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3,029,490

POST-TENSIONING METHOD FOR PRESTRESSING MEMBERS

Filed Nov. 15, 1954

3 Sheets-Sheet 1

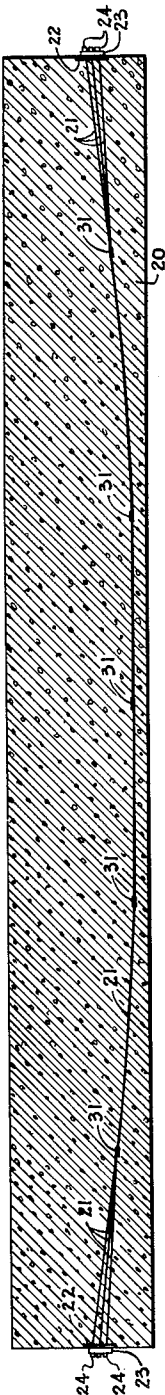


Fig. 1

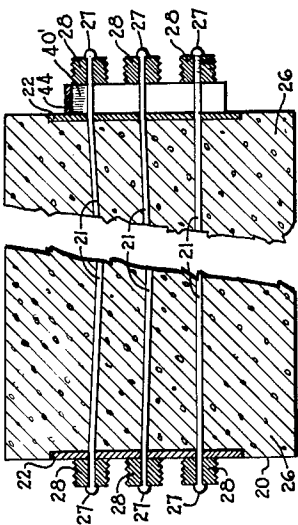


Fig. 4

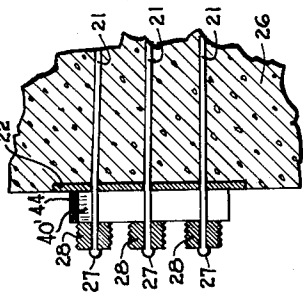


Fig. 3

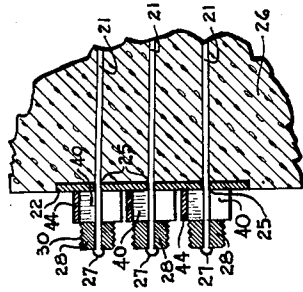


Fig. 2

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3 Sheets-Sheet 3

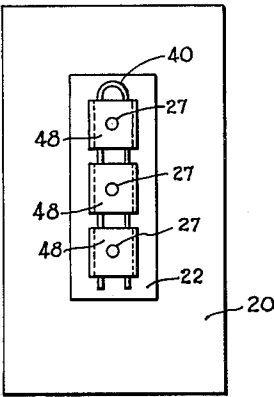


Fig. 12

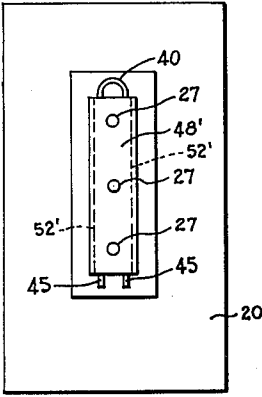


Fig. 13

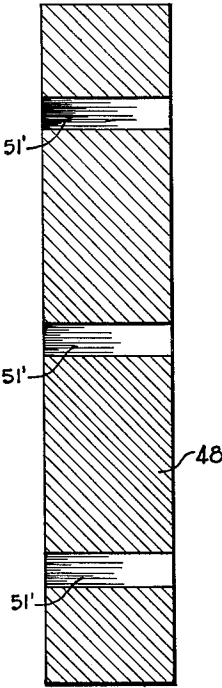


Fig. 14

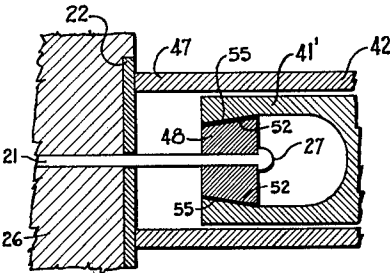


Fig. 15

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POST-TENSIONING METHOD FOR PRE-STRESSING MEMBERS

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2 Claims. (Cl. 25—154)

My invention relates to a post-tensioning method for prestressing concrete members.

