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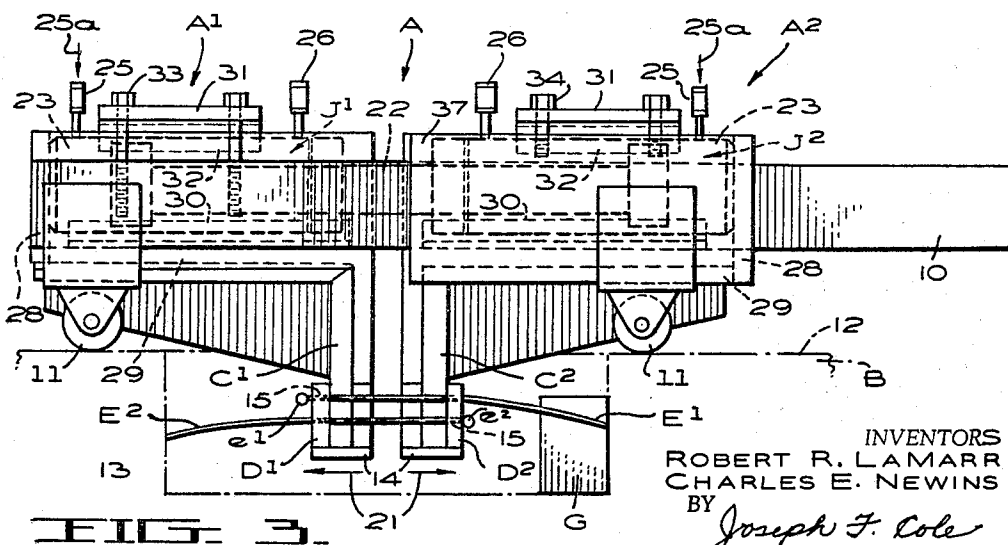
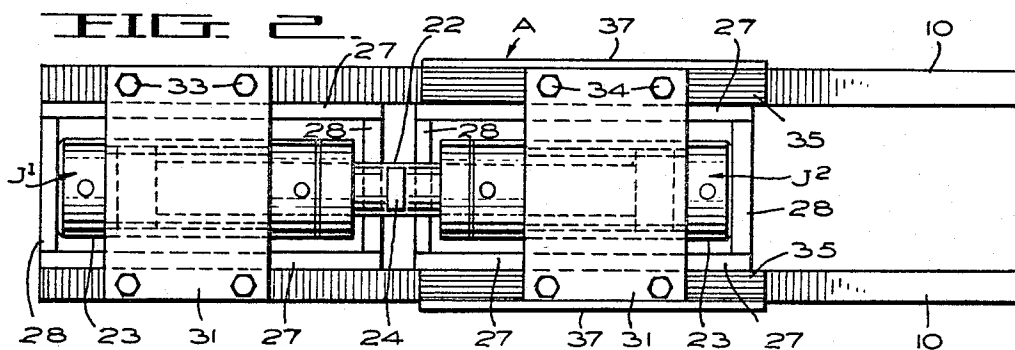
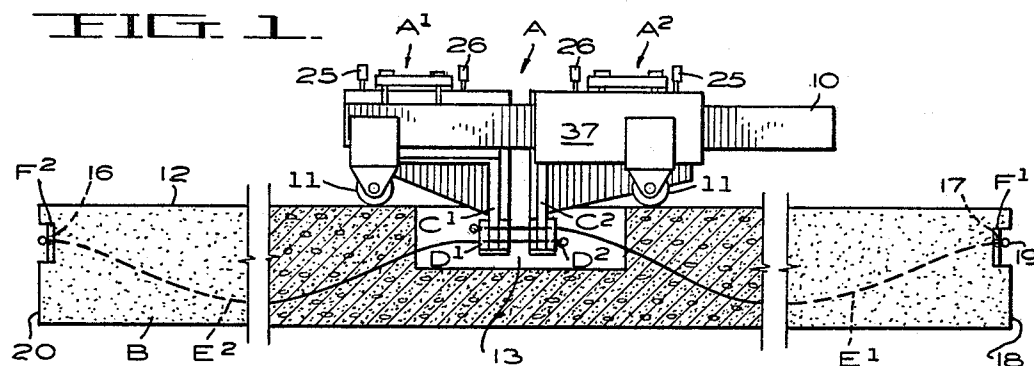
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APPARATUS FOR POST-TENSIONING CONCRETE STRUCTURES

