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(54) **METHOD FOR FORMING A POST-TENSIONED CONCRETE MEMBER**

VERFAHREN ZUM HERSTELLEN EIN NACHGESPANNTES BETONELEMENT

PROCÉDÉ DE FORMATION D'UN ÉLÉMENT DE BÉTON PRÉCONTRAINT

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**US-A- 5 423 362**
**US-A1- 2006 033 003**
**US-A1- 2014 223 854**

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## Description

### Cross-Reference to Related Applications

**[0001]** This application is a nonprovisional application that claims priority from U.S. provisional application number 62/200,945, filed August 4, 2015; U.S. nonprovisional application number 15/226,334, filed 2 August 2016; and, PCT application number PCT/US2016/45147, filed 2 August 2016.

### Technical Field/Field of the Disclosure

**[0002]** The present disclosure relates generally to post-tensioned, pre-stressed concrete construction. The present disclosure relates specifically to a method for use therein.

### Background of the Disclosure

**[0003]** Many structures are built using concrete, including, for instance, buildings, parking structures, apartments, condominiums, hotels, mixed-use structures, casinos, hospitals, medical buildings, government buildings, research/academic institutions, industrial buildings, malls, roads, bridges, pavement, tanks, reservoirs, silos, sports courts, and other structures.

**[0004]** Prestressed concrete is structural concrete in which internal stresses are introduced to reduce potential tensile stresses in the concrete resulting from applied loads; prestressing may be accomplished by post-tensioned prestressing or pre-tensioned prestressing. In post-tensioned prestressing, a tension member is tensioned after the concrete has attained a desired strength by use of a post-tensioning tendon. The post-tensioning tendon may include for example and without limitation, anchor assemblies, the tension member, and sheathes. Traditionally, a tension member is constructed of a material that can be elongated and may be a single or a multi-strand cable. Typically, the tension member may be formed from a metal or composite material, such as reinforced steel. The post-tensioning tendon conventionally includes an anchor assembly at each reinforced steel. The post-tensioning tendon conventionally includes an anchor assembly at each end. The post-tensioning tendon is fixedly coupled to a fixed anchor assembly positioned at one end of the post-tensioning tendon, the "fixed-end", and stressed at the stressed anchor assembly positioned at the opposite end of the post-tensioning tendon, the "stressing-end" of the post-tensioning tendon.

**[0005]** Post-tension members are conventionally formed from a strand and a sheath. The strand is conventionally formed as a single or multi-strand metal cable. The strand is conventionally encapsulated within a polymeric sheath extruded thereabout to, for example, prevent or retard corrosion of the metal strand by protecting the metal strand from exposure to corrosive or reactive fluids. Likewise, the sheath may prevent or retard concrete from bonding to the strand and preventing or restricting movement of the sheath during post-tensioning. The sheath may be filled with grease to further limit the exposure of the metal strand and allow for increased mobility. Once installed in the concrete member, and before the strand is tensioned and sealed, the end of the tension member extending from the concrete member may provide an entry point for fluids such as water resulting from ambient humidity or precipitation.

**[0006]** The document US 5423362 discloses all the features of the preamble of the method of claim 1.

### Summary

**[0007]** The present disclosure provides for a method of forming a post-tensioned concrete as defined in claim 1.

### Brief Description of the Drawings

**[0008]** The present disclosure is best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

FIGS. 1A, 1B depict a partial cross section of a concrete post-tensioning tendon within a concrete form consistent with at least one embodiment of the present disclosure.

FIGS. 2A, 2B, 2C depict an anchor and pocket cap consistent with at least one embodiment of the present disclosure.

FIG. 3 depicts an anchor and pocket cap not falling under the scope of the present invention.

### Detailed Description

**[0009]** It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples which are limited by the appended claims. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

**[0010]** When stressing concrete member 40, anchoring systems may be provided to hold the tension member before and after stressing. As depicted in FIGS. 1A, 1B, post-tensioning tendon 11 is positioned within concrete form 21. Concrete form 21 is a form into which concrete

may be poured to form concrete member 40. Post-tensioning tendon 11 includes a fixed end anchor 13, tension member 15, and stressing end anchor 17. As depicted in FIG. 1A, fixed end anchor 13 may include fixed end anchor body 14. Fixed-end anchor body 14 is positioned within concrete form 21 such that fixed-end anchor body 14 will be encased in concrete 23 after concrete is poured into concrete form 21. In some embodiments, fixed end cap 19 may be positioned at distal end 41 of fixed end anchor body 14. Fixed end cap 19 may, in certain embodiments, protect tension member 15 from corrosion after concrete 23 is poured by preventing or retarding corrosive or reactive fluids or concrete from contacting tension member 15.

