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METHOD OF REINFORCING CONCRETE UNITS

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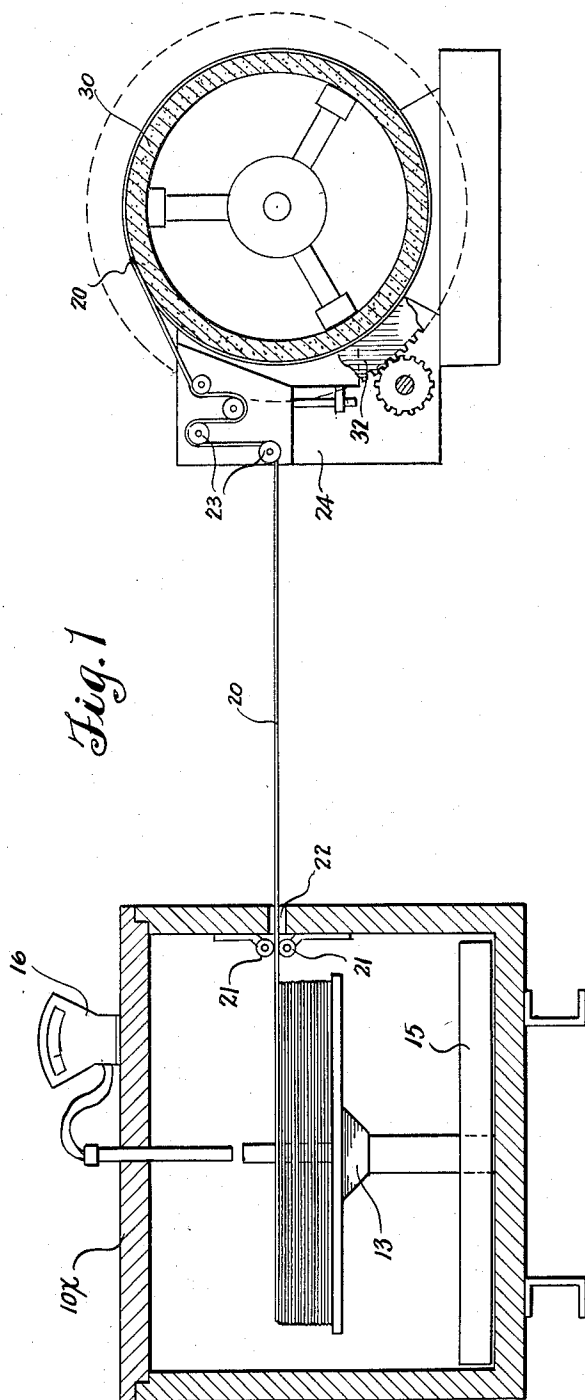


Fig. 1

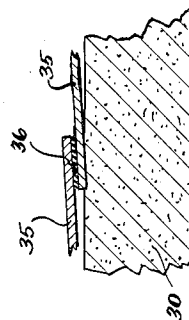


Fig. 4

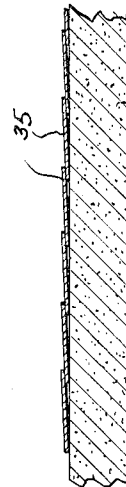


Fig. 5

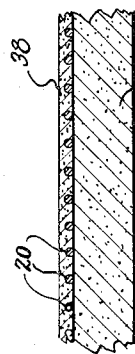


Fig. 2

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METHOD OF REINFORCING CONCRETE UNITS

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5 Claims. (Cl. 29—452)

This invention relates to reinforced concrete units and it has reference more particularly to a method, or process of reinforcing precast concrete units by the external application thereto of metal tension members that have been prestressed under controlled heat and applied to the concrete units while hot; it being one of the principal objects of the present invention to provide a process of applying heat treated tensioning bands or spirals externally to concrete units, such as, for example, precast columns, pipe, or similar units, in such manner that the temperature difference, at the time of application, between the precast concrete member and the externally applied tensioning member will, upon the members subsequently reaching equilibrium, result in producing stresses in the precast concrete member equal to a design computed stress of compression in the precast concrete member and a design computed stress in the tension member.

Another object of the invention is to provide, as an alternative for wire or round rod, for use of flat, heat-treated metal strap as the tensioning member, and to so apply the strap to a precast unit, such as a column, pipe or the like, as to completely encase the unit in a metallic, water-proof shell that, upon cooling brings about the desired stresses both in the precast concrete and in the tensioning member.