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2 Sheets-Sheet 1



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APPARATUS FOR POST-TENSIONING CONCRETE STRUCTURES

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The present invention relates to improvements in an apparatus for post-tensioning concrete structures. It consists of the combinations, constructions, and arrangement of parts, as hereinafter described and claimed.

In the post-tensioning of concrete structures, it is common practice at the present time to place tendons (wires or rods) in forms so that concrete may be cast around the tendons. The latter are coated or enclosed in a sheath and suitably treated so that the tendons may be tensioned after the concrete has reached sufficient strength, with the force being transmitted to the concrete structure so as to support greater weight. The sheath prevents bonding of the concrete to the tendons, permitting the latter to slip and friction is reduced.

The post-tensioning is accomplished by use of hydraulic jacks, and great force is required to apply the necessary tensioning to the tendons, and thus there is a limit to the length of a span that may be post-tensioned with conventional equipment, since one end of each tendon is secured to a dead-end or anchor plate, while its opposite end is attached to a tensioning device coupled to the hydraulic jack.

Accordingly, it is proposed in this invention to provide an apparatus for post-tensioning concrete structures wherein spans of greater length may be reinforced with tensioned tendons, as compared with conventional arrangements. More specifically stated, it is proposed to anchor the outer ends of two sets of tendons to dead-end plates at opposite end portions of the concrete structure, with these two sets of tendons extending toward one another and having their inner ends disposed adjacent to each other and being attached to a pair of tensioning plates.

The apparatus provided herein is adapted to engage with the tensioning plates to move the latter so as to post-tension both sets of the tendons with the required force, and thus the general overall length of span of concrete that may be post-tensioned may be increased materially.

Another object of the invention is to provide a post-tensioning apparatus having a pair of jaws depending therefrom and adapted to enter a recess formed in the concrete structure, with the tensioning plates at the inner ends of the tendons being exposed in this recess. The apparatus may be made in the nature of a carriage, including carriage sections to which the depending jaws are attached. These jaws are engageable with the tensioning plates so as to apply the required tensioning force to the tendons. Subsequently, the tensioning plates may be secured in fixed relation with one another and the apparatus removed.

Other objects and advantages will appear as the specification proceeds, and the novel features of the invention will be pointed out in the appended claims.

Drawings

For a better understanding of the invention, reference should be had to the accompanying drawings, forming part of this specification, in which:

FIG. 1 is a side elevational view of our post-tensioning apparatus for concrete structures, a portion of the latter being shown in section.

FIG. 2 is a plan view thereof.

FIG. 3 is an enlarged side elevational view of the apparatus, part of the concrete structure being disclosed by dot-dash lines.

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FIGS. 4 and 5 are elevational views looking at the left and right ends, respectively, of the apparatus.

FIG. 6 is an elevational view illustrating the tensioning plates after being separated from one another so as to post-tension the tendons, with a shim or block being interposed between these tensioning plates to maintain tension on the tendons.

FIG. 7 is a view similar to FIG. 3, but showing the tendons being tensioned by moving the tensioning plates toward one another.

While we have shown only the preferred embodiment of our invention, it should be understood that various changes, or modifications, may be made within the scope of the appended claims without departing from the spirit thereof.

