United States Patent [19]

Andrews

[11] **3,778,869**

[45] **Dec. 18, 1973**

[54] **APPARATUS FOR DETENSIONING STRANDED CABLE**

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[22] Filed: **Mar. 15, 1971**

[21] Appl. No.: **124,159**

[52] **U.S. Cl.** ..... **24/115 R,** 24/126 C, 24/122.6, 52/223 L

[51] **Int. Cl.** **F16g 11/04**

[58] **Field of Search** ..... 24/263 KS, 263 CA, 24/122.6, 126 C, 126 B, 126 R; 52/230, 223 L; 287/20.3, 52.06

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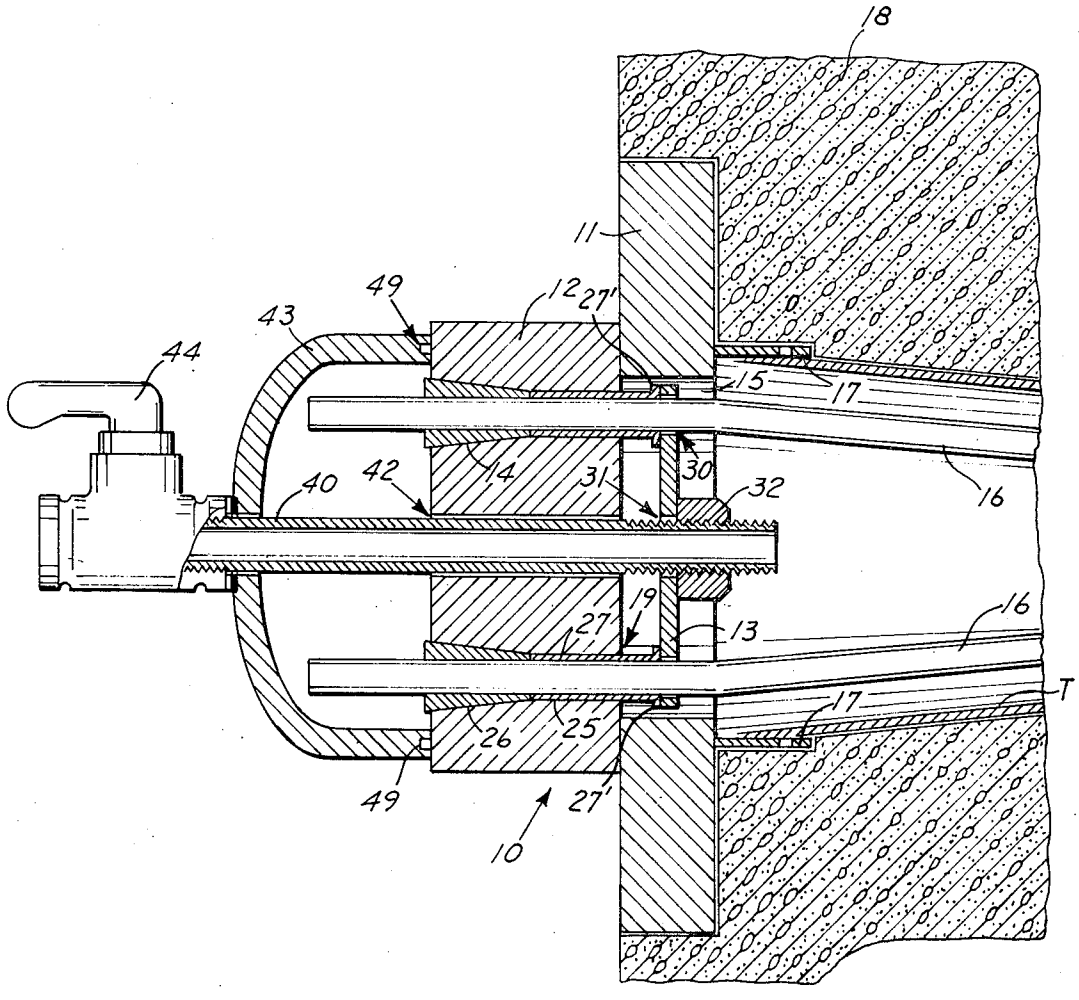
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[57] **ABSTRACT**

A detensioning method and apparatus has been devised for detensioning one or more stranded cables which are anchored or set under tension in cable passageways by wedges seated at the ends of the passageways. The detensioning device which is made up of push tubes, a push plate and a detensioning screw is installed within the cable assembly so that the anchored cables may be detensioned, for instance, to replace a defective cable, by retensioning the cables, unseating the wedges and operating the detensioning screw to retract the push tubes against the wedges thereby retaining the wedges clear of the cables to permit detensioning and replacement. After the defective cable has been replaced, the cables are retensioned and anchored under tension by reseating the wedges.