One of the purposes of my invention is to avoid the use of means enclosing the wire units to prevent adherence of the concrete thereto, such as water-tight, flexible tubing, or coating the tension members with some suitable coating material and wrapping these in paper to retain the coating material therein and prevent the adherence of the tension members to the concrete, or the making of chases through the concrete with mandrels or rubber tubing and inserting the wires through such mandrels or rubber tubing.

In carrying out my improved method I make use of positive end anchorage, such as is provided by headed wires, and my method is applicable to units that are composed of one or more wires retained in a predetermined relative position.

My method comprises the assembly of the tension members in position so that the concrete can be poured around the same, said tension members being provided with temporary spacers that are set between a stressing member and the spacing or bearing plate provided in position against the concrete body adjacent the stressing member, removal of the spacing members after the concrete has set for a predetermined time, and tensioning the individual tension members or wires at the end of the concrete unit opposite that at which the temporary spacing members had been placed in position to move the tension members longitudinally of themselves in the concrete. The method can be carried out to accomplish a back and forth movement as often as is necessary to break any bond between the tension members and the concrete by alternately tensioning the tension members at opposite ends thereof. While it may be advisable to coat the wires or other tension members with some compound to induce slippage to assist in this freeing action, this is not absolutely necessary.

The method further comprises the tensioning of the tension members after the concrete has been cured sufficiently to reach its proper strength to elongate the tension members to such an extent as to apply the desired stress to the concrete. Obviously a gauge or torsion meter can be attached to the tensioning device, such as a jack, to determine the exact stress that is placed in each tension member.

Among the advantages of my method are that a proper stress is assured in each tension member, costly covering materials are eliminated to prevent adhesion during the pouring operation, any grouting operation is eliminated, and no heavy bearing plate is necessary since the distribution of the stressing members is such that there are no pockets under the bearing plate and each bearing member has a sufficient area in engagement with the concrete to carry its own stress without transmission through a heavy bearing plate.

In order to carry out my improved method and to maintain the tension members in properly spaced relationship, I provide a plurality of clips that are of such a character that the tension members are kept in the desired relative position but will only slightly grip the tension members so that these can be readily shifted or slipped longitudinally of themselves through said spacing members, said spacing members spacing the tension members transversely of the length thereof. Preferably said spacing members

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comprise clips that are indented between the tension members, such as wires, to space the same from each other and slightly grip them.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined in the claims.

In the drawings:

FIG. 1 is a view in side elevation of a concrete structural member made in accordance with my invention.

FIG. 2 is a fragmentary vertical sectional view on an enlarged scale through the same at one end thereof.

FIG. 3 is a view similar to FIG. 2 of a modification.

FIG. 4 is a fragmentary vertical sectional view on an enlarged scale through the opposite end portions of the structural member shown in FIG. 1, the mid-portion thereof being broken away, showing the parts in the position which the same would assume in the second step of my method.

FIG. 5 is a horizontal sectional view through a fragmentary portion of the stressing means and a fragmentary portion of a structural member to which my invention is applied, with the stressing means in engagement with the right hand end of one of the structural members shown in FIG. 4.

FIG. 6 is a transverse sectional view on a further enlarged scale through one of the spacing members and the tension members associated therewith.

FIG. 7 is a plan view of the spacing member, showing fragmentary portions of the tension members spaced thereby.

FIG. 8 is an end elevation of a structural member, showing the form of the invention illustrated in FIG. 3.

FIG. 9 is an enlarged cross sectional view through one of the stressing members shown in FIGS. 2, 3 and 4.

FIG. 10 is a similar view of a modified form of stressing member.

FIG. 11 is an end elevation of the stressing member shown in FIG. 10.

FIG. 12 is a view similar to FIG. 8 of a structural member, showing the form of stressing member illustrated in FIGS. 10 and 11.

FIG. 13 is a similar view, showing a further modified form of stressing member.

FIG. 14 is a vertical sectional view through the stressing member shown in FIG. 13, on an enlarged scale, and

FIG. 15 is a view similar to FIG. 5, showing a modified form of stressing means for cooperation with a modified form of stressing member that is not threaded.