In the drawings forming a part of this application:

Fig. 1 is a somewhat diagrammatic illustration of an apparatus designed for the heat treatment of the tensioning member and whereby the member may be applied about a precast concrete unit under controlled tension.

Fig. 2 is an enlarged, sectional detail taken on line 2—2 in Fig. 1, and showing the tensioning material as applied to the precast concrete member and as later encased in a protective coating.

Fig. 3 is a similar sectional view, showing the application of flat band to a tubular precast unit in accordance with one of the objects of the present invention.

Fig. 4 is an enlarged detail of the sealed joint between overlapped portions of the tensioning band.

The present process takes into consideration the pre-casting of high compressive strength concrete units and the processing of tensioning material, such as wire, rods, band or fiber, in a neutralizing oven or furnace and finally the application of the heat treated tensioning material under tension about the precast unit.

The present concrete units, which may be columns, cylindrical tubular members, and the like, or other shapes capable of being wrapped, are designed as the compressive members of a prestressed, reinforced concrete system to be reinforced by the external application thereto of heat treated tension members. The concrete units may, if necessary or desired, contain nominal internal reinforcing members to insure their safe handling during the manufacturing process but this is not a necessary requirement.

The processing of the tensioning wire, rods or bands of metal, or of glass fiber, is carried out in a suitable neutralizing oven, the function of which is to bring the tensioning material to, and hold it at a controlled tem-

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perature for a sufficient length of time to cause it to be relieved of stresses. Incidentally, under the treating temperature employed, the wire, or band is freed of all oils and other foreign material that might interfere with the proper bonding therewith of a final protective covering of the reinforcement. The oven temperature, after the stress relieving period, is adjusted and the temperature of the wire, band, or the tensioning material is allowed to drop to that desired for its application. This latter temperature is determined by the computation of the coefficient of expansion of the tensioning material times the temperature difference between the precast concrete member and the tensioning material at the point of application, as equated to the elongation of the tensioning material at the computed tension of application required to produce a designed compressive strength in the tension member.

Adjustments in these computations must be made to allow for plastic flow of the precast concrete member, deformation of the concrete at point of contact with the tensioning member, physical characteristics of the tension member and the initial tension of application prior to heat reduction of the tension member.

The heat treated tensioning member, upon being reduced to the required temperature of application, is then wound under tension about the precast unit. The convolutions of wire or band are spaced to more or less extent, as shown in Fig. 2, according to requirements or good practise. The winding of the tensioning member is so accomplished that the temperature differential between the precast concrete and the tensioning material will result in the designed tensile stress in the tension member and the designed compressive stress in the precast concrete member. The tensioning band should be reduced to atmospheric temperature as soon as secured to the concrete member; this securing being accomplished either by anchorages or due to surface friction between the tension material and application surface. The heat reduction should be undertaken as soon as possible to minimize the temperature rise of the precast concrete member and to obtain the best characteristics of the tensioning member. The tensioning devices will be so designed as to produce a uniform tension of the preheated tension member.

Finally, the external wrapping is covered with a dense, high compressive strength concrete that will bond firmly with the precast concrete member and the tension member, or with some other covering that will be permanent and will prevent corrosion.

In Fig. 1 of the drawing, an apparatus for practicing the present process has been shown. In this view, 10 designates an oven providing an enclosed chamber 11 within which a spool 12 of wire, band or the like, which is to be used as the tensioning material is supported for rotation about a vertical axle 13. Any suitable method for interiorly heating the chamber to a required temperature, may be employed. A heating means is herein designated at 15 and an instrument for indicating the internal temperature of the oven is designated at 16. The top portion 10x of the oven is here shown to be removable therefrom to permit the placing of the spool of tensioning material within the chamber 11 for heat treatment in accordance with this invention. Ovens of other forms may be used if desired, and the arrangement therein of supporting means for the tensioning material can be altered to suit conditions.

The tensioning member, here shown to be in the form of a continuous wire strand 20, is extended from the spool 12 between guide rolls 21—21 mounted on a side wall of the oven, thence through a wall opening 22, thence about or over a plurality of tensioning sheaves 23 or other suitable devices, here shown to be mounted on a support

24 and finally to the unit to be wrapped and is attached at its end thereto. In Fig. 1 the precast member is shown to be in the form of a tube, 30, that is supported for axial rotation. The supports are applied to the ends of the tube and may be of any suitable kind. It is herein indicated that the tube is adapted to be axially rotated by gearing as designated at 32.