**[0011]** The tension member 15 includes strand 27 and sheath 29. Strand 27 may be a single or multi-strand metal cable. Sheath 29 may be tubular or generally tubular and may be positioned about strand 27. In some embodiments, space between strand 27 and sheath 29 may be filled or partially filled with a filler such as grease. When installing tension member 15, in some embodiments, a length of sheath 29 may be removed from first end 43 of tension member 15, exposing strand 27. Strand 27 may be inserted through fixed end anchor body 14 and secured thereto, for example and without limitation, by one or more wedges. After strand 27 is secured, fixed end anchor body 14 may be installed in concrete form 21. Tension member 15 may be positioned within concrete form 21 and tension member 15 may be cut to correspond with the length of concrete form 21. In some embodiments, a length of sheath 29 may be removed from second end 44 of tension member 15, exposing strand 27. Strand 27 may be inserted through stressing end anchor body 18. After insertion of strand 27 through stressing end anchor body 18, stressing end anchor 17 may be positioned within concrete form 21. End wall 22 may include strand aperture 45 through which strand 27 may extend.

**[0012]** Pocket former 100 is positioned between stressing end anchor body 18 and end wall 22 of concrete form 21. Pocket former 100 prevents or restricts concrete 23 from filling the space between stressing end anchor body 18 and end wall 22, thus forming a cavity or pocket in edge 42 of concrete member 40 formed by concrete 23 within concrete form 21. Pocket former 100 thus allows access to tension member 15 from outside concrete member 40 once concrete member 40 is sufficiently hardened and end wall 22 is removed. As used herein, "stressing end anchor assembly" refers to the combination of stressing end anchor 17, pocket former 100, and, as described hereinbelow, pocket cap 103.

**[0013]** In some embodiments, as depicted in FIGS. 2A, 2B, pocket former 100 may include pocket former body 101. In some embodiments, pocket former body 101 may include a coupler for coupling pocket former 100 to stressing end anchor 17. In some embodiments, pocket former body 101 may be hollow. In some embodiments, pocket former body 101 may be a cylindrical or generally cylindrical member. Pocket former body 101 may be any shape suitable for providing a pocket in concrete 23 to allow access to the end of tension member 15 including, but not limited to, cylindrical, frustoconical, prismatoidal, ellipsoidal, or any combination thereof. Additionally, the cross-sectional shape of pocket former body 101 may be any shape including, but not limited to, square, round, oblong, ovate, ellipsoidal, triangular, polyhedral, or any combination thereof. As depicted in FIG. 2A, pocket former body 101 may be frustoconical or otherwise tapered from pocket former outer edge 120 to pocket former inner edge 130. In some embodiments, by tapering pocket former body 101 from pocket former outer edge 120 to pocket former inner edge 130, removal of pocket former body 101 from concrete 23 may be accomplished more easily than a non-tapered pocket former body. As depicted in FIG. 2A, when pocket former body 101 is removed from concrete 23 (once concrete 23 has reached a sufficient strength), cavity 101' is formed in concrete 23. The shape of cavity 101 corresponds with the outside shape of pocket former body 101.

**[0014]** The pocket former 100 includes a keyway former 102. Keyway former 102 may be annular or generally annular and may be positioned on outer tapered surface 140 of pocket former body 101. As depicted in FIG. 2A, at least a part of keyway former 102 may extend radially outwardly from outer tapered surface 140 of pocket former body 101. As depicted in FIG. 2B, when keyway former 102 is removed from concrete 23, keyway 102' is in concrete 23. Keyway 102' is a cavity within concrete 23. The shape of keyway 102' may correspond with the outside shape of keyway former 102.

**[0015]** A pocket cap 103 s positioned around strand 27. Pocket cap 103 covers cavity 101' and prevents or restricts fluid intrusion thereinto. Pocket cap 103 may be positioned between cavity 101' and strand 27. In some embodiments, pocket cap 103 may be annular or generally annular. Pocket cap 103 couples to keyway surface 102" using a coupling with an extension adapted to fit into keyway 102'. In some embodiments, pocket cap 103 may include one or more extensions 107 that couple pocket cap 103 to keyway surface 102" as depicted in FIG. 2C. As depicted in FIG. 3, cavity 101' may include cylindrical section 105 and frustoconical section 106. This pocket cap 103 may fit within cylindrical section 105 by, for example and without limitation, a friction or press fit. The cylindrical section 105 may instead be tapered inwardly or outwardly. Surface 23' of concrete 23 in cavity 101' may, for example, be rough enough to retain pocket cap 103 therewithin without locking members.

**[0016]** In some embodiments, as depicted in FIGS. 2B, 2C, pocket cap 103 may be filled with a filler such as grease 111. Grease 111 may, for example and without limitation, prevent or restrict corrosive or reactive fluids from contacting strand 27. Grease 111 may be positioned within pocket cap 103 before pocket cap 103 is installed to cavity 101'.