Referring in detail to the drawings, in FIG. 1 a structural member 20, which may be a beam and which has a concrete body portion, is shown as having a plurality of tension members 21 embedded therein, such as wires, that can be put under tensile stress to prestress the structural member 20. A spacing and bearing plate 22 is provided in each end of the structural member 20 through which the members 21 pass, and in FIG. 1 said members are shown as being provided with spacing means 23 at each end thereof between said plates 22 and stressing members 24, the position of the parts shown in FIG. 1 being that of the finished prestressed beam with the tension members 21 under the full tensile stress to which these are to be put to get the desired prestressing of the member 20. The spacing means 23 may be of any desired character and the stressing members 24 may be of various types as will be described below.

In FIG. 2 a fragmentary portion of one end of such a structural member as shown in FIG. 1 is shown, in which the members 21 are shown as being held in a predetermined spaced relation by means of the plate 22, which has openings therethrough at 25 through which said ten-

sion members pass. Thus the tension members 21 are arranged in spaced relation in the body of concrete 26. Each of said tension members, which are preferably in the form of wires of high tensile strength, are provided with heads 27 that are formed thereon from the material of the wire. A screw-threaded block 28 serves as a stressing member for each of said tension members 21, there being an opening 29 centrally through each of said members 28 (see FIG. 9) and said member 28 being externally screw-threaded as indicated at 30 in the drawings.

In assembling the structure shown in FIG. 1 a plurality of spacing members for transversely spacing the tension members are arranged at desired intervals lengthwise of the tension members 21, such spacing members being indicated by the numeral 31 in FIG. 1. The details of construction of the spacing members are shown in FIGS. 6 and 7. Each of said spacing members is made up of a pair of sheet metal members 32 and 33, which are each provided with a portion 34 which is reduced in width and which is adapted to be bent around the end edge 35 of the opposite end of the member cooperating therewith, as shown at 36 in FIGS. 6 and 7, to clamp the members 32 and 33 to each other. In FIG. 6 the reduced portion 34 is shown in the position that it has before being crimped over into holding position at the left of said figure, and in its crimped over position or holding position at the right thereof. The length of the spacing members and thus of the portions 32 and 33 thereof is dependent upon the number of tension members that are spaced thereby, the number shown in FIGS. 6 and 7 being a relatively small number of tension members that would be so connected together in spaced relation by said spacing members in practice. The spacing members are provided with indentations 37 that are opposite each other so as to provide adjacent portions 38 in the opposite members 32 and 33 of said spacing member, and said members 32 and 33 are bent toward each other at 39 adjacent the end portions 35 and reduced portions 34 to thus form pockets in which the tension members 21 are located and from which these can not move toward or away from each other when the tongues 34 are crimped around the end edges 35 in the position shown at 36 in FIGS. 6 and 7. However, the tension members 21 are not gripped tightly enough by the spacing members to prevent sliding of the tension members 21 through the spacing members lengthwise of said tension members 21.

Said tension members 21 are placed in the desired position in the form with the spacing members 31 provided thereon at the desired points along the length thereof to obtain the desired transverse spacing thereof and the spacing plates 22 are placed in the desired position in the form. The spacing plates 22 and the stressing members 24 are placed on the tension members 21 before the heads 27 are formed thereon. When the tension members 21 are placed in position in the form the stressing members, such as the members 28 shown in FIG. 2, are put in position adjacent the heads 27, and U-shaped spacing members 40 are placed in position between the members 28 and the plate 22, said spacing members being of such size that this will place the members 28 at the other ends of the tension members 21 in position against the plate 22 at the other end of the structural member that is to be prestressed.

The concrete is then poured and after it has been allowed to set a sufficient time to permit movement of the tension members 21 longitudinally of themselves therein without damage to the structural member the tension members 21 are shifted lengthwise of themselves in the concrete body portion. To do this the spacing members 40 are removed from the end of the tension members to which these have been applied, which is the left hand end as shown in FIG. 2, and the tensioning or stressing means is applied to the other end of the tension members 21, for example, in the manner illustrated in FIG. 5, at

the right hand end of said members. The stressing or tension applying means is shown as being a movable member 41 of a jack having a body portion 42 that engages the plate 22 at the right hand end of the structural member 20. Said jack may be of any desired or well known character and is provided with a suitable internally screw-threaded portion 43 that is screw-threadedly engaged by the threads 30 on the member 28. Obviously the tensioning is accomplished by moving the member 41 to the right relative to the member 42 as viewed in FIG. 5. The movement of the parts is only sufficient to move the member 28 on the member 21 at the opposite end or left hand end of said structural member 20 into engagement with the plate 22 at that end thereof.

