ANCHORING SYSTEM USED IN POST STRESSING CONCRETE

The specification discloses an anchor for post-tensioning a cable in a body of set concrete. The anchor comprises an elongated cylindrical tapered case having an internal bore tapering from a large diameter to a small diameter. An imbedding flange is formed around the outer periphery of the case and a cylindrical insert is fitted securely within the small bore opening in the case. The insert is adapted with a circular flange extending radially outwardly so that the insert is prevented from moving completely into the case. The insert receives the cable in sealing relationship to prevent the ingress of moisture and unset concrete into the case through the small end. Wedge segments, slidably mounted in the case, mate with the tapered bore in the case and have a serrated surface on their inner surface for gripping the cable. A collapsible sealing cap encircles the larger end of the case. In an alternate embodiment, the cap walls are formed with accordion pleats which collapse when compressed. A cylindrical flange is affixed to the sealing cap and defines an opening therein; the flange extends to the outside of the cap and receives the cable in a sealing relationship to prevent the ingress of moisture and unset concrete into the case through the large ends. A coil spring is positioned between the wedge segments and the sealing cap maintaining the wedge segments in assembled relationship with the tapered bore within the case.

6 Claims, 9 Drawing Figures
ANCHORING SYSTEM USED IN POST STRESSING CONCRETE

FIELD OF THE INVENTION

This invention relates to an anchor used in post tensioning techniques and more particularly to a cable anchor used in post stressing concrete structures.

PRIOR ART

Concrete structures have the characteristic of being considerably stronger in compression than in tension and for this reason have traditionally been designed so that the structure is subjected primarily to compressive stress. This physical characteristic of concrete has generally ruled out designs which result in any significant tensile stress in the structure.

Recent innovations in introducing compressive loading in concrete structures have made possible the loading of such structures in tension without creating large tensile stresses therein. Ordinarily, one of two methods are used to stress a concrete structure, pretensioning and post-tensioning. In pretensioning, high strength steel bars, wires or cables, generally called tendons, are stretched between anchor points on a concrete form, and a large tensile stress is applied thereto. Then the concrete is poured into the forms and allowed to set. When the concrete is set, the external tension on the tendons is released, transferring the pre-stress to the concrete through the bond between the concrete and the steel. Thus, the induced compressive stresses in the concrete tend to counteract the tensile forces that will occur when the structure is loaded.

In post-tensioning, the tendons are generally fixedly threaded through metal anchors which are attached to the concrete forms. Only enough tensile stress is applied to maintain the tendons in a proper position within the concrete form. The concrete is then poured in the form and allowed to set. When the concrete has hardened, the tendons are tightened to impart a compressive loading to the structure through the use of a hydraulic jack or other similar means by drawing the tendon through the anchor now set in the hardened concrete.

One prior art post-tensioning anchoring apparatus is composed of a metal case with a tapered bore therethrough. One end of the bore is adapted to receive a cable to be tensioned. Rubber grommets fit into the tapered bore within the anchoring case during pouring and setting of the concrete. The portion of the grommets extending exteriorly of the anchor case positions the anchor from the concrete forms and prevents concrete from entering the bore. The bore in the anchor is sized to receive a two-piece gripping jaw assembly which fits into the bore and encircles the cable threaded therethrough. After the concrete has set, the concrete forms and the rubber grommets must be removed in order to introduce the metallic gripping elements into the bore in the anchor case. Then tensioning may proceed.

Another anchoring apparatus is described in U.S. Pat. No. 3,399,434, issued to W. F. Kelley on Sept. 3, 1968, wherein the anchor is composed of a tapered case, having a gripping jaw assembly slidably mounted therein. The anchor is further adapted with a reaction plate attached to the outer periphery of the case to more securely imbed the anchor when set in the concrete. To prevent concrete from coming into contact with the cable and jaw segments within the case, a solid sponge rubber seal is positioned around the larger opening of the case. This rubber seal has an opening through which the cable passes. As described in the Kelly patent, in order to post-tension the tendons, the forms to which the anchors are attached before the concrete is poured and the sponge rubber seal covering the end of the anchor are removed. Jacking equipment is then applied to the anchor and the tendon is drawn therethrough to develop the proper tensile stress.

In both systems just described, removal of the forms to permit the withdrawal of the rubber seals prior to tensioning has been found to be both uneconomical and inconvenient. Thus a need has arisen for an anchor which may be tensioned without removal of the concrete forms and with the sealing member in place.