**[0017]** In some embodiments, strand end 170 of strand

27 may pass through pocket cap 103. In some such embodiments, pocket cap 103 may have a cylindrical or generally cylindrical interior wall 113 having a pocket cap diameter 150 generally corresponding to strand outer diameter 160. In some embodiments, grease 111 may be positioned along cylindrical interior wall 113. In some embodiments, cylindrical interior wall 113 may terminate in end flange 115. End flange 115 may retain grease 111 within pocket cap 103. In some embodiments, one or more seals 117 may be positioned between cylindrical interior wall 113 and strand 27 to retain grease 111 within pocket cap 103.

**[0018]** As depicted in FIG. 3, pocket cap 103 may enclose strand end 170 of strand 27. Pocket cap 103 may include cap end wall 119 positioned to retain grease 111 within pocket cap 103.

**[0019]** The gasket 109 as depicted in FIG. 3 may seal between stressing end anchor body 18 and pocket cap 103. Gasket 109 may be compressed between stressing end anchor body 18 and pocket cap 103. Gasket 109 may be formed from an elastic material such as rubber.

**[0020]** Post-tensioning tendon 11 is positioned within concrete form 21 as depicted in FIG. 1A. Pocket former 100 of stressing end anchor 17 may be positioned such that pocket former 100 is in contact with end wall 22. Concrete 23, as depicted in FIG. 1B is poured into concrete form 21 and allowed to set. End wall 22 of concrete form 21 is removed. Pocket former 100 and keyway former 102 are removed from cavity 101' as depicted in FIG. 2A. A pocket cap 103 may be placed within cavity 101'. Pocket cap 103 remains coupled to keyway surface 102" until access to strand 27 is desired, such as, for example, when strand 27 is to be post-tensioned; pocket cap 103 may be decoupled and removed to access strand 27. In some embodiments, pocket cap 103 may be removed from cavity 101', as depicted in FIG. 2B, by mechanical action.

**[0021]** Pocket cap 103 may be formed by, for example and without limitation, injection molding, milling, turning, or casting. Pocket cap 103 may be formed as a single unit or may include multiple components.

**[0022]** The foregoing outlines features of several embodiments so that a person of ordinary skill in the art may better understand the aspects of the present disclosure. Such features may be replaced by any one of numerous equivalent alternatives, only some of which are disclosed herein. The scope of the invention is defined by the appended claims.

## Claims

1. A method of forming a post-tensioned concrete member comprising:

   positioning a post-tensioning tendon (11) within a concrete form (21), the post-tensioning tendon including a tension member (15), fixed anchor (13), and a stressing end anchor (17), the tension member including a strand (27);
   positioning a pocket former (100) comprising a key way former (102) between the stressing end anchor (17) and the concrete form (21), the pocket former (100) coupled to the stressing end anchor, the stressing end anchor having a stressing end anchor body (18);
   pouring concrete (23) into the concrete form (21) thereby forming a concrete member (40);
   encasing the post-tensioning tendon (11) and pocket former in the concrete member;
   forming a cavity (100') in the concrete (23) by removing the pocket former (100), the cavity corresponding to the outer shape of the pocket former, the cavity (100') having a cavity surface; and
   removing the keyway former (102) from the concrete member leaving a keyway (102') in the cavity (100) corresponding to the outer shape of the keyway former, the keyway having a keyway surface; the method being **characterized by**
   coupling a pocket cap (103) to the cavity surface; and
   coupling an extension (107) of the pocket cap to the keyway surface (102").

2. The method of claim 1, wherein the pocket former (100) has an outer tapered surface and wherein the keyway former (102) extends radially outward from the outer tapered surface of the pocket former.

3. The method of claim 1 or claim 2, further comprising positioning the pocket cap (103) around the strand (27).

4. The method of any one of claims 1 to 3, wherein the cavity has a cylindrical section (105) and a frustoconical section (106) and the pocket cap (103) is positioned within the cylindrical section using friction or press fit; optionally,
   wherein the pocket cap does not include a locking member.

5. The method of any one of claims 1 to 4 further comprising:

   filling the pocket cap (103) with grease (111) prior to coupling a pocket cap to the cavity surface; and/or,
   prior to the step of coupling the pocket cap to the cavity surface: forming the pocket cap by injection molding, milling, turning, or casting.

6. The method of any one of claims 1 to 5 after the step of coupling the pocket cap (103) to the cavity surface: decoupling the pocket cap from the cavity surface.

7. The method of any one of claims 1 to 6, wherein pocket cap (103) comprises a cylindrical interior wall (113) and the method further comprises positioning one or more seals (117) between the cylindrical interior wall and the strand.

8. The method of any one of claims 1 to 7 further comprising compressing a gasket (109) between the stressing end anchor body and the pocket cap (103).

9. The method of any one of claims 7 or 8, wherein the strand (27) passes through the pocket cap.

10. The method of claims 7 to 9 wherein the cylindrical interior wall (113) terminates in an end flange (115).

11. The method of claims 7 to 9 wherein the cylindrical interior wall (113) terminates in a cap end wall (119) and the pocket cap (103) encloses the strand end.