If desired spacing members 40 can then be inserted between the members 28 and the plate 22 at the right hand end of the structural member as viewed in FIG. 1, or the tensioning means, after having moved the tension members 21 all to the right longitudinally of themselves in the manner above described, can be engaged with the members 28 on the tension members 21 at the opposite or left hand end of the structural member to again move the tension members 21 lengthwise of themselves in the concrete body portion of the structural member 20 and this can be repeated alternately at opposite ends of the tension members 21 as often as may be necessary to break any bond that might exist between the tension members and the concrete body portion to permit movement thereof longitudinally for the purpose of tensioning said members 21 when the post-tensioning thereof for prestressing the concrete structural member 20 is to be performed. This is not done until the concrete of the structural member has been cured sufficiently to reach its maximum strength, whereupon the post-tensioning is completed by applying the tensioning means first to one end of the structural members 21 and inserting spacing members 23 between the stressing members 28 and the plate 22 at that end of the structural members, then tensioning the members 21 at the other end thereof to the desired amount and placing spacing means 23 between said members 28 and the plate 22 at the last mentioned end of said structural member, completing the prestressing.

During the shifting of the tension members 21 lengthwise of themselves the spacing members 31 hold these in properly spaced relation transversely of the structural member 20 and the plate 22 will hold the same in properly spread out relation at the ends thereof in the structural member, but neither of the spacing members in any manner interferes with the longitudinal shifting of the tension members 21.

Instead of using a separate U-shaped spacing member 40 between each of the stressing members 28 and the plate 22 adjacent the same as shown in FIG. 2, a single U-shaped spacing member 40' for a group of said members 28 may be provided, as shown in FIG. 3. The member 40' is also shown as being applied to the structure to space the members 28 from the plate 22 in FIG. 8. The members 40' are provided with a bend at 44 connecting a pair of parallel legs 45, thus forming a U-shaped member. The members 40 are similarly made, but the leg portions are shorter, as will be obvious from FIG. 2. Said U-shaped spacing members 40 or 40' can be very readily inserted between the members 28 and the plate 22 while the tensioning means comprising the members 41 and 42 are in position, as shown in FIG. 5, by passing the same between the plate 22 and the member 28 through the space 46, as the body portion 42 has openings therein between the spaced legs 47 provided thereon.

In FIG. 4 the structural member is shown after the tension members 21 have been shifted lengthwise of themselves from the position shown in FIG. 2 and a spacing member 40' has been inserted between the stressing members 28 at the right hand end of said tension members 21 and the plate 22. With the member 40' in the position shown in FIG. 4, or members 40 such as shown in FIG. 2,

in such a position, the tensioning means can be applied to the stressing member 28 at the left hand end of the tension members 21 as shown in FIG. 4 until the desired tension has been placed on each thereof to pre-stress the concrete to the desired amount. Then a spacing member 40' or a plurality of spacing members 40, can be inserted between the members 28 and the member 22 at the left hand end of the structural member, as viewed in FIG. 4. This is the condition of the structural member illustrated in FIG. 1. This last step is, of course, not taken until the concrete body portion 26 has reached its maximum strength. The spacing members 40 or 40' are made of greater thickness between the two opposite edges thereof that are in engagement with the members 28 and 22 than the thickness of the material from which it is made, which, however, is of sufficiently heavy gauge that it will withstand the compression that is exerted on the spacing member in use.