SUMMARY OF THE INVENTION

The present invention relates to an improved anchor for post-tensioning a cable in a body of set concrete. The anchor includes an elongated cylindrical case with a tapered body. The case has a tapered bore therethrough which decreases in diameter from the large to the small end of the case. An imbedding flange is formed around the outer periphery of the case to more securely imbed the anchor in the concrete which surrounds it and to control expansion of the case. A cylindrical insert is set securely within the small opening of the bore in the case and is adapted to receive the cable therein. The insert is of an appropriate size and material to form a seal between it and the cable passing therethrough, thereby preventing the ingress of moisture and unset concrete into the case.

A gripping assembly composed of wedge segments each having an outer side contoured to mate with the surface of the bore is inserted in the anchor case; the inner side of each segment is serrated for gripping the cable which it engages. A collapsible sealing cap is fitted over the larger end of the case. The cap has an opening therein which coaxially aligns with the axis of the case when the cap is properly fitted on the case. A circular flange is affixed within the opening and extends to the outside of the cap. The flange is sized to receive the cable and form a seal around the cable thereby preventing the ingress of moisture and unset concrete into the case through the larger end. The flange is further sized to fit within an opening in the concrete form against which the case is positioned and thus further seals the case from the entry of concrete and moisture.

A coil spring is positioned between the wedge segments located within the case and the sealing cap in order to maintain the wedge segments in an assembled relationship with the tapered bore. The action of the coil spring forces the wedge segments toward the smaller end of the tapered bore in the case thus causing the teeth of the segments to become engaged with the cable passing through the case.

In accordance with a modification of the previous system, the cylindrical insert fitted within the bore in the smaller end of the case is made with a circular flange to prevent the cylindrical insert from moving into the case as the cable is inserted.