12. The method of claim 11 wherein the pocket cap (103) contains grease (111).

**Patentansprüche**

1. Verfahren zum Herstellen eines nachgespannten Betonelements, umfassend:

Positionieren eines Spannglieds (11) innerhalb einer Betonschalung (21), wobei das Spannglied einen Zugstab (15), festen Anker (13) und spannungsseitigen Anker (17) beinhaltet, wobei der Zugstab eine Litze (27) beinhaltet;
Positionieren eines Aussparungsformers (100) umfassend einen Keilnutformer (102) zwischen dem spannungsseitigen Anker (17) und der Betonschalung (21), wobei der Aussparungsformer (100) mit dem spannungsseitigen Anker verbunden ist, wobei der spannungsseitige Anker einen spannungsseitigen Ankerkörper (18) aufweist;
Gießen von Beton (23) in die Betonschalung (21), wodurch ein Betonelement (40) hergestellt wird;
Einbetonieren des Spannglieds (11) und des Aussparungsformers im Betonelement;
Herstellen eines Hohlraums (100') im Beton (23) durch Entfernen des Aussparungsformers (100), wobei der Hohlraum der Außenform des Aussparungsformers entspricht, wobei der Hohlraum (100') eine Hohlraumoberfläche aufweist; und
Entfernen des Keilnutformers (102) vom Betonelement, wobei eine Keilnut (102') im Hohlraum (100') hinterlassen wird, die der Außenform des Keilnutformers entspricht, wobei die Keilnut eine Keilnutoberfläche aufweist; wobei das Verfahren durch Verbinden einer Aussparungsabdeckung (103) mit der Hohlraumoberfläche gekennzeichnet ist; und
Verbinden einer Verlängerung (107) der Aussparungsabdeckung mit der Keilnutoberfläche (102").

2. Verfahren nach Anspruch 1, worin der Aussparungsformer (100) eine äußere Kegelfläche aufweist und worin sich der Keilnutformer (102) radial nach außen von der äußeren Kegelfläche des Aussparungsformers erstreckt.

3. Verfahren nach Anspruch 1 oder Anspruch 2, ferner umfassend Positionieren der Aussparungsabdeckung (103) um die Litze (27).

4. Verfahren nach einem der Ansprüche 1 bis 3, worin der Hohlraum einen zylindrischen Abschnitt (105) und einen kegelstumpfförmigen Abschnitt (106) aufweist und die Aussparungsabdeckung (103) innerhalb des zylindrischen Abschnitts mittels Reib- oder Presspassung positioniert ist; wahlweise,
worin die Aussparungsabdeckung kein Verriegelungselement beinhaltet.

5. Verfahren nach einem der Ansprüche 1 bis 4, ferner umfassend:

Füllen der Aussparungsabdeckung (103) mit Fett (111) vor Verbinden einer Aussparungsabdeckung mit der Hohlraumoberfläche; und/oder,
vor dem Schritt des Verbindens der Aussparungsabdeckung mit der Hohlraumoberfläche:
Formen der Aussparungsabdeckung durch Spritzgießen, Fräsen, Drehen oder Gießen.

6. Verfahren nach einem der Ansprüche 1 bis 5, wobei, nach dem Schritt des Verbindens der Aussparungsabdeckung (103) mit der Hohlraumoberfläche,
das Lösen der Aussparungsabdeckung von der Hohlraumoberfläche erfolgt.

7. Verfahren nach einem der Ansprüche 1 bis 6, worin die Aussparungsabdeckung (103) eine zylindrische Innenwand (113) umfasst und das Verfahren ferner das Positionieren einer oder mehrerer Dichtungen (117) zwischen der zylindrischen Innenwand und der Litze umfasst.

8. Verfahren nach einem der Ansprüche 1 bis 7, ferner umfassend Komprimieren einer Dichtung (109) zwischen dem spannungsseitigen Ankerkörper und der Aussparungsabdeckung.

9. Verfahren nach einem der Ansprüche 7 oder 8, worin die Litze (27) durch die Aussparungsabdeckung (103) verläuft.

**10.** Verfahren nach Anspruch 7 bis 9, worin die zylindrische Innenwand (113) in einem Endflansch (115) endet.

**11.** Verfahren nach Anspruch 7 bis 9, worin die zylindrische Innenwand (113) in einer abdeckungsseitigen Wand (119) endet und die Aussparungsabdeckung (103) das Litzenende umschließt.