With one end of the wire 20 secured to the concrete tubular member, axial rotation of the member will cause the wire to be wrapped under tension thereabout, and by causing relative advancement of the tube as it is axially rotated, the wire can be caused to be wrapped about the member in spaced convolutions or spirals, as indicated by their showing, in Fig. 2.

In lieu of using wire or similar material as the tensioning member, it is anticipated that flat metal band, such as that shown at 35 in Fig. 3, be employed and that it be so applied about the concrete member that successive spirals thereof will have edges overlapped. The joint between the overlapped edges can be automatically sealed by the applying of a joint sealing compound to the surface portions that are to be overlapped. Such a compound being designated in Fig. 4 at 36.

It can be readily understood that the tensioning band, or wire, can be heated in the oven to the temperature required to relieve it of all stresses, and that the oven temperature can then be adjusted by control of the heating unit, or otherwise, to bring the temperature of the wire down to that which is proper for its application. The tension to which the band or wire is subjected during application can be regulated by use of proper tensioning apparatus, and its proper adjustment, and the spacing of the turns or convolutions of the band about the unit can be adjusted as required or desired to bring about the desired results.

Advantages of this process reside in the fact that it allows both the tension and the compression members to assume the applied stresses uniformly due to the stress relieving effect accomplished by the preheating treatment of the tension member which allows it, throughout its entire area to uniformly take its load. The compression member by the present method is loaded over a period of several minutes during the cooling process, thus allowing the precast concrete to gradually assume its load. The preheating of the tension members allows the equalization of stress between the inner and outer fibers when the tension member is applied as the reinforcement on the outer shell of precast circular concrete units, thus making the most effective use of the tension member of the reinforced system.

This process provides for the manufacture of prestressed reinforced concrete pipe that with maximum allowable unit tension in the tension member, due to the application of the stress relieved tension member under a condition of very low initial tension and a gradual uniform increase of tension during and by reason of the cooling of the tension member.

This process also provides a means of cleansing oil and other foreign materials from the tensioning wire, rods or fibers that would reduce the bond of the protective high quality concrete coating of the pipe or other reinforced concrete unit. Furthermore, the present process provides for the application of tension members to a prestressed reinforced concrete system prior to the cooling of the tension member, thus allowing the full application of the fiber stress in the tension member to the resistance of external tension and at the same time minimizing internal stresses within the tension member.

The present invention anticipates the use of wire, rod, flat band or glass fiber strands or rope as the tensioning member, and their heat treatment and application under tension to precast concrete members of any shape not inconsistent to the disclosures herein made or the mode of application disclosed.

The invention further anticipates the use of individual bands applied about the concrete member in lieu of the continuous spiral wrapping. However, the treatment of the individual bands would be like that of the continuous strands and the mode of application would be such as to accomplish the same results.

It would not be required that the shell as formed by the spirally wrapped band 35 be covered with a protective coating. However, when wire is used such a coating is desirable, and has been designated at 38 in Fig. 2.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent, is:

1. The process of reinforcing a pre-cast concrete unit which comprises, subjecting a tensioning band to a controlled heat of predetermined degree for a period of sufficient duration to cause the band to be relieved of stresses, readjusting the temperature of the band to a predetermined lower degree for application, applying the band about the concrete unit under tension, securing it at its ends and allowing it to gradually cool.

2. The process of reinforcing a pre-cast concrete unit of the character described comprising subjecting a continuous band of tensioning material to oven heat of sufficient degree to free it of stresses, adjusting the oven heat to bring the material of the band to predetermined lower degree for application, anchoring one end of the band to the unit and then causing the band to be wound under tension about the unit as continuous convolutions, securing the other end of the band to the unit and then allowing the band to cool.

3. The process as recited in claim 2 wherein the readjusted temperature of the stress free band results in a temperature difference between the pre-cast concrete unit and the tensioning band at the time of application will, upon the unit and band reaching equilibrium, result in producing stresses in the concrete member equal to a design computed stress of compression and a design computed stress in the tensioning band.

4. A process as in claim 2 wherein the tensioning band is in the form of a flat metal strap, and is wound on the unit in such manner as to cause the edge portions of successive convolutions to be slightly overlapped.

5. A process as in claim 4 wherein a joint sealing compound is applied to the band prior to its application to effect the sealing of the joint between the overlapping portions of the successive convolutions of the band.

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