11 Claims, 5 Drawing Figures



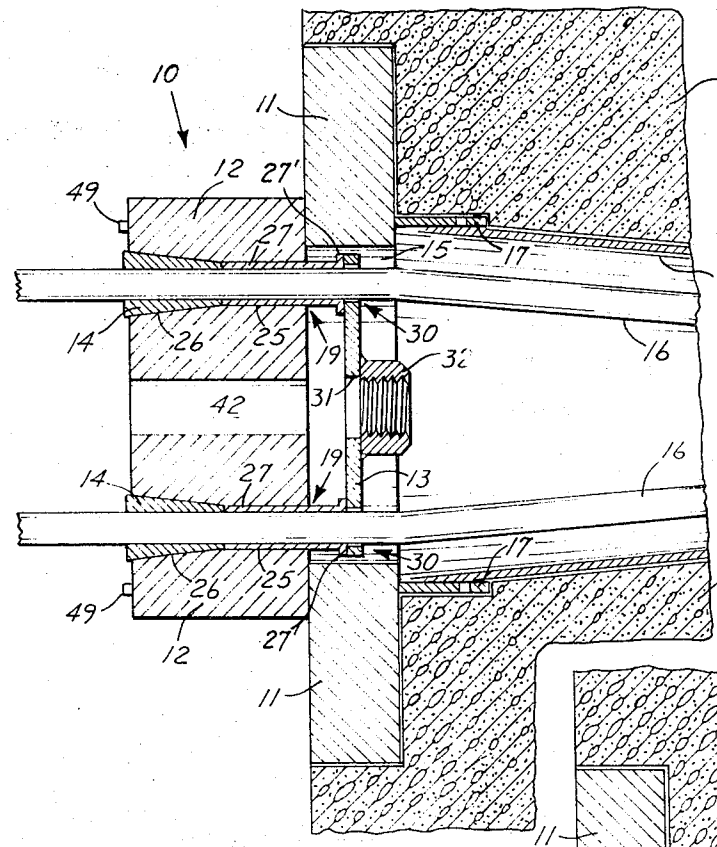


FIG. 1

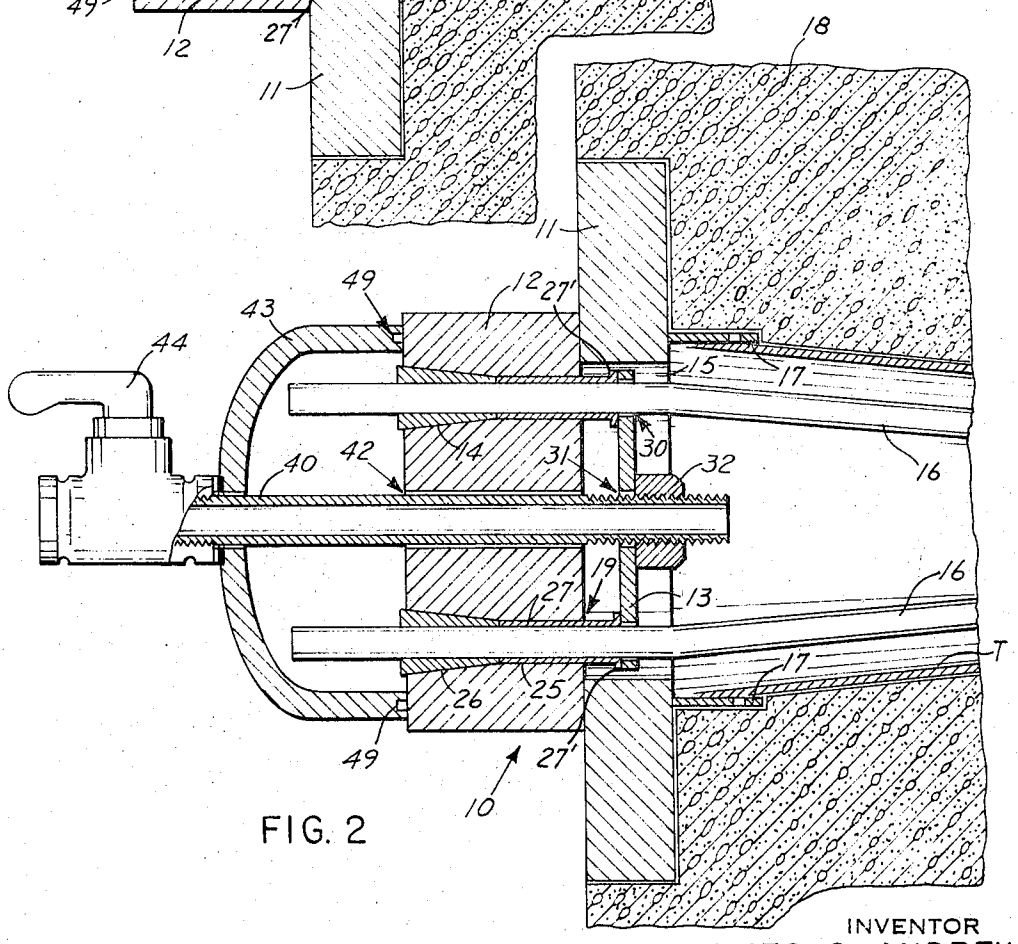