In accordance with still another modification, the walls of the collapsible sealing cap are made with a plurality of accordion pleats. This construction facilitates
the collapse of the cap's walls in such a way as to pre-
terference with the cable passing therethrough.
In a prior art post-tensioning system, rubber grom-
mets are used to prevent moisture and unset concrete
form passing into the end of the anchor case. The
grommets are made in half sections and are inserted
into the anchor case where the gripping elements will
be located during the tensioning process. In this system,
the forms must be removed after the concrete has set
in order to remove the rubber grommets from the an-
chor case. Only after the rubber grommets have been
removed may the gripping elements be inserted into the
unit and tensioning of the cables effected.
In the Kelly patent, removal before tensioning of the
concrete forms and the sponge rubber seal located be-
tween the anchoring case and the forms is made neces-
sary by the design of the seal used.
The present invention allows a cable to be tensioned
without the removal of the concrete forms or the seal-
ing cap. By eliminating the need to remove the forms
and sealing cap before tensioning, the time required to
tension the numerous cables associated with a post-
tensioned concrete structure is greatly reduced thereby
reducing the cost of the procedure and the finished
product.
A more complete understanding of the present inven-
tion may be had by referring to the following detailed
description when taken in conjunction with the draw-
ings, wherein:
FIG. 1 is a pictorial of an anchor of the present inven-
tion as in use in a concrete structure;
FIG. 2 is an end view of the anchor of the invention;
FIG. 3 is a sectional view of an anchor of the inven-
tion taken longitudinally through its center;
FIG. 4 is a sectional view taken generally along the
lines 4—4 looking in the direction of the arrows;
FIG. 5 is a sectional view of a plastic sheathed cable
for use as a tendon in post-stressing concrete struc-
tures;
FIG. 6 is a sectional view of an anchor of the present
invention imbedded in concrete and showing use of a
hydraulic jack for tensioning a tendon with a wood
form in place;
FIG. 6A is a plan view of a steel mounting plate for
use in post-stressing tendons with an anchor of the
present invention;
FIG. 7 is a sectional view of an anchor of the present
invention imbedded in concrete and showing the use of a
hydraulic jack for post-tensioning a tendon with the wood
form removed; and
FIG. 8 is a side view of an alternate embodiment of the
invention.
FIGS. 2, 3 and 4 illustrate an anchor used in post-
tensioning concrete structures embodying the present
invention. The anchor includes a tapered case 10 with
an anchoring flange member 11 formed over the
outer periphery of the case. The flange member 11 may
be formed as an integral part of the case 10 or may be
a separate piece attached to the case by suitable means.
Case 10 has a tapered bore extending substantially
the length of the case along its longitudinal axis. The bore
opening is larger at the larger end of case 10 and tapers
gradually to a smaller opening at the small end of the
case.
The smaller opening is fitted with a cylindrical insert
12 which fits snugly into the bore opening. The insert
is adapted with a flange 13 which limits the insertion of
the insert to the immediate end of case 10. The inner
diameter of the insert is properly dimensioned to ac-
cept a tensioning cable 14 and forms a seal between the
cable and anchor case 10. The seal formed is sufficient
to prevent the ingress of moisture and unset concrete
into the case through the small end.
Referring to FIG. 5, the tensioning cable 14 is en-
closed within a plastic sheath 14a and typically is a
seven strand steel cable. A lubricant, such as a thick
grease, encircles the cable 14 between the sheath 14a.
This plastic sheath and lubricant coating significantly
reduces the amount of force required to properly ten-
sion the cable 14.
Wedge segments 15 and 15a are contoured on their
outer surface to mate with the bore in case 10. The
inner surface of the segment 15 and 15a are serrated
for gripping the cable 14 against which they are en-
gaged.
A collapsible sealing cap 16 encircles the larger end
of case 10. The cap is fitted with an inwardly extending
flange 17 which seals over and mates with flange 18 ex-
tending radially from case 10. The engagement of cap
16 over the end of case 10 is so designed and con-
structed to prevent the entry of moisture and unset
concrete into the case.
The cap 16 has an opening in its head which when as-
sembled on the case 10 is coaxially aligned with the axis
of case 10. The opening is defined by a cylindrical
flange 19 which extends longitudinally outside of cap
16. The inside diameter of flange 19 is so sized to effect
a positive seal against cable 14 which passes through it.
The external extension of flange 19 allows it to be in-
serted in complementary opening 0 in the concrete form
F to which the case 10 is attached by pins P. This en-
gagement creates a second seal between cap 16 and
form F to prevent entry of moisture and unset concrete
into the case through the large end.
A coil spring 20 is positioned between the wedge seg-
ments 15 and 15a and the sealing cap 16. With the cap
fixedly attached to the case, the action of the spring
20 forces segments 15 and 15a into an assembled relation-
ship with the tapered bore of the case 10 to thereby
cause the serrated surfaces of segments 15 and 15a to
touch the cable 14 passing through the anchor.
FIG. 2 illustrates ribs 21 on imbedding flange 11.
These ribs strengthen flange 11 while requiring a mini-
mum of additional material. Although in the present
embodiment, the ribs are cast as an integral part of im-
bedding flange 11, they may be pressed from the rib
portion or added as separate pieces by any suitable
means of attachment.
In use, referring to FIG. 1, the small bore opening in
case 10 is fitted with insert seal 13. Cable 14 is then
threaded through insert seal 13 and into and through the
bore in casing 10. Wedge segments 15 and 15a are
inserted into the bore in case 10 and around cable 14.
Spring 20 is positioned around cable 14 and engaged with
segments 15 and 15a. Spring 20 is compressed and
retained in position by fixedly securing cap 16 around
the flange 18 on the large end of case 10. The action of
spring 20 forces segments 15 and 15a into the
smaller end of the tapered bore in case 10 thus causing
the serrated surfaces of the wedge segments to engage
cable 14 passing therethrough.
The assembled anchor is then attached to concrete
form F using pins P. Cable 14 is threaded through an
opening in concrete form F and the flange 19 on cap
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16 is inserted into a complemental opening 0 to establish a seal between flange 19 and form F.

Cable 14 is then lightly tensioned to properly align the cable in the structure to be formed. Then concrete C is poured and permitted to harden. After the concrete has hardened, post-tensioning may be performed without removal of form F or cap 16.

Referring to FIG. 6, in tensioning the cable 14 with the form F in place, jacking equipment 22 is attached to the cable 14 exteriorly of the form. The cable 14 is passed through a set of jack grippers 24 and the jack nose 26 is placed against the form F with a steel plate 28 intermediate between the jack nose and the form. A typical configuration for the steel plate 28 is illustrated in FIG. 6A.

Hydraulic pressure is applied to the jacking equipment 22 to move the jack grippers 24 away from the wood form F to tension the cable 14. As the cable 14 is tensioned by drawing it through the case 10, the action of the spring 20 engages wedge segments 15 and 15a against cable 14. After tensioning the cable 14 to the desired stress requirements, hydraulic pressure to the jack 42 is released and the wedge segments 15 and 15a gripping the cable 14 prevent slippage of the cable out of the case 10 and thereby retain the applied tension.