**12.** Verfahren nach Anspruch 11, worin die Aussparungsabdeckung (103) Fett (111) enthält.

**Revendications**

**1.** Un procédé de formation d'un élément de béton post-contraint comprenant les étapes consistant à :

positionner une armature de postcontrainte (11) à l'intérieur d'un coffrage à béton (21), l'armature de postcontrainte comprenant un élément de tension (15), un ancrage fixe (13) et un ancrage d'extrémité de sollicitation (17), l'élément de tension comprenant un toron (27) ;
positionner un dispositif de formation de poche (100) comprenant un dispositif de formation de rainure de clavette (102) entre l'ancrage d'extrémité de sollicitation (17) et le coffrage à béton (21), le dispositif de formation de poche (100) étant couplé à l'ancrage d'extrémité de sollicitation, l'ancrage d'extrémité de sollicitation présentant un corps d'ancrage d'extrémité de sollicitation (18) ;
verser du béton (23) dans le coffrage à béton (21) ce qui forme un élément en béton (40) ;
encastrer l'armature de postcontrainte (11) et le dispositif de formation de poche dans l'élément en béton ;
former une cavité (100') dans le béton (23) en retirant le dispositif de formation de poche (100), la cavité correspondant à la forme extérieure du dispositif de formation de poche, la cavité (100) présentant une surface de cavité ; et
retirer le dispositif de formation de rainure de clavette (102) de l'élément en béton ce qui laisse une rainure de clavette (102') dans la cavité (100') correspondant à la forme extérieure du dispositif de formation de rainure de clavette, la rainure de clavette présentant une surface de rainure de clavette ;
le procédé étant **caractérisé par** le couplage d'un capuchon de poche (103) à la surface de la cavité ; et
le couplage d'un prolongement (107) du capuchon de poche à la surface de rainure de clavette (102").

**2.** Le procédé de la revendication 1, dans lequel le dispositif de formation de poche (100) présente une surface extérieure conique et dans lequel le dispositif de formation de rainure de clavette (102) s'étend radialement vers l'extérieur depuis la surface conique extérieure du dispositif de formation de poche.

**3.** Le procédé de la revendication 1 ou la revendication 2, comprenant en sus l'étape consistant à positionner le capuchon de poche (103) autour du toron (27).

**4.** Le procédé d'une quelconque des revendications 1 à 3, dans lequel la cavité présente une section cylindrique (105) et une section tronconique (106) et le capuchon de poche est positionné à l'intérieur de la section cylindrique avec un ajustement par friction ou par pression ; en option, dans lequel le capuchon de poche ne comprend pas d'élément de verrouillage.

**5.** Le procédé d'une quelconque des revendications 1 à 4 comprenant en sus les étapes consistant à :

remplir le capuchon de poche (103) avec de la graisse (111) avant de coupler un capuchon de poche à la surface de la cavité ; et/ou,
avant l'étape consistant à coupler le capuchon de poche à la surface de la cavité :
former le capuchon de poche par moulage par injection, fraisage, tournage ou coulage.

**6.** Le procédé d'une quelconque des revendications 1 à 5 après l'étape consistant à coupler le capuchon de poche (103) à la surface de la cavité :
découpler le capuchon de poche de la surface de la cavité.

**7.** Le procédé d'une quelconque des revendications 1 à 6, dans lequel le capuchon de poche (103) comprend une paroi intérieure cylindrique (113) et le procédé comprenant en sus l'étape consistant à positionner un ou plusieurs joints d'étanchéité (117) entre la paroi intérieure cylindrique et le toron.

**8.** Le procédé d'une quelconque des revendications 1 à 7 comprenant en sus l'étape consistant à comprimer une garniture (109) entre le corps d'ancrage d'extrémité de sollicitation et le capuchon de poche.

**9.** Le procédé d'une quelconque des revendications 7 ou 8, dans lequel le toron (27) passe à travers le capuchon du capuchon de poche (103).

**10.** Le procédé des revendications 7 à 9 dans lequel la paroi intérieure cylindrique (113) se termine en une bride d'extrémité (115).

**11.** Le procédé des revendications 7 à 9 dans lequel la paroi intérieure cylindrique (113) se termine dans

une paroi d'extrémité de capuchon (119) et le capuchon de poche (103) renferme l'extrémité du toron.