FIG. 2

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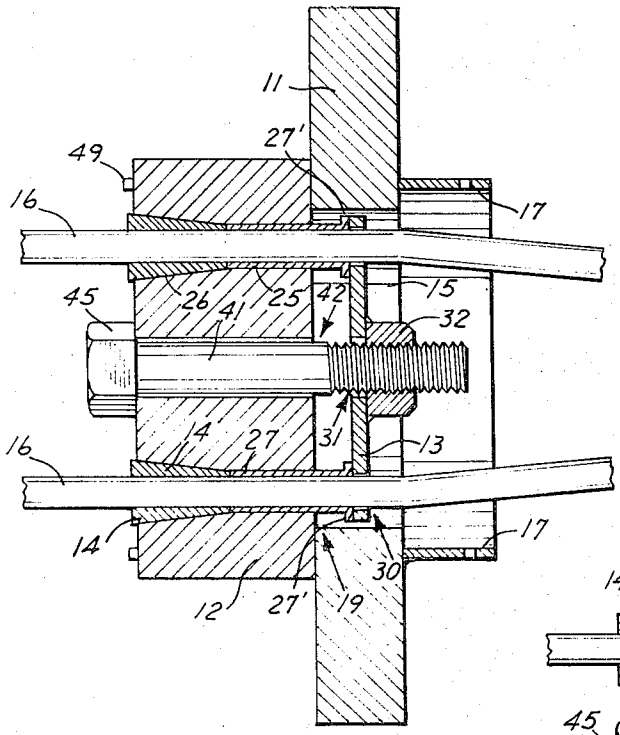