With the tensioning technique of FIG. 6, the form F is retained in place resulting in a considerable saving of time and reducing the cost of post-tensioning. When desired, the form F may be removed and the jacking equipment 22 and steel plate 28 assembled directly against the concrete structure.

Referring to FIG. 7, there is shown tensioning of the tendon cable 14 with the form F removed. Again, the jacking equipment 22 is attached to the cable 14 with the cable passing through the jack grippers 24 as previously explained. The jack nose 26 is assembled against the steel plate 28 which in turn is in contact with hardened concrete 30 of the structure to be tensioned. Actual tensioning of the cable 14 takes place in the same manner as described with reference to FIG. 6.

During tensioning with either the method of FIGS. 6 or 7, movement generally occurs between the jacking equipment 22 and the anchor assembly. The hollow collapsing sealing cap 16 permits such movement without binding against or otherwise adversely affecting the movement of cable 14 through case 10.

In an alternate embodiment, illustrated in FIG. 8, the side walls of cap 16 are formed as shown in FIG. 3. Inner walls 16a are formed with accordant pleats such that at the time of tensioning of the cable, the walls 16a may collapse without binding against or otherwise adversely affecting the movement of cable 14 through anchor case 10. Such a structure further allows achievement of a positive seal between the head of cap 16 and form F to which the anchor is attached since the walls 16a will adjust to align the cap head with the form.

While preferred embodiments of the present invention have been shown and described, it is nevertheless to be understood that various changes may be made therein, without departing from the spirit and scope of the claims hereto appended.

What is claimed is:

1. An anchor for tensioning a cable in a body of set concrete comprising:
   an elongated cylindrical case tapering in diameter from a large end to a small end and having a bore therethrough tapering in diameter from a large opening to a small opening;
   an imbedding flange formed around the outer periphery of said case;
   a cylindrical insert adapted to fit securely within the small bore opening in said case, said insert being adapted to receive said cable in sealing relationship thereby preventing the ingress of moisture and unset concrete into said case through the small end;
   wedge segments slidably mounted in said case, said segments being contoured on their outer surface to mate with the tapered bore in said case and having a serrated surface on their inner surface for gripping the cable;
   a collapsible sealing cap encircling the larger end of said case and having an opening therein which coaxially aligns with the axis of said case when said cap is properly fitted on said case;
   a cylindrical flange as an integral part of said sealing cap and defining the opening therein, said flange extending to the outside of said cap and adapted to receive said cable in sealing relationship thereby preventing the ingress of moisture and unset concrete into said case through the large end; and
   flexible means positioned between said wedge segments and said sealing cap maintaining said wedge segments in assembled relationship with the tapered bore within said case.

2. The anchor in claim 1 wherein said cylindrical insert further comprises a flange attached thereto extending radially outwardly so that the insert is prevented from moving completely into said case.

3. The anchor in claim 1 wherein the walls of said collapsible sealing cap are characterized by inner accordant pleats which collapse when compressed.

4. The anchor in claim 1 wherein said case further comprises an outwardly extending flange around said large end and said sealing cap comprises a corresponding inwardly extended flange whereby the two flanges form a sealing engagement in an overlapping relationship to effect a positive seal around the large end of said case.

5. An anchor for tensioning a cable in a body of set concrete comprising:
   an elongated cylindrical case tapering in diameter from a large end to a small end and with a bore therethrough tapering in diameter from a large opening to a small opening;
   wedge segments slidably mounted in said case;
   a cap having an opening therein which coaxially aligns with the axis of the case sealing the larger end of said case and characterized by accordant pleats which collapse when compressed;
   means between the wedge segments and the sealing cap for engaging the wedge segments against the cable;
   a cylindrical insert adapted to fit securely within the small bore opening in said case, said insert being adapted to receive the cable in sealing relationship thereby preventing the ingress of moisture and unset concrete into the case through the small end; and
   a cylindrical flange as an integral part of said sealing cap and defining the opening therein, said flange extending to the outside of said cap and adapted to receive said cable in sealing relationship thereby preventing the ingress of moisture and unset concrete into the case through the large end.

6. The anchor in claim 5 wherein said cylindrical insert further comprises a flange attached thereto extending radially outwardly so that the insert is prevented from moving completely into the case.