**12.** Le procédé de la revendication 11 dans lequel le capuchon de poche (103) contient de la graisse (111).

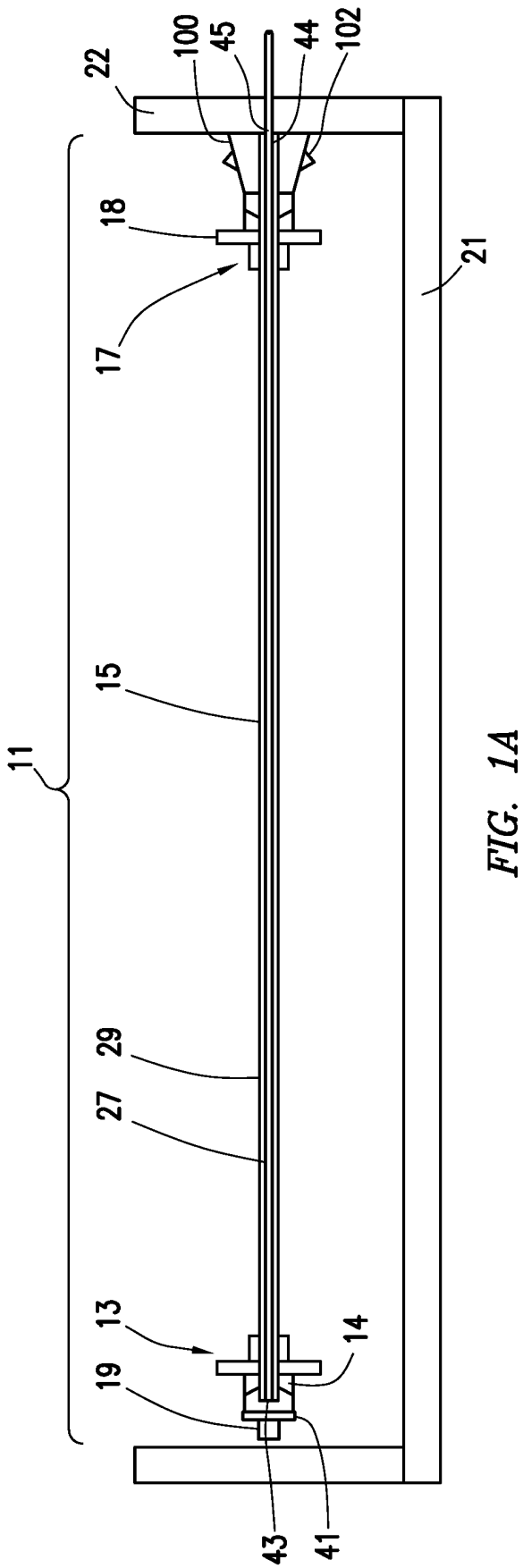
22
100
45
44
102
18
17
21
11
15
29
27
13
14
19
43
41

FIG. 1A

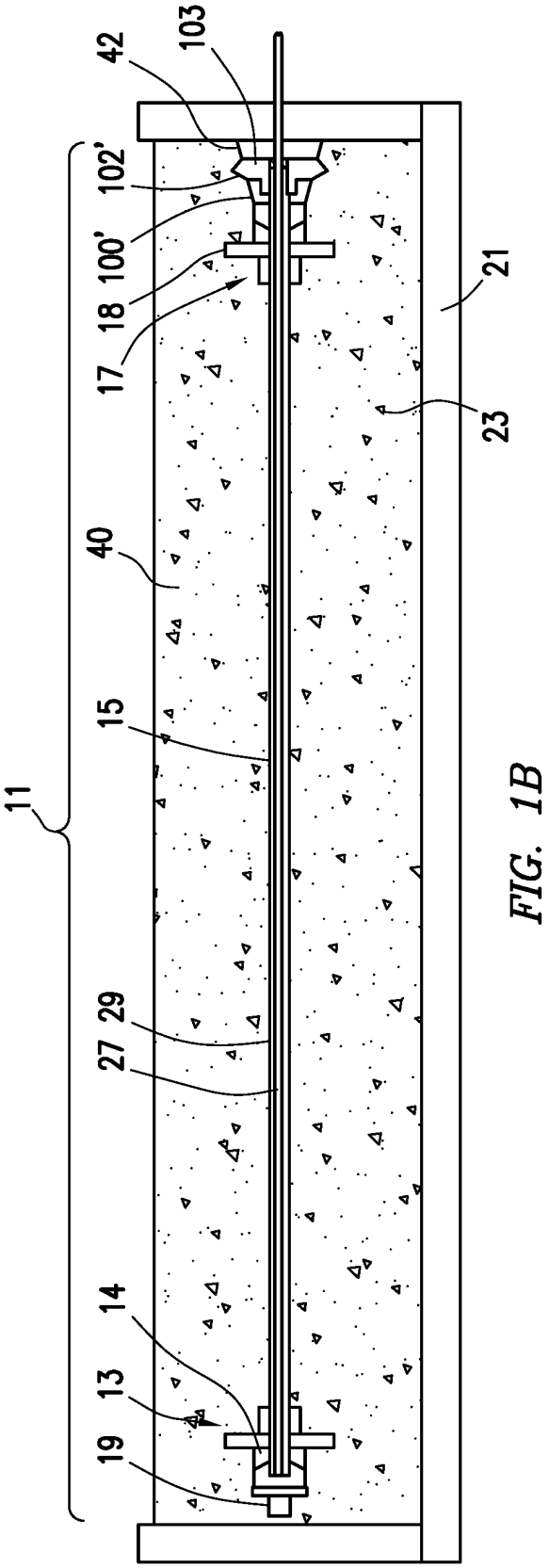
42
103
102'
100'
18
17
21
23
40
15
11
29
27
14
13
19