Detailed description

Referring now to the drawings in detail, we have shown a post-tensioning apparatus designated generally at A defining carriage sections A¹ and A², the former having a pair of parallel guide bars 10-10 secured thereto on which the latter carriage section is slidably mounted so that the two carriage sections may be moved toward and away from one another. These carriage sections have supporting rollers 11 that are adapted to ride along the top 12 of a concrete structure B, for instance a slab.

The carriage sections A¹ and A² have jaws C¹ and C² fixed thereto, respectively, so as to depend therefrom into a recess 13 formed in the concrete structure B. These jaws have keepers 14 upon which tensioning plates D¹ and D², respectively, are removably mounted. As shown in FIGS. 3 to 6, inclusive, these tensioning plates have a series of holes 15 therein. A tendon E¹ extends through preselected holes in both tensioning plates, and this tendon has a button head e¹ disposed to bear against the left face of the tensioning plate D¹. Actually, there are a plurality of these tendons E¹ as will appear from FIG. 4 of the drawings.

The outer end of the tendon E¹ extends through a hole 17 formed in a dead-end or anchor plate F¹ anchored in the right-hand end 18 of the concrete structure B (see FIG. 1), and has a button head 19 disposed to the right of this dead-end plate. Of course, all of the other tendons E¹ would have their right-hand ends passing through holes in the dead-end plate F¹.

In a like manner, tendon E² passes through selected holes 15 in both tensioning plates D¹ and D² and has a button head e² arranged to bear against the right side of the tensioning plate D². The outer end of the tendon E² passes through a hole 16 in the dead-end or anchor plate F² at the end 20 of the concrete structure B. Again, a plurality of tendons E² would be arranged in the same way as mentioned above.

When these tendons are initially fabricated, they are mastic coated and then encased in sheathings (not shown), which may be made from kraft paper in the conventional manner so that the concrete will not bind to the tendons, and thus the tendons may slip relative to the concrete structure B during tensioning of the tendons. The mastic used in coating the tendons is a non-volatile material designed to vary only slightly in consistency in extremes of temperature. It contains rust inhibitors and other additives which makes it especially suited to this purpose. After each tendon is coated, it is spirally wrapped with waterproof, fiberglass reinforced kraft paper. The tendons have the tensioning plates and dead-end plates installed thereon in the factory, and each end of a tendon is then provided with a button head. The tendons are factory made to length.

When the tendons E¹ and E² are installed in the forms for the concrete structure B, prior to pouring the concrete, they sag as disclosed in FIG. 1. After the con-

crete has set sufficiently, the jaws C^1 and C^2 are spread apart, which will apply the desired tension to the tendons and cause the sagging parts of the tendons to be raised to thus strengthen the concrete structure between supports (not shown).

It will be noted from FIGS. 1 and 3 that the tendons E^1 and E^2 have their inner or inboard end portions arranged in overlapping relation, and that these tendons will be tensioned when the jaws C^1 and C^2 are moved apart, as suggested by the arrows 21 in FIG. 3. Assuming that the end wall 20 is closer to the recess 13 than the end wall 18, a block G of predetermined size is placed in this recess so as to limit the outward movement of the jaw C^2 to the right, thus preventing the tendon E^2 from being over stretched, while the jaw C^1 continues to move to the left to further tension the tendon E^1 .

After the proper tension has been reached, shims or blocks H are inserted between the spread tensioning plates D^1 and D^2 , as shown in FIG. 6, and then the apparatus A may be removed and the recess 13 filled with concrete, leaving the tensioning plates D^1 and D^2 and the spacing shims H in place to thus maintaining the tendons under proper tension.

For the purpose of moving the carriage sections A^1 and A^2 toward and away from one another, hydraulic jacks J^1 and J^2 are clamped thereto, respectively. A piston rod 22 extends into the cylinders 23 of these jacks and a centering bar 24 is provided on this piston rod between the cylinders (see FIG. 2). When fluid pressure is injected into the cylinders 23 through conduits 25, as suggested by the arrows 25a in FIG. 3, the jaws C^1 and C^2 will be spread apart. When fluid pressure is injected into these cylinders through conduits 26, the jaws will be moved toward one another.

