

Brandestini et al.

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[54] METHOD OF WINDING WIRE ABOUT PRESTRESSED CONTAINERS

[72] Inventors: **Antonio Brandestini**, Zurich, Switzerland;
Walter Thorpe, New Mills near Stockport,
England

[73] Assignee: **Simon-Carves Limited, Stockport, England**

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52/223, 224; 254/29 A

[56]

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Primary Examiner—John F. Campbell

Assistant Examiner—Victor A Di Palma

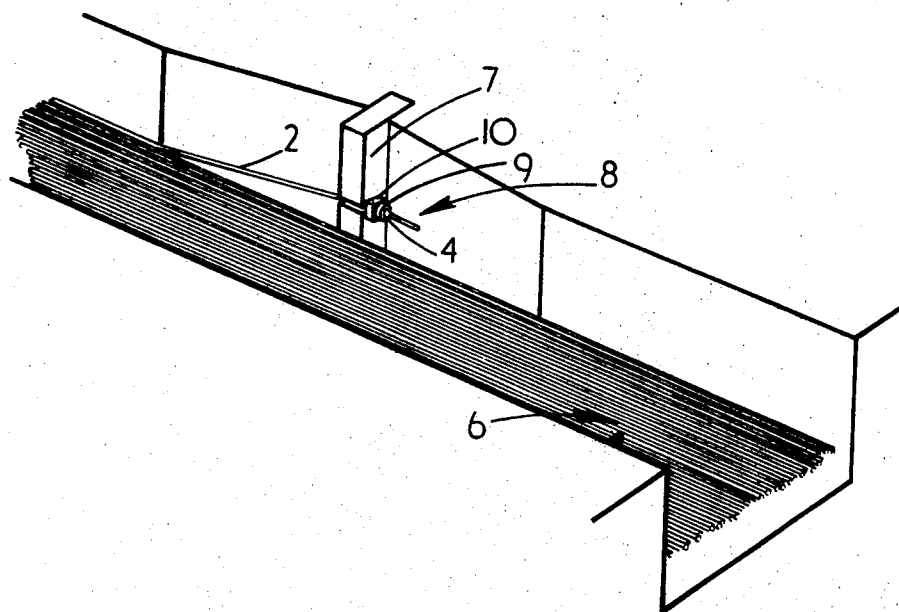
Attorney—Norris & Bateman

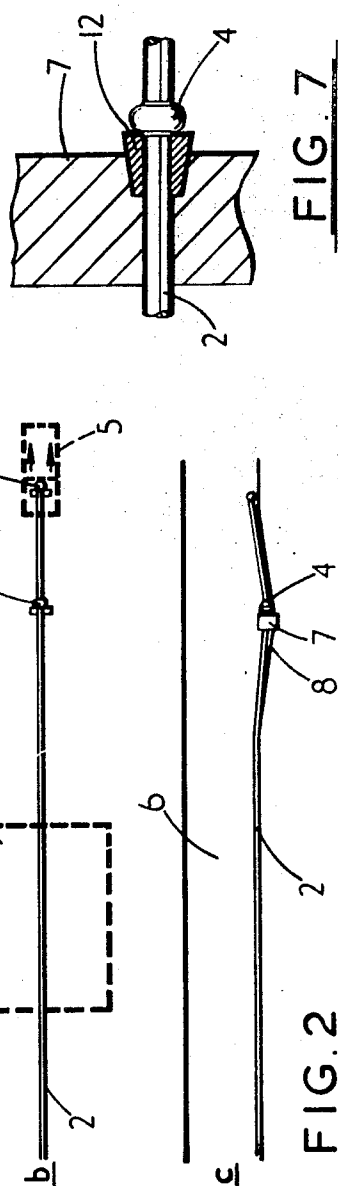
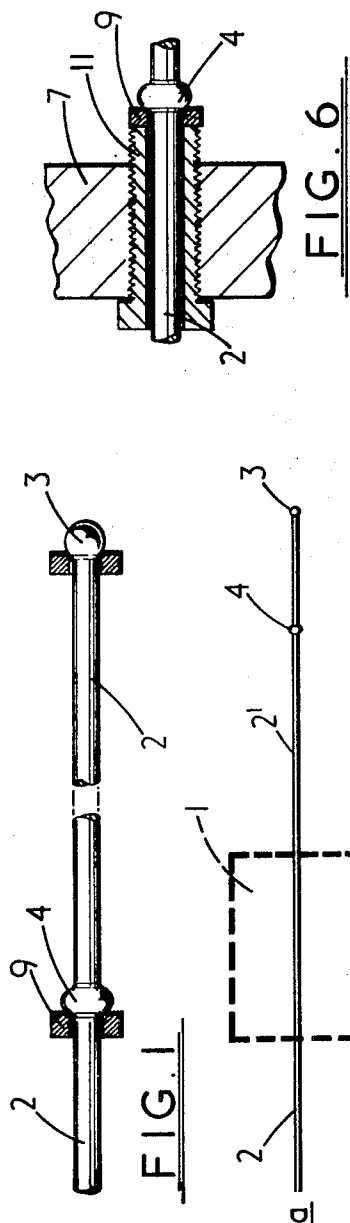
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ABSTRACT