FIG. 3

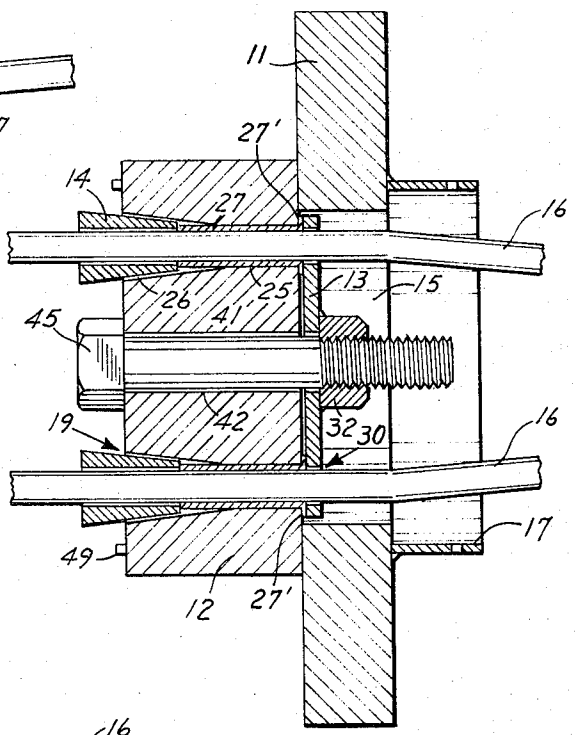


FIG. 4

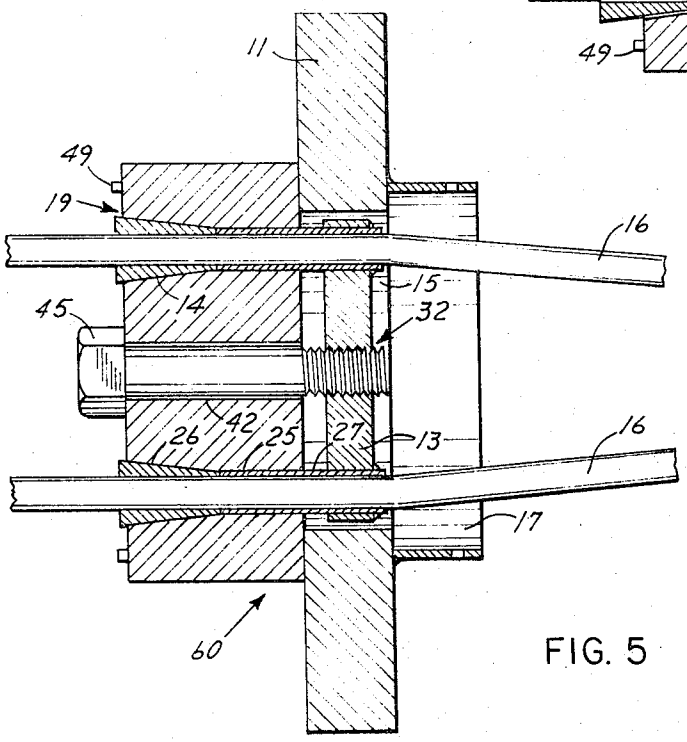


FIG. 5

APPARATUS FOR DETENSIONING STRANDED CABLE

BACKGROUND OF THE INVENTION

The present invention relates to detensioning of anchored stress members, such as, stranded cable members. More particularly, the present invention relates to an improved detensioning method and apparatus for tendons or stranded cables anchored under tension in a concrete structure, such as a bridge.

Assemblies have been devised for anchoring stranded cables or tendons under tension in concrete structures. Generally, such assemblies include an anchor block with cable passageways defined therein through which the stranded cable members are inserted and also include gripping wedges seated in the cable passageways to anchor the stranded cables therein. The conventional procedure employed for anchoring stranded cables in such an anchor assembly consists of using a suitable hydraulic jack or tensioning press to tension or stretch the cable threaded through the cable passageways in the anchor block, followed by seating the gripping wedges in the passageways of the anchor block. Upon releasing the tension applied to the stranded cables by the tensioning press, the cables are gripped by the wedges to anchor the stranded cables in place under the desired tension.

One particular problem associated with such anchoring assemblies is that no provision has been made for detensioning the cables once anchored in place. In the event that one of the strands of an anchored cable assembly ruptured or was found to be defective, it was necessary to remove and replace the entire assembly, and was rather expensive and unduly time consuming.

It is accordingly an object of the invention to provide an improved assembly for anchoring tendons or stranded cables under tension which is characterized by including a novel arrangement for detensioning cables anchored therein so as to obviate the aforementioned disadvantages of prior art anchoring assemblies.

It is further an object of the present invention to provide a novel arrangement for detensioning stranded cables or the like anchored under tension.

It is additionally an object of the present invention to provide a positive, reliable method and means for detensioning stranded cables or the like anchored under tension in an anchor assembly by gripping wedges in which the detensioning means is incorporated as a part of the assembly and is operative to hold the gripping wedges clear of the cables so that the cables may be released from tension for replacement of one or more cables.

It is also an object of the present invention to provide an improved method and apparatus for anchoring stranded cables or the like under tension in a concrete structure, such as a bridge, which are capable of selectively detensioning the anchored cables when necessary in a rapid, safe and dependable manner.

In accomplishing the above and other objects, the instant invention is intended for use as part of an anchor assembly having an anchor block or plate secured against a bearing plate which is mounted in a concrete bridge structure. Cable passageways are formed in the anchor plate to receive the stranded cables. The outer ends of the cable passageways in the anchor block are shaped for receiving gripping wedges which are inserted therein for anchoring the cables under tension.