The carriage sections A^1 and A^2 are provided with box-shaped frames defining a pair of side plates 27, end plates 28, and bottom plates 29, all of these plates being welded or otherwise secured together to form the box-shaped frames. A lower alignment channel 30 is fixed to each of the bottom plates 29 so as to provide saddles in which the cylinders 23 rest. Moreover, holddown plates 31 are mounted over the cylinders and each has an upper channel 32 fixed thereto so as to bear against the tops of the cylinders. Bolts 33 pass downwardly through the left-hand holddown plate 31 and are threaded into the guide bars 10-10, while bolts 34 pass downwardly through the right-hand hold-down plate 31 and are threaded into bars 35 that are secured to the side plates 27 of the carriage section A^2 , see FIG. 5.

It will be seen that a second bar 36 is secured to the side plates 27 of the carriage section A^2 in parallel relation with the first bar 35 (see FIG. 5), and that guide bar keepers 37 are secured to both sets of these bars to form guideways for slidably receiving the parallel guide bars 10-10 (see FIGS. 2, 3 and 5).

As shown in FIGS. 4 and 5, the tensioning plates D^1 and D^2 are longer than the widths of the jaws C^1 and C^2 , respectively, so that the tendons E^1 and E^2 are disposed laterally beyond these jaws. Thus the latter may be disengaged from the tensioning plates while leaving these tensioning plates in place.

The post-tensioning apparatus A shown in FIGS. 1 to 6, inclusive, is adapted to tension the tendons when the tensioning plates D^1 and D^2 are spread apart. However, the same apparatus may be used for tensioning the tendons when the tensioning plates D^1 and D^2 are moved toward one another, as suggested by the pair of arrows 37' in FIG. 7. Here the inner or inboard ends of the tendons E^1 and E^2 do not overlap one another. When using the apparatus shown in FIG. 7, the jaws C^1 and C^2 initially are spread apart and the tensioning plates are arranged inboard of the jaws and rest on the keepers 14. Then fluid pressure is admitted to the cylinders 23 through the conduits 26, as suggested by the arrows 38 so that the carriage sections A^1 and A^2 will be moved toward one

another, thus post-tensioning the tendons E^1 and E^2 . Thereafter, these tensioning plates may be interconnected by any suitable means so as to hold them in the positions to which they have been moved, and the apparatus A may then be removed, leaving the tensioning plates and tendons in place.

Referring again to FIG. 3, the tensioning plates D^1 and D^2 are arranged on the outboard sides of the jaws C^1 and C^2 so as to tension the tendons upon moving the jaws apart. Thus the same apparatus may be used for post-tensioning the tendons, whether the jaws are moved toward or away from one another during the tensioning operation.

It will be noted that the tensioning plates D^1 and D^2 are arranged substantially parallel with one another. In FIG. 3, the jaws C^1 and C^2 are inserted between these tensioning plates, while in FIG. 7 the jaws straddle the tensioning plates.

I claim:

1. In an apparatus for post-tensioning concrete structures wherein a pair of tensioning plates are provided, one tensioning plate being secured to inboard ends of each of two sets of tendons, with these sets of tendons extending in opposite directions through a concrete structure relative to one another, the outboard ends of both sets of the tendons being anchored to the concrete structure, the combination of:

(a) a pair of jaws engageable with these tensioning plates;

(b) and means connected to the jaws and being operable to move the tensioning plates simultaneously relative to one another so as to post-tension all of the tendons at one time.

2. The combination as set forth in claim 1;

(c) and in which the jaws depend substantially vertically from said means so as to extend downwardly into a recess provided in the concrete structure wherein the tensioning plates are disposed.