A method of anchoring an end of a tensioned wire wrapped by a winding unit, including the step of upsetting the portions of the wire destined to become the initial and/or terminal ends of the wire constituting a winding to form an attachment button or buttons adapted to transmit tension to an anchorage or anchorages in which the end or ends of the wire can be received.

9 Claims, 10 Drawing Figures





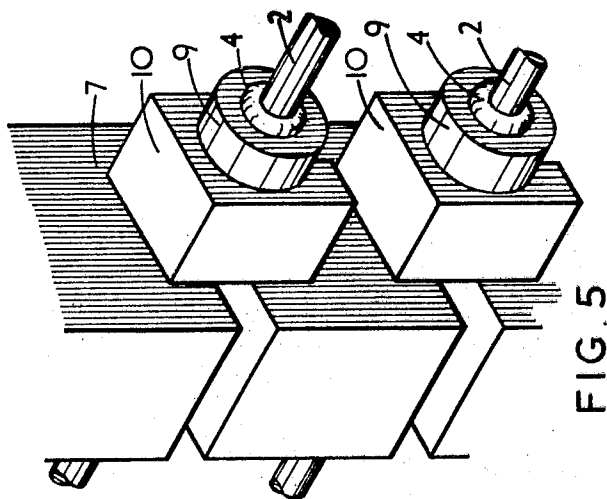
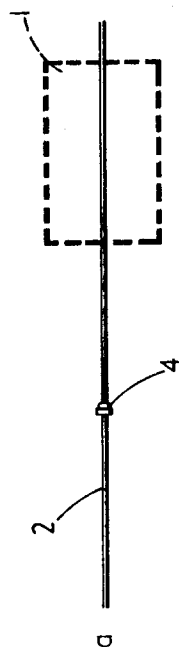
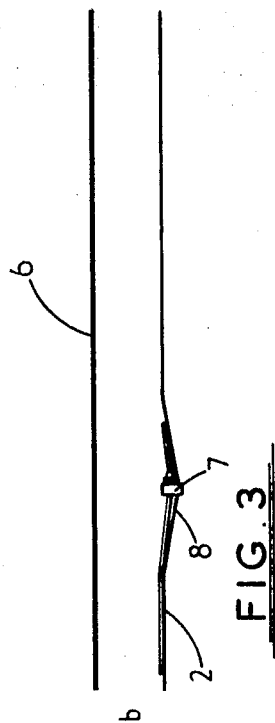


FIG. 5



a



b

FIG. 3

INVENTORS
ANTONIO BRANDESTINI
WALTER THORPE
By: Norman J. Boleman, Atty.

