and expeditious manner.

Another object of the present invention is to provide a new tank construction particularly useful in the construction of circular structures such as, for example, water reservoirs, nuclear reactor, pipe and pressure vessels in general wherein it is desired to confine pressures safely.

Another object of the present invention is to provide improved means and techniques which allow convenient servicing if and when it becomes necessary to remove the wire or strip wrapping as, for example, under conditions of corrosion.

Another specific object of the present invention is to provide improved means and techniques whereby individual sections of wire or strip wrapping may be removed and replaced without disturbing other sections of wrapping.

Another specific object of the present invention is to provide improved means and techniques for minimizing or obviating corrosion problems.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is a view of a circular concrete structure in which prestressing is accomplished in accordance with features of the present invention.

FIGURES 2 and 3 are views taken as indicated by lines **2—2** and **3—3** in FIG. 1.

FIGURE 4 is a view taken as indicated by line **4—4** in FIGURE 2.

FIGURE 5 illustrates in enlarged form and in section details of the cable clamp shown in FIGURE 4.

FIGURE 6 illustrates a modified form of the invention.

FIGURES 7 and 8 are views taken as indicated by lines **7—7** and **8—8** in FIGURES 1 and 2 respectively.

FIGURE 9 is a perspective view of the anchoring device shown in FIGURES 1 and 8.

FIGURES 10–12 illustrate modifications of the invention.

The present invention is particularly useful in the prestressing of a concrete structure exemplified in FIGURE 1 as being a water reservoir, nuclear reactor housing and/or shield or pressure retainer, pipe or any other like vessel intended to maintain internal pressures. The concrete structure **10** is initially formed with an annular grooved portion or slot indicated generally by the reference numeral **12** having a width commensurate with the diameter of the wire, strand or cable which is ultimately wrapped around and in such slot under tension to obtain a prestressing of the concrete.

As shown in FIGURES 1 and 8 this slot **12** may, for example, be of a width slightly larger than the diameter of the wire **20** or as in FIG. 6 to accommodate additionally a metal liner **21**, or as in FIG. 7 to accommodate three diameters of wire in addition to two thicknesses of a separator **23**.

During and/or after winding of the wire, cable anchoring devices of the character exemplified in FIGURES 4, 5 and 9 and previously secured in the concrete may be used.

The anchoring device of FIG. 9 involves a bar **25** having a base portion **25A** intended, as shown in FIG. 8, to be placed in the concrete prior to its hardening. The exposed end is formed with an open slotted portion **25B** of width slightly larger than the diameter of wire **20** upon one end of which is secured a circular collar **20C** adapted to contact such bar **25** whereby such wire end is retained or secured during and after the subsequent wire wrapping operation.

It will be seen that such winding operation involves placement of the innermost convolution first such that the order of winding is as indicated by the progressive series of numbers **1, 2, 3, 4, 5, 6, 7, 8** in FIG. 3. After the last convolution is wound (the eighth convolution in the example illustrated) the wire is secured using for example, the wedge type anchoring device **30** shown in FIGS. 4 and 5.

The device **30** involves generally a split anchored collar **32** having a plurality of tabs or fingers **32A** embedded in the concrete and the same may include a slotted portion **32B** of width slightly larger than the diameter of the wire to allow placement of the wire. A sleeve **34** having an internal tapered portion **34A** abuts the collar **32** and receives a plurality of generally circular wedges **36** which are driven into the sleeve to secure the wire end passing therethrough.

In the form of the invention shown in FIG. 6 the concrete slot may be lined continuously or at different spaced locations with metal liner **21** which may be of one piece construction or may comprise a plurality of arcuate sections joined together or spaced from each other. The order of winding as indicated in FIG. 3 is retained.

In FIG. 7 there are three separate sections **10A, 10B, 10C** with each section having its individual inner anchor device **25** and its individual outer anchoring device **30** staggered however circumferentially to provide clearance between anchoring devices.

Preferably as shown in FIG. 7 the individual windings **10A, 10B, 10C** are separated using dividers **50A, 50B** in the form of arcuate flat sheets each joined at their common base **50** which is contacted by the innermost convolution of each winding **10A, 10B** and **10C**.

The various arrangements have as one important advantage the fact that one section at a time may be replaced if and when necessary without disturbing the other wire wrappings. This is of particular importance when cor-

rosion problems are anticipated as in, for example, nuclear reactor constructions.