The cables are anchored in the anchor block under tension by employing a conventional ram or tensioning press to tension the cables and seat the wedges. A central hole is formed in the anchor block through which a grout tube may be inserted for applying grout around the cables to cement them in place in the bridge structure. Should one of the strands of an anchored cable rupture, or be found to be defective, a novel detensioning arrangement is incorporated as a part of the assembly for unseating the gripping wedges so that the defective cable may be removed and replaced. The detensioning arrangement includes wedge-releasing members disposed inwardly of and behind the anchor block for movement through each of the cable passageways in the anchor plate to push against the inner ends of the wedges in the direction of release. A common movable push plate is associated with the release members and is operated by a detensioning screw from the outside of the assembly to selectively urge the wedge-releasing members against the gripping wedges. In the procedure of detensioning anchored cables, the tensioning press is employed to hold the cables at the tension at which they are anchored and to unseat the wedges while the detensioning arrangement is operated to prevent the gripping wedges from being reseated when the tension on the cables is removed for return of the cables to a detensioned state and replacement of any one or more cables. Thereafter the detensioning apparatus is released and the cable assembly then may be anchored and set in place as described. Thus, there is provided an improved assembly for detensioning stranded cable or the like anchored under tension together with an improved method of detensioning and selectively replacing the stranded cables.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, advantages and features of the present invention will become more readily appreciated and understood from a consideration of the following detailed description when taken with the accompanying drawings, in which:

FIG. 1 is a sectional view of an anchoring assembly having a preferred form of mechanism for detensioning cables anchored under tension therein according to the present invention;

FIG. 2 is a sectional view of the assembly of FIG. 1 illustrating a grout tube inserted therein for applying grout around the tensioned cables anchored therein;

FIG. 3 is a sectional view of the assembly similar to FIG. 1 with a modified form of push tube illustrating a detensioning screw secured to the detensioning mechanism for detensioning the cables;

FIG. 4 is a sectional view of the assembly of FIG. 3 illustrating the manner in which cables anchored therein may be detensioned by means of the detensioning arrangement illustrated in FIG. 3; and

FIG. 5 is a sectional view of an anchoring assembly having a modified form of mechanism for detensioning cables anchored under tension according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in more detail, there is shown in FIGS. 1–4 a preferred form of anchoring assembly generally designated by the numeral **10**. The assembly **10** is made up of a bearing plate **11**, an anchor

block or plate 12, a push plate 13 and gripping wedges 14. The bearing plate 11 is preferably a flat square plate and defines a relatively large generally circular opening 15 in its center which forms a passageway for a plurality of stranded cables or tendons 16 which are to be anchored in the assembly 10. The bearing plate has a tubular extension or collar 17 formed on one of its sides around the opening 15 and in a conventional manner is disposed at the end of a trumpet T which converges into a conduit, not shown, to serve as a housing for the tendons 16 within a concrete structure represented at 18. Thus, the collar 17 together with the trumpet and conduit permits movement of the tendons relative to the concrete during the post tensioning process to be described.

With one side of the bearing plate 11 set or secured in the concrete structure 18, the anchor block 12 is secured centrally on the other side of the plate 11 to cover the opening 15. The anchor block 12 is preferably rectangular in shape having a flat, square-shaped end in facing relation to the bearing plate. Exposed cable passageways or holes 19 in equally spaced circumferential relation, two of which are shown in FIGS. 1–4, are formed to run lengthwise throughout the block 12 from one end to the other. The passageways 19 are of uniform diameter throughout the inner portion 25 from the inner end which is adjacent the bearing plate 11. Outer portions 26 of the passageway 19 which join the portions 25 are flared outwardly into a frustoconical shape to form conical seats for the gripping wedges 14. The passageways are disposed on mutually parallel axes which extend perpendicularly to the flat faces of the bearing plate 11, and the cable passageways 19 communicate with the opening 15 in the plate 11 so that the cables 16 may be advanced into the passageways 19 by passage through the opening 15.

Wedge-releasing members are defined by push tubes 27 which are dimensioned and disposed for movement through each passageway 19 in the hole portions 25. Each tube 27 is dimensioned to fit within an associated hole portion 25 with sufficient clearance to permit the tube 27 to slide axially therethrough. Thus, since the hole portions 25 are cylindrical in the exemplary assembly 10 here shown, the tubes 27 are also cylindrical but of a diameter slightly smaller than that of the hole portions 25. Each tube 27 is rigid and longer than its associated hole portion 25. In this way, the push tubes 27 provide a convenient arrangement for pushing or driving against the inner ends of the wedges 14 so that the wedges 14 may be unseated from their associated frustoconical seats or hole portions 26. Each push tube 27 and its associated wedge form common channels along the axis of the holes 19 which are dimensioned so that one of the stranded cables 16 may be passed through each common channel. Each wedge 14 preferably is made up of semi-cylindrical two-piece members which are capable of lateral expansion and contraction. In addition, as illustrated in FIGS. 1 to 4, the tubes may be given flared ends or external shoulders 27f. With the wedges 14 expanded, as in FIG. 4, the longitudinal channels defined thereby are sufficiently large to permit a stranded cable 16 to be advanced or passed therethrough or removed therefrom. With the wedges 14 contracted, however, as shown in FIGS. 1–3 where the wedges 14 are shown seated in hole portions 26, the wedges 14 bind against the cables 16 and positively anchor the cables 16 in place in the anchoring assembly 10.