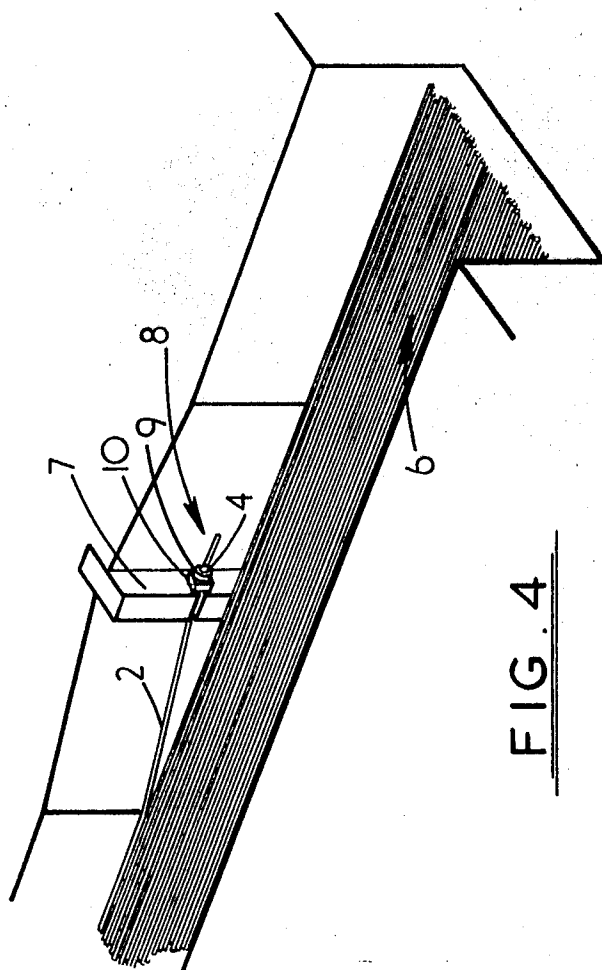


FIG. 4

INVENTORS
ANTONIO BRANDESTINI
WALTER THORPE

By Thomas A. Coleman, Atty.

METHOD OF WINDING WIRE ABOUT PRESTRESSED CONTAINERS

This invention is concerned with improvements in or relating to prestressed containers.

In particular it refers to a method of anchoring the ends of tensioned wire wrapped by a winding unit preferably within grooves formed in or on the outer surface of containers, such as concrete pressure vessels. The wire is tensioned because the rate of travel of the winding unit around the container is greater than the rate of pay-off of wire from the unit and the degree of tension is a function of the differential between these rates.

It is apparent that both the initial and terminal ends of the wire winding must be anchored and suitable anchorages must meet a number of requirements. The anchorage at the initial end is preferably capable of withstanding the high forces acting thereon when the maximum wire tension is being induced by the winding unit and there should be no risk of slippage or other faults which tend to relieve the tension of the winding. If the anchorage at the initial end does not meet this requirement full tension cannot be applied immediately, and some wire would then need to be wound at less than the full working stress. Similarly, the terminal anchorage should be able to withstand the forces acting on it as a result of the tension in the winding and it must be possible to secure the end of the wire to the terminal anchorage without relieving the tension in the winding. The difficulty of providing suitable anchorages is increased by the requirement that the anchorages should not extend into the zone occupied by the winding and must therefore be of minimum dimensions.

According to the present invention, there is provided a method of anchoring an end of a tensioned wire wrapped by a winding unit, including the step of upsetting the portions of the wire destined to become the initial and/or terminal ends of the wire constituting a winding to form an attachment button or buttons adapted to transmit tension to an anchorage or anchorages in which the end or ends of the wire can be received.

A method in accordance with the invention may comprise the steps of stopping the winding unit during a wrapping operation so that it maintains tension in the wire paid out to the rear of the unit while an untensioned length of wire extends forwardly of the unit, upsetting the free end of said length of wire and a portion spaced from said end to form spaced terminal and intermediate attachment buttons respectively, applying a force to said free end to tension said length of wire by an amount sufficient to equalize the tension in the wire to the front and rear of the winding unit, and anchoring said intermediate button by lateral displacement onto an anchorage in a recessed portion of a side of the groove and subsequently releasing the force applied to the free end of the wire.

A method in accordance with the invention may comprise the steps of stopping the winding unit during a winding operation so that it maintains the tension in the wire paid out to the rear of the unit, upsetting a portion of the tensioned wire to the rear of the unit to form an attachment button, anchoring said button by lateral displacement onto an anchorage in a recessed portion of a side of the groove and subsequently releasing the wire from the winding unit so as to transfer the force exerted by the tensioned winding from said unit to said anchorage.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic side view of a tensioning wire upon which has been formed an intermediate button and a terminal button used in carrying out a method of tensioning according to one aspect of the present invention.