Another important advantage involves the fact that a high concentration of force is obtained in a narrow band.

It will be further appreciated that instead of metal wire other materials of other cross section configuration may be used. Thus, for example, the elongated prestressing element may be of nylon, fibreglass, Mylar, asbestos, glass of circular or square or rectangular cross section as, for example, in strip form. Further the structure which is to be prestressed may be of concrete, steel, metal, fibre, glass, wood or the like. Also the prestressing elongated element may be involve the use of a plurality of materials in a composite structure as, for example, piano wire embedded in any epoxy or fibreglass.

An important concept underlying the use of any of the arrangements is that the elongated element is radially stacked, i.e. successive turns or convolutions are on top of each other, this being so whether or not such stacking is accomplished inside of a groove as illustrated in the previous figures or as in FIGURE 10 where the elongated prestressing element **60** is in the form of a strip with successive convolutions wound on top of the next preceding convolution on the external wall **61** of structure **62** to form an external exposed bundle which may later be protected from corrosive effects using teachings herein.

Alternately, as in FIGURE 11, the strip **70** may be wound in an internal grooved portion **71** of structure **70**. The strips as in FIGURE 10 may be epoxy coated either before or during the wire wrapping such that the epoxy covers the surfaces and edges of the strip, i.e. the epoxy **72** shown in FIGURE 11 is in sandwiched relation between adjacent strip convolutions; and subsequently a much thicker coat of mortar, epoxy or other protective coating which may be flush with the outer wall **76** serves to completely fill the grooved portion **71**.

As alluded to previously and as exemplified in FIGURE 12, the piano wire **80** of circular cross section may be embedded in a plastic material **82** of general square or rectangular cross section and the composite structure **80, 82** is then wound either externally of or within a grooved portion of a structure. The plastic material **82** may be an epoxy and/or fibreglass. Of course the wire so may be of much larger cross-section than piano wire and may be square, rectangular or flat strip or other cross-sectional configuration.

It will be appreciated that the term width of elongated stressing material has reference to the diameter of the wire in, for example, FIGURES 3, 6, 7 and 8 and to the width of the strip in FIGURES 10 and 11 and to the width of the composite structure **80, 82** in FIGURE 12.

Also as alluded previously successive convolutions may be wound while being maintained at an increased tension. For example, the first convolution may be wound while mounting a tension on the stressing material of X pounds and the second layer may be wound while maintaining a pressure of X plus YX pounds where Y may either be greater or less than one.

Winding in a slot as described previously has the additional advantage that the slot itself defines part of a chamber which may be maintained under vacuum or may be pressurized for anti-corrosion purposes. In the latter instance an inert pressurizing gas may be used. To withstand such vacuum or pressurization a circumferentially extending channel shaped structure **78** is sealingly mounted to enclose the slot **71** and materials therein to form a closed chamber **79** in comunication with a nipple portion **73** to which subatmospheric, atmospheric, or above atmospheric pressures may be applied.

While the drawings illustrate specifically only wire anchoring means it will be appreciated that conventional means may be used to anchor the stressing element when such element has a cross section other than a circular cross section.

I claim:

1. In a system for prestressing a structure using an elongated stressing element, the steps comprising forming a slot in said structure, stacking by winding convolutions of said element in layers, one over the other, with each successive upper convolution of said element being immediately above the preceding lower convolution of said element to form a first stack in said slot with the width of the stack being equal to the width of the element, again stacking by winding in the same manner convolutions of said element in said slot to form a like second stack adjacent to said first stack while maintaining the two stacks spaced one from the other such that if and when desired one of such stacks may be removed without disturbing the other stack.

2. In a system for prestressing a structure using an elongated stressing element, the steps comprising forming a slot in said structure having a width commensurate with the width of said element and having a depth exceeding several thicknesses of said element, securing one end of said element near the bottom of said slot, stacking by winding successive layers of said element, one over the other with each successive upper convolution of said element being immediately above the preceding lower convolution of said element to form a stack in said slot which substantially fills said slot, and securing the other end of said element near the upper end of said slot, said structure being a generally circular concrete structure and said slot being an annular groove therein, said slot having a width commensurate with a dimension corresponding to an integral number of widths of said element plus the width of spacers separating individual stacks of said element and said winding results in separate one of said stacks separated by said spacers.

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ALFRED C. PERHAM, Primary Examiner

U.S. Cl. X.R.

52—224; 138—176; 242—7.02