3. In an apparatus for post-tensioning concrete structures wherein a pair of spaced substantially parallel tensioning plates are provided, one tensioning plate being secured to inboard ends of each of two sets of tendons, with these sets of tendons extending in opposite directions through a concrete structure relative to one another, the inboard ends of both sets of the tendons being arranged in overlapping relation, the outboard ends of both sets of the tendons being anchored to the concrete structure, the combination of:

(a) a pair of jaws insertable between the spaced tensioning plates;

(b) and means connected to the jaws and being operable to move the tensioning plates simultaneously further apart so as to post-tension all of the tendons at one time.

4. In an apparatus for post-tensioning concrete structures wherein a pair of spaced substantially parallel tensioning plates are provided, one tensioning plate being secured to inboard ends of each of two sets of tendons, with these sets of tendons extending in opposite directions through a concrete structure from that of the other set of tendons, the inboard ends of one set of tendons being spaced from the inboard ends of the other set of tendons, the outboard ends of both sets of the tendons being anchored to the concrete structure, the combination of:

(a) a pair of jaws positionable to straddle the tensioning plates;

(b) and means connected to the jaws and being operable to move the tensioning plates simultaneously toward one another so as to post-tension all of the tendons at one time.

5. In an apparatus for post-tensioning concrete structures:

(a) a carriage defining a pair of substantially horizontally-disposed carriage sections that are guided

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for rectilineal movement toward and away from one another;

- (b) each carriage section having a jaw secured thereto and movable thereby;
- (c) the jaws depending substantially vertically from their respective carriage sections to positions therebelow so as to extend downwardly into a recess provided in a concrete structure wherein a pair of tensioning plates are disposed;
- (d) means on the lower ends of the jaws to engage with and support the tensioning plates, with one tension plate being supported on each jaw;
- (e) and means operable to move the carriage sections toward and away relative to one another.

6. The apparatus for post-tensioning concrete structures, as set forth in claim 5;

- (f) and in which said last-named means is operable to move both carriage sections simultaneously, either toward or away relative to one another.

7. In an apparatus for post-tensioning concrete structures:

- (a) a carriage defining a pair of substantially horizontally-disposed carriage sections that are guided for rectilineal movement toward and away from one another;
- (b) each carriage section having a jaw secured thereto and movable thereby;
- (c) the jaws depending substantially vertically from their respective carriage sections to positions therebelow so as to extend downwardly therefrom to engage with a pair of tensioning plates, each jaw engaging with one of the tensioning plates;
- (d) and a pair of hydraulic jacks, one jack being clamped to each of the carriage sections, and the jacks being operable to move the carriage sections simultaneously relative to one another.

8. In an apparatus for post-tensioning concrete structures:

- (a) a carriage defining a pair of substantially horizontally-disposed carriage sections that are guided for rectilineal movement toward and away from one another;
- (b) each carriage section having a jaw secured thereto and movable thereby;
- (c) the jaws depending substantially vertically from

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their respective carriage sections to position therebelow for engagement with tensioning plates that are secured to tendons;

- (d) and means operable to move the carriage sections simultaneously toward and away relative to one another.

9. The apparatus for post-tensioning concrete structures, as set forth in claim 8;

- (e) and in which the carriage sections are provided with supporting means therefor that engage with the concrete structure.

10. The apparatus for post-tensioning concrete structures, as set forth in claim 8;

- (e) and in which the jaws have less lateral width than the lengths of the tensioning plates, whereby the tendons may be confined to the ends of the tensioning plates disposed beyond the lateral sides of the jaws.

11. In an apparatus for post-tensioning concrete structures:

- (a) a carriage defining a pair of carriage sections;
- (b) a pair of parallel guide bars secured to one of the carriage sections, and the other carriage section having guideways slidably receiving the guide bars, whereby the carriage sections are guided for rectilineal movement toward and away from one another;
- (c) each carriage section having a jaw secured thereto and movable thereby, and the jaws depending substantially vertically from their respective carriage section to positions therebelow;
- (d) and means operable to move the carriage sections simultaneously toward and away from one another.

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