FIGS. 2a, 2b, and 2c are views illustrating three stages in a method of anchoring according to the present invention employing the tensioning wire of FIG. 1.

FIGS. 3a and 3b are views indicating two stages in a method of anchoring according to the present invention employing a tensioning wire upon which an intermediate button only has been formed.

FIG. 4 is a perspective view of an anchored wire tensioning by the method illustrated either in FIGS. 2a-2c or in FIGS. 3a and 3b.

FIG. 5 is a perspective view on a larger scale of an anchorage shown in FIG. 4, but shown with an anchorage block adapted to retain in tension a plurality of tensioning wires.

FIG. 6 is a sectional view of a further mode of fixing a tensioning wire to an anchorage block in a method of anchoring according to the present invention, and

FIG. 7 is a sectional view of another mode of fixing a tensioning wire to an anchorage block in a method of anchoring according to the present invention.

Both of the above embodiments are concerned with the task of anchoring the ends of tensional wire wrapped by a winding unit within grooves formed in the outer surface of a concrete pressure vessel. A detailed knowledge of the construction of the winding unit and associated equipment for laying the wire winding around the container is not necessary to an understanding of the invention and it suffices to say that the winding unit is arranged to be displaceable in the groove and travel around the container while paying out wire at a rate less than the rate of travel of the unit so as to tension the wire by an amount which is adjustable by varying the differential between said rates.

Referring to FIGS. 1, 2a, 2b, and 2c, the winding unit indicated by the reference numeral 1 is stopped after laying down one winding but still maintains the wire 2 in the tensioned state. A length 2' (see FIG. 2a) of untensioned wire extends from the front of the unit 1 and it is on the free end of this length and at a location to the rear of this end that upsetting operations are performed resulting in the formation of a terminal attachment 3 and an intermediate attachment button 4 spaced therefrom. (See particularly FIG. 1). A subsidiary tensioning unit 5 (see FIG. 2b) of known type, for example hydraulically operated, is now employed to apply a tensioning force via the terminal attachment button 3 to the hitherto untensioned length 2' of wire until the tensions in this length 2' and in the remainder of the winding are equalized, whereupon the wire 2 is released from the winding unit 1 without any loss of stress. FIG. 2b indicates the conditions where the tensions are equalized.

The intermediate attachment button 4 is now displaced laterally with respect to groove 6 in which the wire has been wound and the wire to its rear is fitted into one of a number of slots in a terminal anchorage block 7 located in a recess 8, the dimensions of the block 7 and recess 8 being such that the block 7 does not extend into the zone occupied by the winding. A washer 9 which has been threaded onto the wire before upsetting bears against packing shims 10 (only one shown) which bear against the block 7 and fill any gap which would otherwise exist between the washer 9 and block 7. (See FIG. 5). Alternatively, as shown in FIG. 6, a threaded adjuster sleeve 11 likewise threaded onto the wire before upsetting, can be provided around the wire 2 which, by engaging with a suitable thread in the terminal anchorage block 7, can ensure that the load in the wire 2 is transmitted to the anchorage block 7 without transfer loss.

The subsidiary tensioning unit 5 attached to the terminal button 3 is now slowly released to transfer the load in the winding to the anchorage block 7.

In the second embodiment shown in FIGS. 3a and 3b, the winding unit 1 is again stopped after laying down a winding and holds the wire 2 to maintain the tension in the wire 2. In this case, however, a single attachment button 4 is formed at a chosen site on the tensioned wire 2 to the rear of the unit 1. This button 4, which may also be referred to as an intermediate attachment button, is then displaced laterally onto an anchorage block 7 using packing shims 10 or an adjuster

sleeve as described above to take up any clearance between the button 4 and the block 7 in the same manner as described above in the description of the first embodiment. However in this embodiment any washers or adjuster sleeves must be positioned on the wire before winding.

The winding unit can now be slowly released from the wire so that the tensional forces are transferred from the winding unit 1 onto the anchorage block 7.