The push plate 13 is movably mounted centrally of the opening 15 of the bearing plate 15 to abut against the flared ends 27' of the push tubes 27 as shown in FIGS. 1 and 2. The push plate 13 is preferably defined by a flat circular plate and has holes 30 formed therein in a pattern to match and align with the cable passageways 19 in the anchor block 12. It is noted that all of the push tubes 27 are preferably of the same length so that with the wedges 14 seated in the holes 26 each of the tubes 27 extends substantially the same distance into the opening or cavity 15. Centrally formed on the push plate 13 is a central bore 31 in the plate 13 aligned with a threaded sleeve 32 fixedly secured on the side of the plate 13 remote from the block 12. The sleeve 32 is designed for mating with the externally threaded portion of either a grout tube 40 or of a detensioning screw 41. A bore 42 is formed centrally in the anchor block 12 in alignment with the axes of the push plate bore 31 and the sleeve 32 so that the grout tube 40 or detensioning screw 41 may be threaded in the sleeve 32.

The grout tube 40 is shown in FIG. 2 inserted through a grout cap 43, the bore 42 and threaded into the thread structure 32 on the plate 13. The grout cap 43 is sealed against the end of the block 12 remote from the bearing plate 11 by an O-ring seal 49. A valve 44 is shown connected to the grout tube 40 externally of the grout cap 43 to control the supply of grout to the tube 40. As is hereinafter explained, grout is applied by the grout tube 40 to the region within the collar 17, trumpet T and conduit structure to bond the cables 16 anchored in the assembly 10 in place. The detensioning screw 41, as shown in FIGS. 3 and 4 is dimensioned so that when threaded in the sleeve 32 its head or cap 45 rests against the end of the anchor block 12, remote from the bearing plate 11. Thus, by turning the detensioning screw 41, the push plate 13 is drawn towards the anchor block 12 so as to simultaneously force the push tubes 27 longitudinally through the cable passageways 19 against the inner edges of the gripping wedges 14 after the wedges 14 have been unseated and thereby permit detensioning of the cables 16.

In operation, the following procedure is conventionally employed for anchoring the stranded cables 16 under tension in the anchoring assembly 10. It is noted that at the commencement of the anchoring procedure the bearing plate 11 of the assembly 10 which provides the structure for securing the assembly on a concrete structure has already been cemented in place and as yet no grout has been injected into the cavity defined by the collar 17. In the anchoring procedure, the stranded cables 16 are advanced through the holes 30 in the push plate 13, and the tubes 27 are positioned in the passageways 19 and the wedges 14. At this point in the anchoring procedure the wedges 14 are not seated in the hole portions 26 and fit loosely around the cables 16 in positions similar to the positions in which they are shown in FIG. 4.

With the cables 16 thus inserted in the anchoring assembly 10, a conventional tensioning press or ram assembly is utilized to apply a predetermined tension to the cables 16. Once the desired tension is applied to the cables 16, the wedges 14 are seated in the hole portions 26 as shown in FIG. 1 to positively engage the cables 16 and anchor them under tension as shown in FIG. 1. If no strands of the cable 16 have ruptured, the excess

lengths of the cables extending beyond the wedges **14** are trimmed to appropriate lengths and the grout cap **43** and tube **40** may be positioned on the assembly **10** as shown in FIG. **2.** By operating the valve **44,** grout is then applied through the grout tube **40** to the cavity defined within the collar **17** and conduit to bond the cables **16** in place. Here, the cables **16** passed through the holes **30** in the push plate **13** to function to hold the sleeve **32** in place so that the grout tube **41** may be readily threaded therein. The cable anchoring procedure is now complete and the grout tube **40** and cap **43** may be removed from the assembly **10.**