FIG. 1B

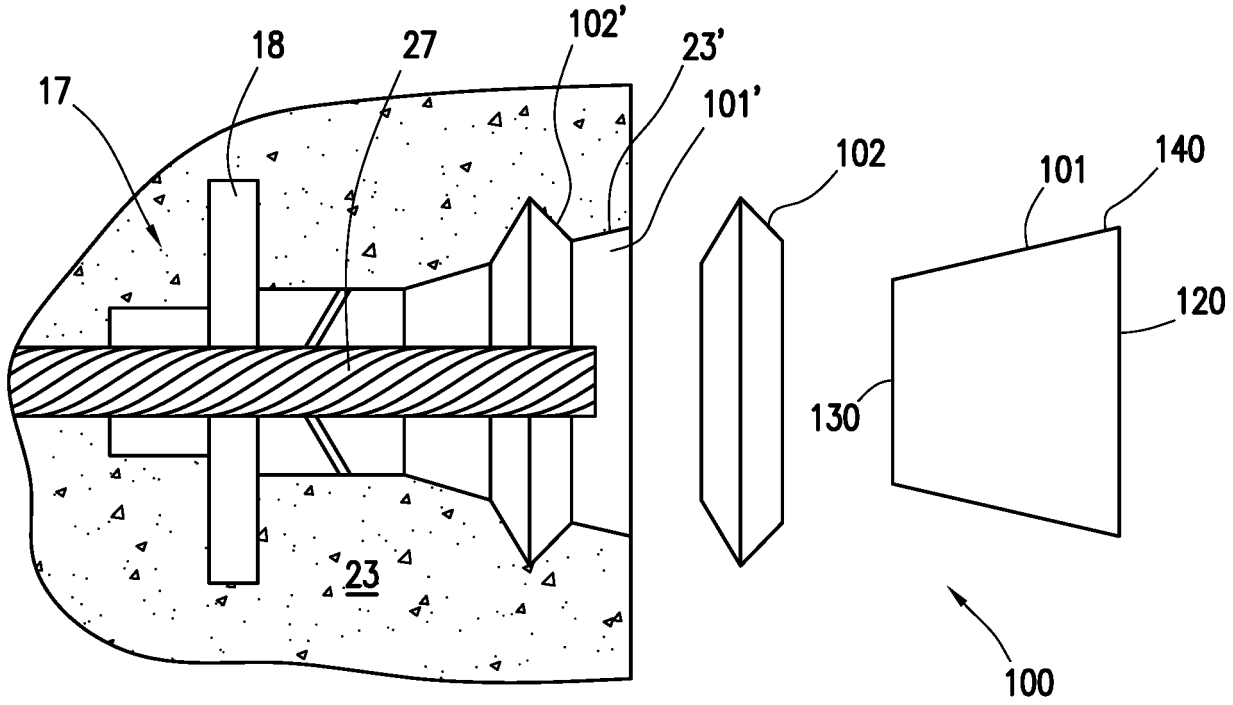
17
18
27
102'
23'
101'
102
101
140
120
130
23
100

*FIG. 2A*

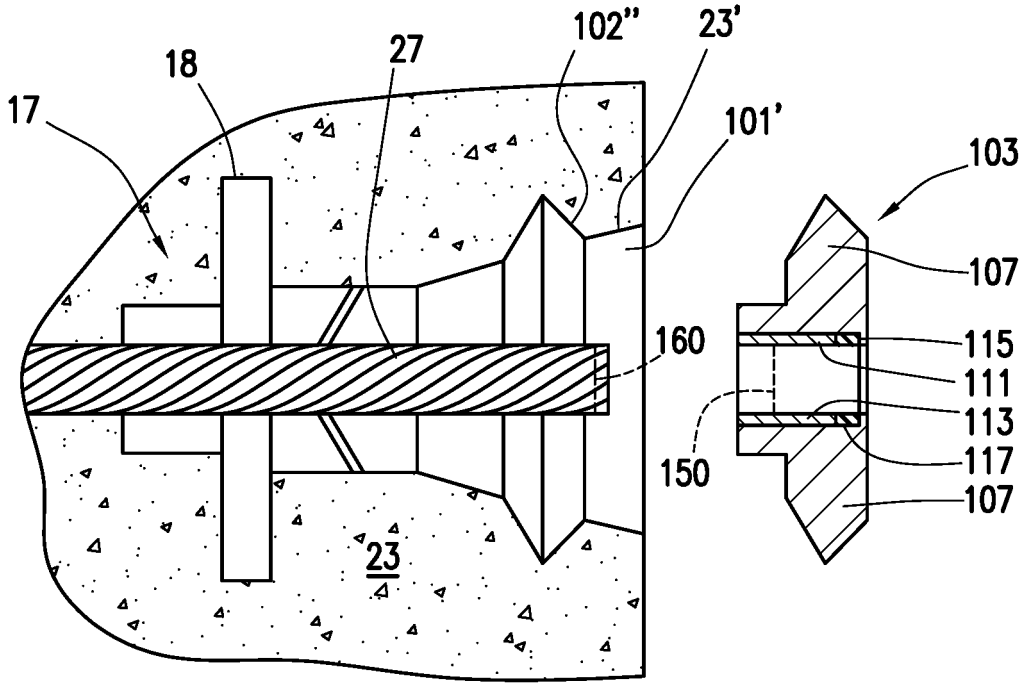
17
18
27
102"
23'
101'
103
107
160
115
111
113
117
150
107
23