The upsetting operation in both embodiments can be performed by known machines one of which, for example, comprises hydraulically operated clamping jaws and upsetting hammers and which can be readily adapted to form end buttons or intermediate buttons. It may, however, be necessary to modify the machine so that the button forming portion situated immediately adjacent to the operating head of the winding unit is of the minimum size.

The wire constituting the winding may be of any suitable length and gauge and is anchored at both ends in the embodiments under discussion by means of attachment buttons formed on the wire by an upsetting operation. Anchorage blocks fixedly located in recesses of the type described above, may be provided on one or both sides of the groove accommodating the winding.

In order that a number of separate windings may be anchored in each groove, each anchorage block is, as mentioned above, provided with a plurality of slots. These slots are spaced at various levels from the floor of the groove in which the end portions of wire adjacent the attachment buttons are received to allow the tensional force in the wire of each winding to be transmitted to the block through the button.

The securing of the initial end of the wire is the same for both embodiments. An upsetting operation forms an attachment button on this end and the adjacent portion of wire is slipped into one of the slots in the initial anchorage block. Displacement of the winding unit tensions the wire and the attachment button is pulled against the anchorage block and transfers the tensional forces thereto.

In the place of a washer between the attachment button and the anchorage block, that end of the slot in the anchorage block adjacent the attachment button may be drilled out to accept a collar against which the button will abut. These measures enhance the reliability of the anchorage by reducing the risk of slippage of the attachment button. The collar may have the form of an annular wedge 12, as shown in FIG. 7.

It will be appreciated that numerous modifications may be made to the embodiments described above without departing from the broad scope of the invention. For example, it may be desirable in some cases to replace the upset button attachment at one or other end of the winding by some other form of anchorage.

Although the word "wire" has been used herein when referring to the wrapped tensioning material, it is to be understood that single or multi-strand wire or cable or any other suitable filamentary material which is capable of being upset to form an attachment button may be employed and references to "wire" in the specification and claims are to be construed accordingly.

What is claimed is:

1. A method of winding a wire under tension around a container using a winding unit comprising the steps of anchoring the initial end of said wire at a winding zone on the container having a laterally open recess at one side containing a stationary anchorage, winding the wire a plurality of times around the container within said winding zone in such manner that the rate of travel of the winding unit is greater than the rate of pay-off of the wire from said unit whereby the wire is tensioned during winding, upsetting a portion of said wire forming the terminal end to form an attachment button, displacing said button laterally of said winding zone about a fixed surface on said container and onto a fixed anchorage while maintaining the wire under winding tension, and then releasing the wire from tensioning by said winding unit and transferring said tension to said anchorage.

2. A method as claimed in claim 1 comprising the steps of stopping the winding unit during a winding operation so that it maintains tension in the wire paid out to the rear of the unit while an untensioned length of wire having a free end extends forwardly of the unit, upsetting the free end of said untensioned length of wire and a portion spaced from said end to form spaced terminal and intermediate attachment buttons respectively, applying a force to said free end to tension said length of wire by an amount sufficient to equalize the tension in the wire to the front and rear of the winding unit, anchoring said intermediate button by lateral displacement onto said anchorage, and subsequently releasing the force applied to the free end of the wire.

3. A method as claimed in claim 1 comprising the steps of stopping the winding unit during a winding operation so that it maintains tension in the wire paid out to the rear of the unit, upsetting a portion of the tensioned wire to the rear of the unit to form an attachment button, anchoring said button by lateral displacement onto said anchorage, and subsequently releasing the wire from the winding unit.

4. The method defined in claim 1 wherein said winding zone is an annular groove in the outer surface of the container and said recess is formed in a side wall of said groove.

5. A method as claimed in claim 1 wherein the container is a pressure vessel.

6. A method as claimed in claim 1, including the step of locating a washer between the attachment button and the anchorage with which said attachment button is associated.

7. A method as claimed in claim 1, including the step of locating one or more packing shims between the attachment button and its associated anchorage in order to maintain the desired tension in the wire.

8. A method as claimed in claim 1, including the step of adjusting the position of a screw-threaded sleeve between the attachment button and its associated anchorage in order to maintain the desired tension in the wire.

9. A method as claimed in claim 1, including the step of anchoring the attachment button with respect to its associated anchorage by locating the button in an annular wedge engageable in a recess in the anchorage.

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