Instead of providing a screw-threaded stressing member, such as the member 28, a stressing member that is of a tapering character may be provided, as illustrated in FIGS. 10 and 11. Said stressing member 48 has a body portion 49 that tapers toward the end 50 thereof and has a central opening 51 therein for the tension member 21. The one pair of opposite side faces 52 thereof taper from the larger end 53 thereof to the smaller end 50 thereof uniformly, thus forming a wedge-like body portion for the stressing member. The faces of the member 48 that extend perpendicularly to the faces 52 are perpendicular to the ends 50 and 53 of the member 48, these faces being indicated by the numeral 54 in FIG. 11. Said stressing members 48 are shown in position on the members 21 with the heads 27 thereof in engagement with the larger ends 53 thereof in FIG. 12, and a U-shaped spacing member 40' is shown as being in position between said members 48 and the plate 22.

If desired, instead of using a plurality of stressing members 48, a single stressing member 48' can be used, which is provided with inclined or tapering sides 52' corresponding to the faces 52 of the member 48, and is provided with a plurality of openings 51' for tension members 21, said member 48' being of a bar-like character as shown so as to receive a plurality of vertically aligned tension members 21 in the manner illustrated in FIG. 13. In the use of such a stressing member as the member 48 or the member 48', the jack has to be modified to provide a movable member 41' that has inclined walls 55 with which the inclined walls 52 or 52' of the members 48 or 48' engage to provide for movement of the stressing member 48 or 48' by means of the jack. The jack is otherwise constructed in the same manner as that used for the threaded members 28, as illustrated in FIG. 5.

An advantage in using a stressing member such as the member 48 or the member 48' is that it can be made by casting without any finishing being required, instead of having a member, such as the member 28, that has to be threaded.

What I claim is:

1. In a post-tensioning method of prestressing an elongated concrete structural member, mounting tension members in spaced relation transversely of their length in a position such that said tension members will extend in a curved path longitudinally of said structural member,

pouring a body of concrete to be prestressed around said so positioned tension members to completely embed said tension members in said concrete except for the opposed ends thereof to leave said ends protruding from said concrete body, allowing said concrete to set sufficiently initially to permit movement of said tension members longitudinally of themselves in the setting concrete without damage thereto, forming a chase for each of said tension members in said concrete by pulling on a protruding end of said tension member to move said tension member bodily lengthwise of itself a distance less than its protrusion from said concrete body at the opposite end thereof in the setting concrete, upon said concrete having attained said sufficient initial set but prior to having reached maximum strength, until each of said tension members is free of any bond with said concrete while maintaining said spacing of said tension members, retaining said tension members longitudinally slidably mounted in said chase in said concrete body portion with the ends thereof protruding after said pulling thereof, and tensioning said tension members when said concrete has been cured sufficiently to reach its maximum strength.

2. In a post-tensioning method of prestressing an elongated concrete structural member, mounting tension members in spaced relation transversely of their length in a position such that said tension members will extend in a curved path longitudinally of said structural member, pouring a body of concrete to be prestressed around said so positioned tension members to completely embed said tension members in said concrete except for the opposed ends thereof to leave said ends protruding from said concrete body, allowing said concrete to set sufficiently initially to permit movement of said tension members longitudinally of themselves in the setting concrete without damage thereto, forming a chase for each of said tension members in said concrete by pulling said tension member alternately at opposite ends to move said tension member back and forth bodily lengthwise of itself a distance less than the protrusion from said concrete body of the end thereof opposite the pulled end in the setting concrete upon said concrete having attained said sufficient initial set but prior to having reached maximum strength, until each of said tension members is free of any bond with said concrete and has formed an individual longitudinally curved chase for itself in which it is positioned in said concrete, retaining said tension members longitudinally slidably mounted in said concrete body portion, with the ends thereof protruding from said concrete body, after said back and forth pulling thereof, and tensioning said tension members when said concrete has been cured sufficiently to reach its maximum strength.

References Cited in the file of this patent

UNITED STATES PATENTS

1,684,663	Dill	Sept. 18, 1928
1,781,699	Parmley	Nov. 18, 1930
2,255,022	Emperger	Sept. 2, 1941
2,319,105	Billner	May 11, 1943
2,371,882	Freyssinet	Mar. 20, 1945
2,414,011	Billner	Jan. 7, 1947
2,535,100	Sourwine	Dec. 26, 1950