If one or more of the cables **16** has been found to be defective after the cables have been anchored under tension in the assembly **10,** of course the cable or cables must be replaced before the grout applied to bond the cables in place is applied. For this purpose, the tensioning press is operated again to apply approximately the same amount of tension at which the cables **16** are anchored on the cable ends extending beyond the wedges **14** in order to unseat the wedges **14** and nullify the pressure exerted on the wedges **14** by their associated cables **16.** After the wedges are unseated, the detensioning screw **41** is inserted in the bore **42** and threaded into the sleeve **32** of the push plate **13,** and a cap **45** on the screw may be suitably provided with a socket, not shown, for insertion of an Allen head wrench. Sufficient force is then applied to the cap **45** of the screw **41** to turn the detensioning screw **41.** Once the screw cap **45** contacts the anchor block **12,** turning the screw **41** further draws the push plate **13** against the push tubes **27,** simultaneously forcing the push tubes **27** against the inner edges of the wedges **14** and unseating them. The detensioning screw **41** is shown threaded in the sleeve **32** of the plate **13** in FIG. **3** in position against the wedges **14,** and the wedges **14** are shown unseated and separated from the cables **16** in FIG. **4,** by the detensioning arrangement or mechanism defined by the detensioning screw **41,** push plate **13** and push tubes **27.** The wedges **14** are therefore prevented from returning to their seated positions within the portions **26** and held clear of the cables **16.** The cables **16** are detensioned by releasing the pressure applied thereon by the tensioning press.

After detensioning, the ruptured cable or cables **16** are removed and replaced. Thereafter, the tensioning press is employed to tension the replaced cable or cables **16** along with the other cables inserted through the anchor block passageways **19** and again seat the wedges **14.** Providing no other strands of these cables **16** are ruptured in this last tensioning and anchoring step, the ends of the cables extending beyond the wedges **14** are trimmed and grout is applied in the manner before describing cementing of the cables **16** in place.

An anchoring assembly having a slightly modified form of detensioning arrangement is shown in FIG. **5.** The assembly is generally identified by the numeral **60** and all parts of the assembly **60** which correspond with the parts of the assembly **10** shown in FIGS. **1–4** are identified by the same reference numerals used in FIGS. **1–4.** In the anchoring assembly **60,** the push tubes **27** are made slightly longer than the push tubes in the assembly **10** and are passed through the push plate **13** and affixed, such as, by welding directly thereto instead of merely abutting against the push plate as in the assembly **10.** Further, in the push plate of the assembly **60,** the sleeve **32** with which the detensioning screw **41** mates is formed in the push plate **13** instead of being secured thereon. In operation, the anchoring assembly **60** and its detensioning arrangement functions in substantially the same manner as the assembly **10,** which manner of operation was described above.

Thus, there has been provided an improved assembly for anchoring stranded cables or the like under tension in a concrete structure, such as, a bridge structure and characterized in particular by a novel detensioning arrangement or mechanism for detensioning the anchored cables. Further, an improved method of anchoring stranded cables or the like under tension in a concrete structure is provided which includes the novel step of detensioning when necessary the anchored cables.

It will be evident that various changes may be made in the exemplary anchoring assemblies **10** and **60** herein described without departing from the spirit and scope of the present invention. For example, one or more detensioning screws **41** could be employed for advancing the push plate **13.** Also, independently operable push plate-detensioning screw arrangements could be employed for separately detensioning each cable **16** one at a time. Further, other means could be used for pushing against the inner ends of the seated wedges **14** other than the push tube, push plate and detensioning screw arrangement herein described.

It is therefore to be understood from the foregoing description of preferred forms of the present invention that various modifications and changes may be made in the specific design, construction and arrangement of mechanism employed and in the steps and order of steps of the present invention without departing from the spirit and scope of the present invention.

What is claimed is:

1. In an assembly for anchoring stranded cables or the like under tension and detensioning cables anchored therein wherein an anchor block is provided with a cable passageway for each cable extending from one end of said anchor block to the other so that a cable to be anchored therein may be advanced therethrough, said cable passageway being shaped at one end to form a seat facing in the direction of tensioning to receive a cable gripping wedge, the combination therewith of:

cable gripping wedge means releasably positioned in the seat formed in each cable passageway, said wedge means normally being movable into the seat formed to grip a cable advanced under tension through said passageway and whereby to anchor the cable under tension therein; and

wedge-releasing means movable through each passageway from the opposite end of each cable passageway to engage said wedge means and prevent its movement into the seat whereby the cable therein may be detensioned and each wedge-releasing means including a tubular member disposed in the end of said cable passageway remote from the seat formed therein for movement along said passageway and common actuating means for advancing said tubular members against the inner ends of said wedge means in each cable passageway.