*FIG. 2B*

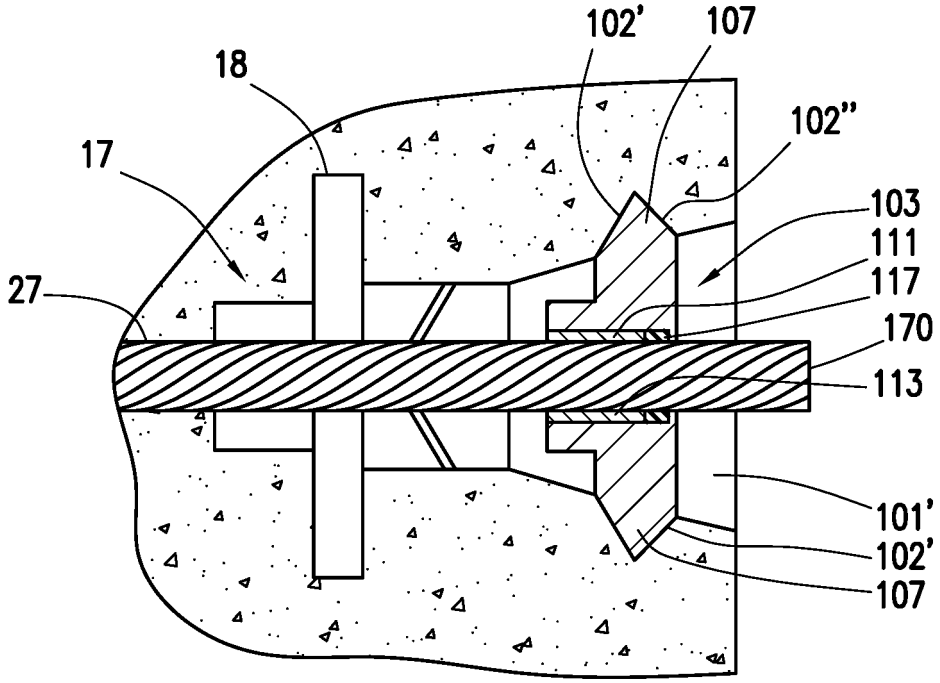
102'
107
18
102"
17
103
111
27
117
170
113
101'
102'
107

*FIG. 2C*

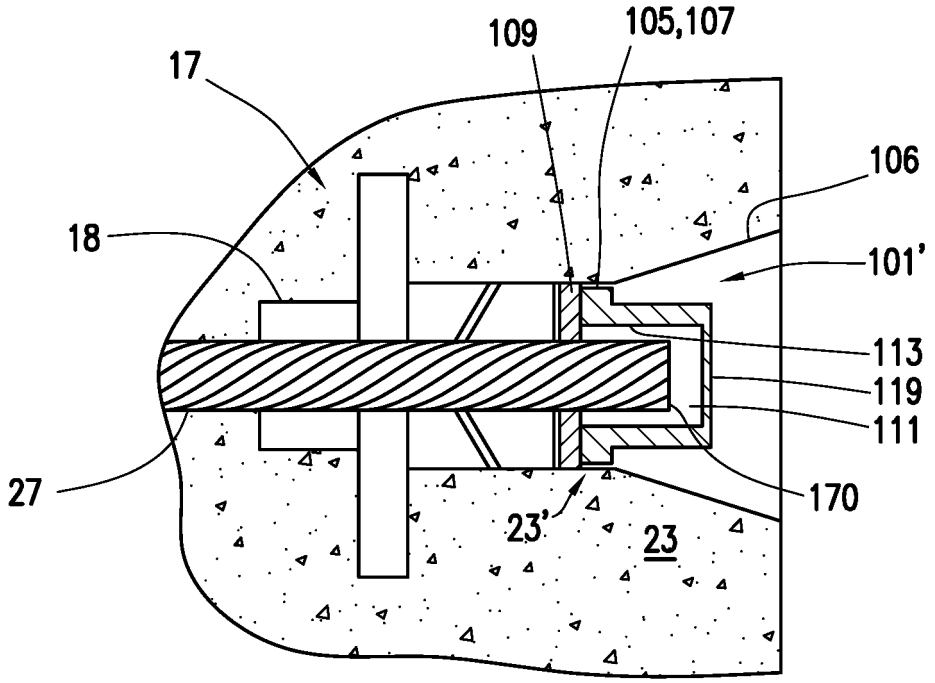
109
105,107
17
106
18
101'
113
119
111
27
170
23'
23

*FIG. 3*

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 62200945 A **[0001]**
- US 22633416 A **[0001]**
- US 201645147 W **[0001]**
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