2. The invention recited in claim **1,** wherein the seat formed in each cable passageway extends from a point

within said anchor block to the one end and has an outwardly expanding cross section, said wedge means has an inner end which is inserted in in the seat formed in the cable passageway, and said wedge-releasing means is movable against the inner end of said wedge means.

3. The invention recited in claim **1,** wherein said actuating means comprises a common support member for said tubular member and a control member extending through said anchor block and connected to said support member for advancing said tubular members through said cable passageway.

4. The invention recited in claim **3,** wherein said control member is defined by an elongated screw movable into threaded engagement with a threaded portion on said support member to control movement of said tubular members.

5. The invention recited in claim **4,** wherein each of said tubular members is defined by semi-cylindrical portions in the end of said cable passageway remote from the seat formed therein for movement along said cable passageway.

6. The invention recited in claim **1,** wherein a plurality of said cable passageways are defined in said anchor block, one of said wedge means is positioned in the seat formed in each of said cable passageways, and said wedge releasing means is operable to simultaneously engage all of said wedge means to prevent their being seated in said cable passageways so as to separate said wedge means from their associated cables and permit the cables in said cable passageways to be detensioned.

7. An assembly for anchoring a stranded cable or the like under tension in a concrete structure and selectively detensioning the cable anchored therein, comprising:

a bearing plate for mounting in the concrete structure;

an anchor block mounted on said bearing plate and having at least one exposed cable passageway defined therein, said cable passageway extending from the end of said anchor block adjacent said bearing plate to its opposite end so that a cable to be anchored therein may be advanced therethrough, said cable passageway having a cylindrical portion joined with a frusto-conical seat portion, said cylindrical passageway portion extending from the end of said cable passageway adjacent said bearing plate to said frusto-conical seat portion, said frusto-conical seat portion expanding outward from said cylindrical passageway portion to the end of said cable passageway remote from said bearing plate;

a frusto-conically shaped cable gripping wedge positioned in said frusto-conical seat portion of said cable passageway, said wedge being operable to grip a cable advanced through said cable passageway and seat in said frusto-conical seat portion whereby to anchor a cable under tension therein;

a cylindrical push tube positioned in said cylindrical passageway portion for movement along said cable passageway, said push tube having a predetermined longitudinal dimension which is greater than the length of said cylindrical passageway portion;

a movable push plate positioned for pushing said push tube against said wedge whereby to unseat said wedge from said frusto-conical seat portion and separate said wedge from a cable therein; and

detensioning screw means connected to said push plate for mechanically moving said push plate and thereby said push tube so as to unseat said wedge.

8. The invention recited in claim **7,** wherein said push plate abuts against the end of said push tube extending from the end of said cable passageway adjacent said bearing plate.

9. The invention recited in claim **7** wherein said push tube is rigidly secured to said push plate for movement therewith.

10. The invention recited in claim **7** wherein a plurality of said cable passageways are defined in said anchor block, one of said wedges is positioned in said frusto-conical seat portion of each of said cable passageways, said push plate is positioned for simultaneously pushing each of said push tubes against its associated one of said wedges whereby to unseat each of said wedges from its associated one of said frusto-conical seat portions, and at least one of said detensioning screw means is connected to said push plate.

11. An assembly for anchoring a stranded cable or the like under tension in a concrete structure and selectively detensioning the cable anchored therein, comprising:

a bearing plate adapted for mounting in the concrete structure;

an anchor block mounted on said bearing plate and having at least one exposed cable passageway defined therein, said cable passageway extending from the end of said anchor block adjacent said bearing plate to its opposite end so that a cable to be anchored therein may be advanced therethrough, said cable passageway having a seat portion at one end facing in the direction of tensioning of said cable and expanding outward from said passageway portion to the end of said cable passageway remote from said bearing plate;

a cable gripping wedge positioned in said seat portion of said cable passageway, said wedge being operable to grip a cable advanced through said cable passageway and seat in said seat portion whereby to anchor a cable under tension therein;

a push tube positioned in said passageway portion behind said seat portion for movement along said cable passageway;

a movable push plate engageable to advance said push tube against said wedge whereby to unseat said wedge from said frusto-conical seat portion and separate said wedge to permit detensioning of a cable therein; and

detensioning screw means extending through said anchor block and bearing plate for connection to said push plate and operative to mechanically move said push plate against said wedge to hold said wedge away from said cable when said cable is detensioned.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,778,869 Dated 18 December 1973

Inventor(s) James S. Andrews

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 4, cancel "bearing plate 15" and substitute -- bearing plate 11 --

Signed and sealed this 23rd day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents