United States Patent [19]

Shorter

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[54] **POST-STRESSING OF REINFORCED CONCRETE STRUCTURES**

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[73] Assignee: **Pre-Stress Pioneers Limited,** Downsview, Ontario, Canada

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

[21] Appl. No.: **198,912**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 873,143, Nov. 3, 1969, abandoned.

[30] **Foreign Application Priority Data**

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Dec. 18, 1968	Great Britain	60,126/68
Aug. 26, 1971	Canada	121387

[52] **U.S. Cl.** ..... **24/115 R; 52/223 R**

[51] **Int. Cl.** **F16g 11/00**

[58] **Field of Search** 52/173, 230, 223; 24/123, 24/122.6

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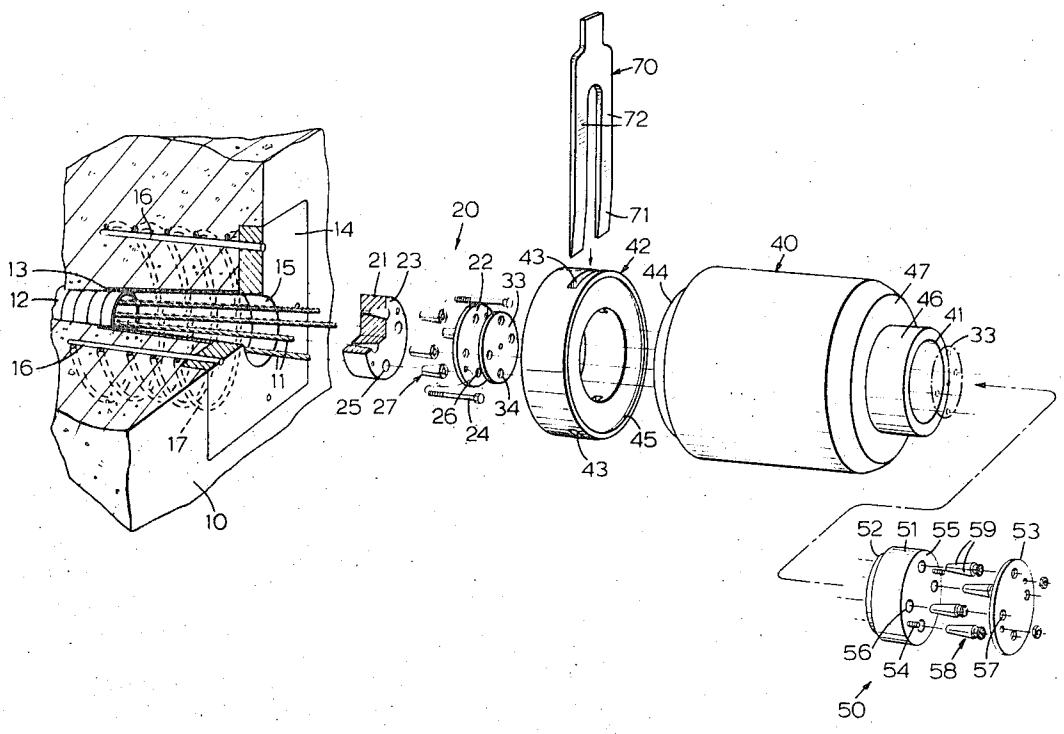
Primary Examiner—Paul R. Gilliam

[57] **ABSTRACT**

An apparatus for post-stressing cables of reinforced concrete structures, in which a template and a drift wedge are used in association with a bearing stool to retain clamping grips in registration with apertures in an anchor head and to assist in seating the grips in the apertures, when the strands of the cable are stressed by a center-hole jack.

13 Claims, 19 Drawing Figures



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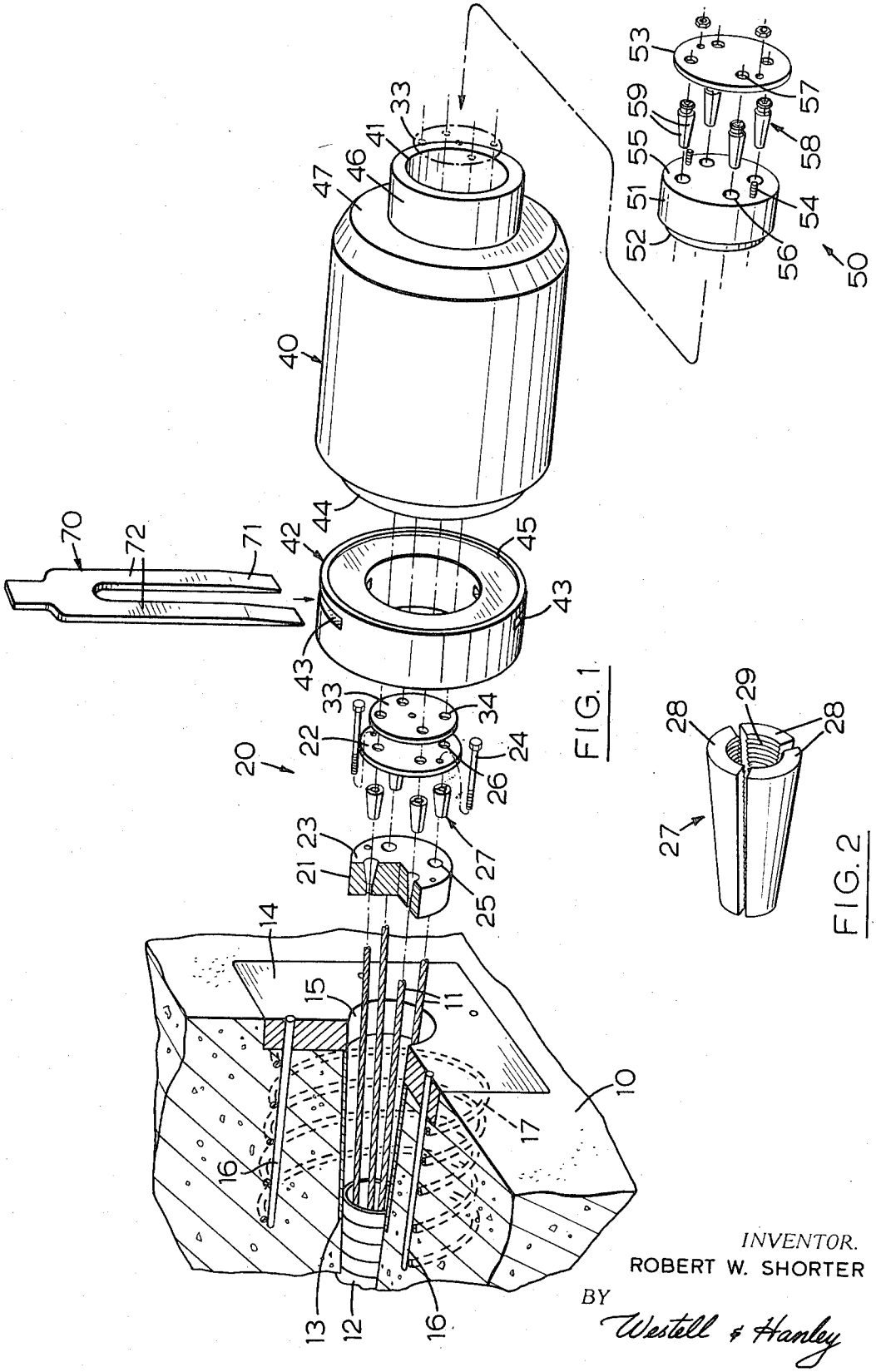

FIG. 1

FIG. 2

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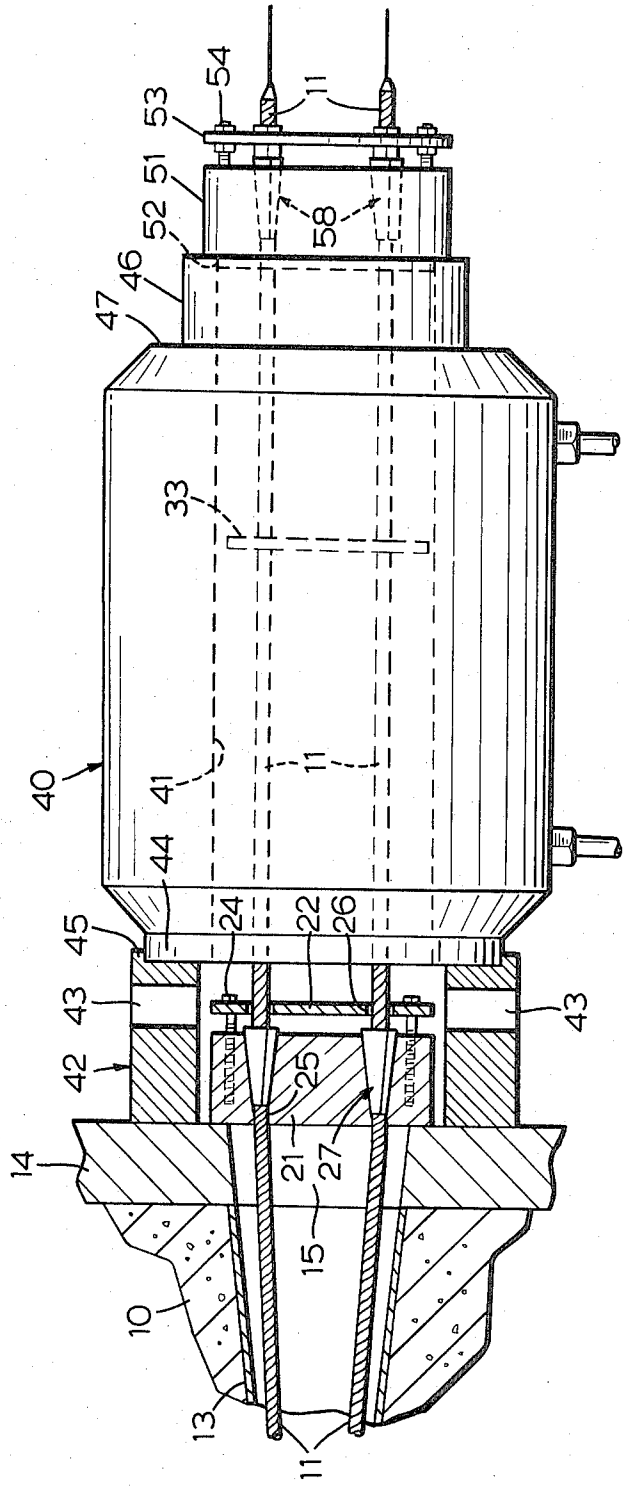

FIG. 3

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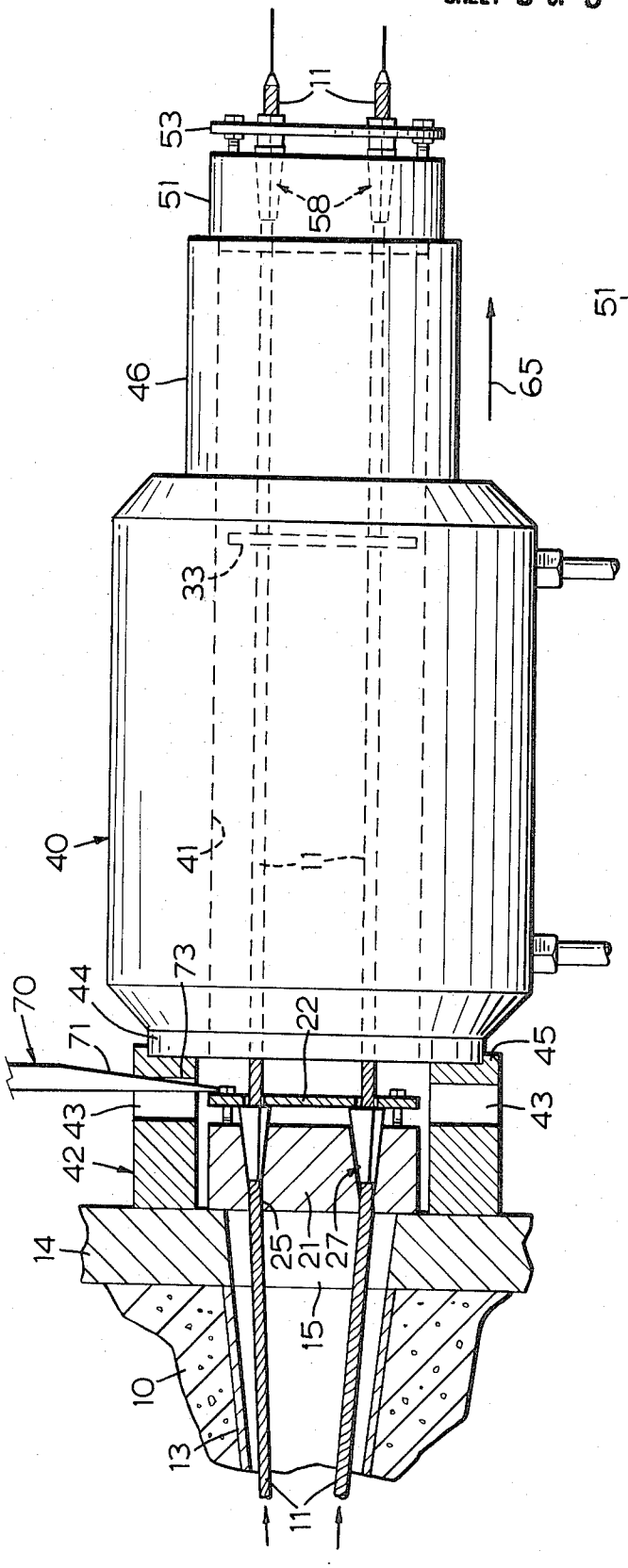

FIG. 4

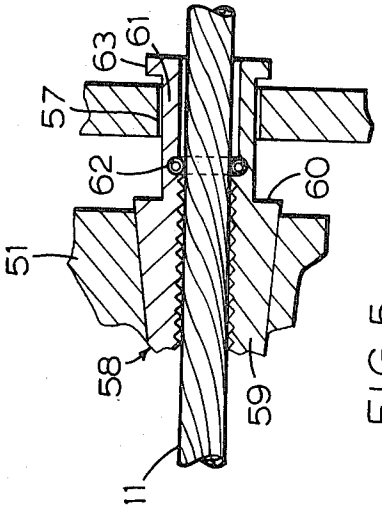

FIG. 5

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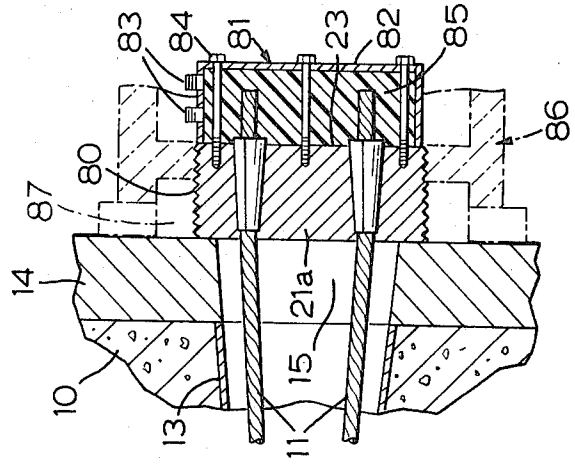

FIG. 7

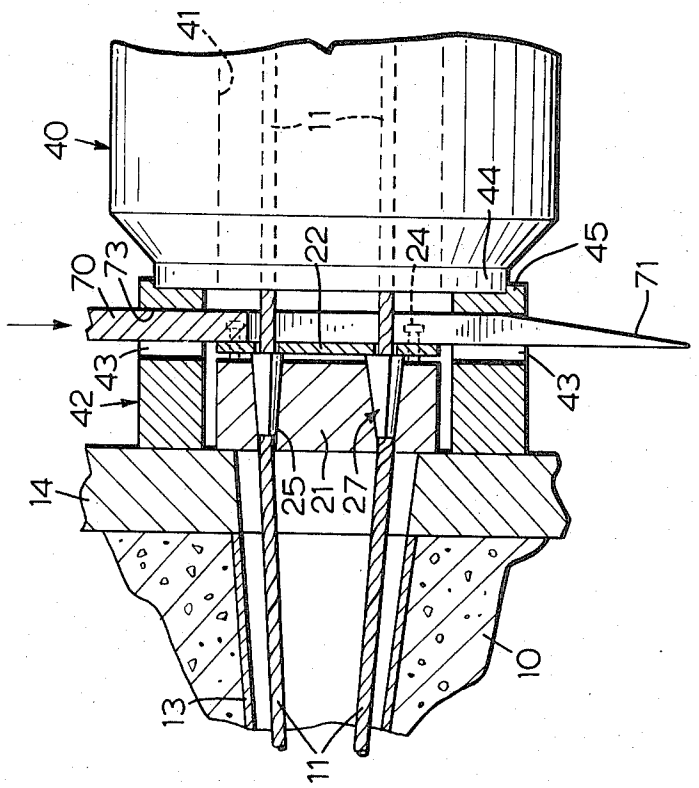

FIG. 6

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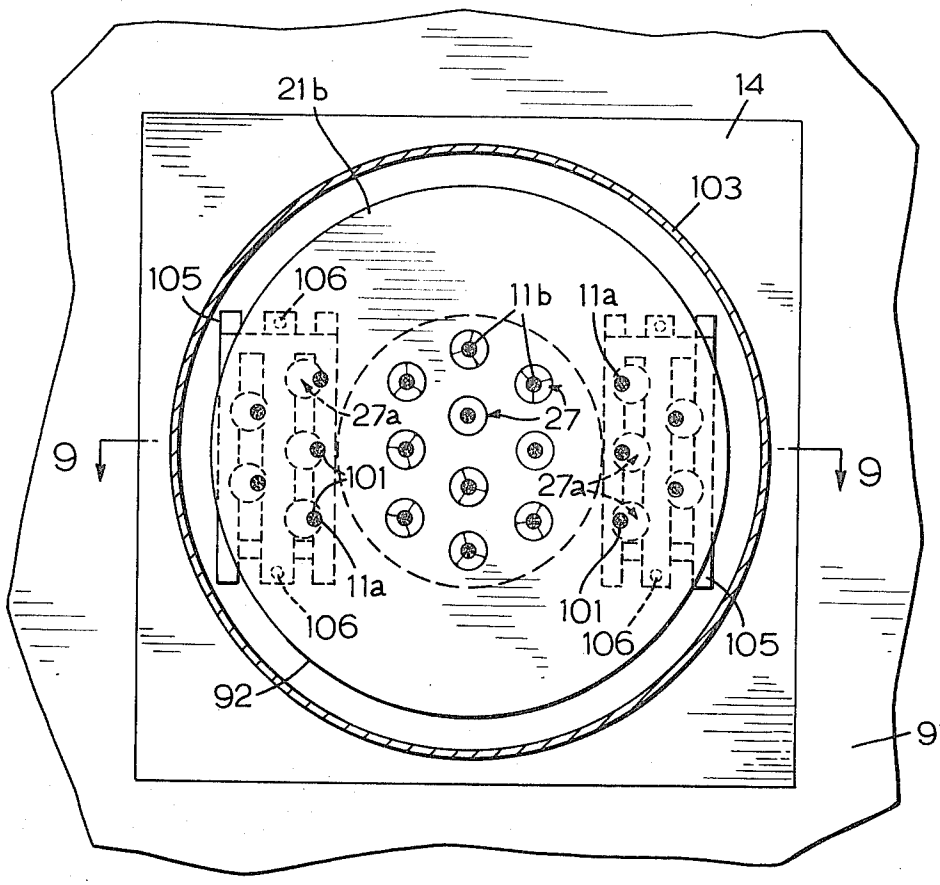

FIG. 8

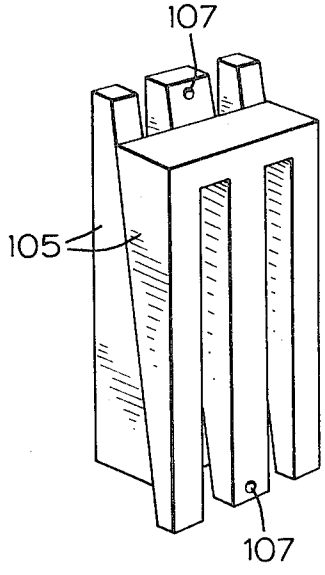

FIG. 10

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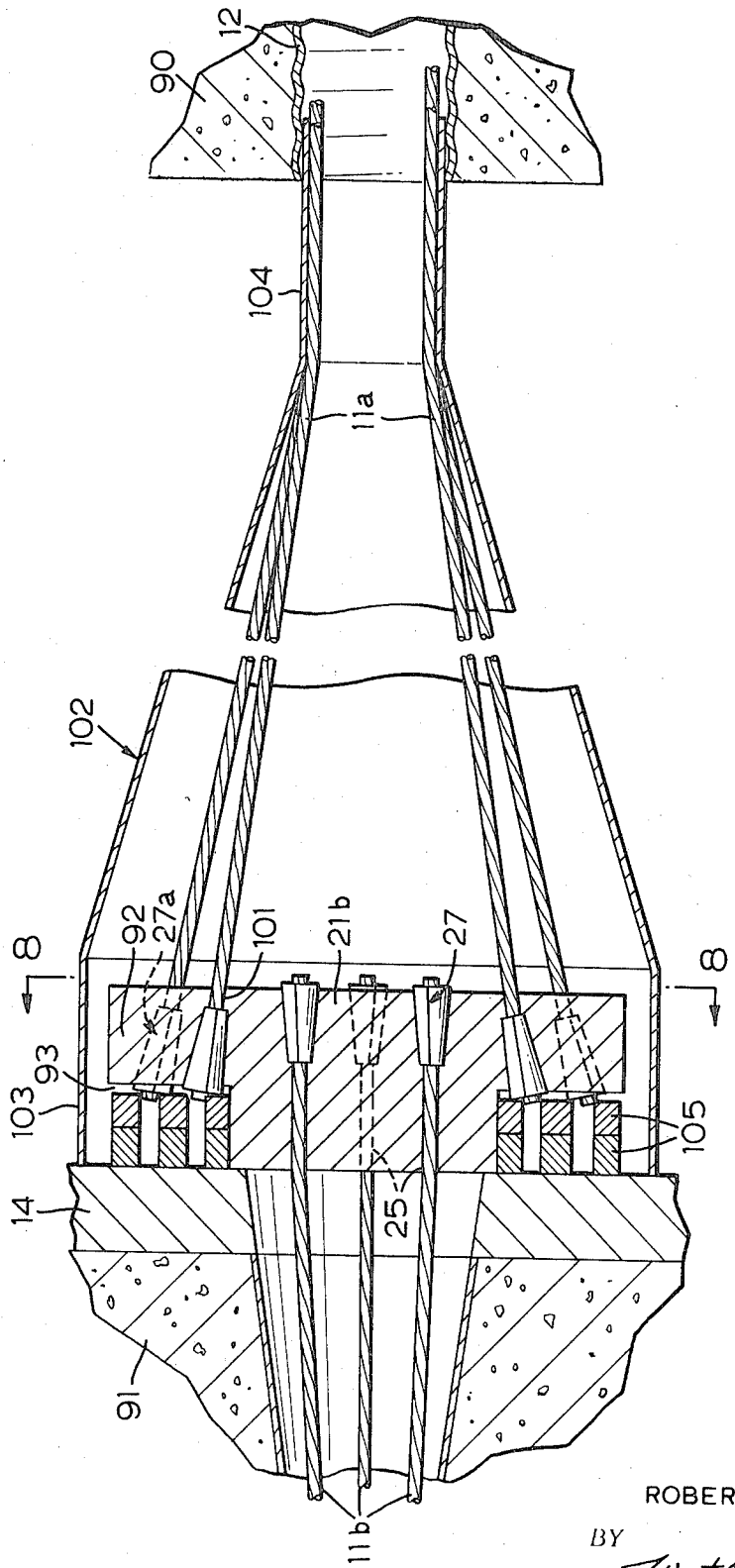

FIG. 9

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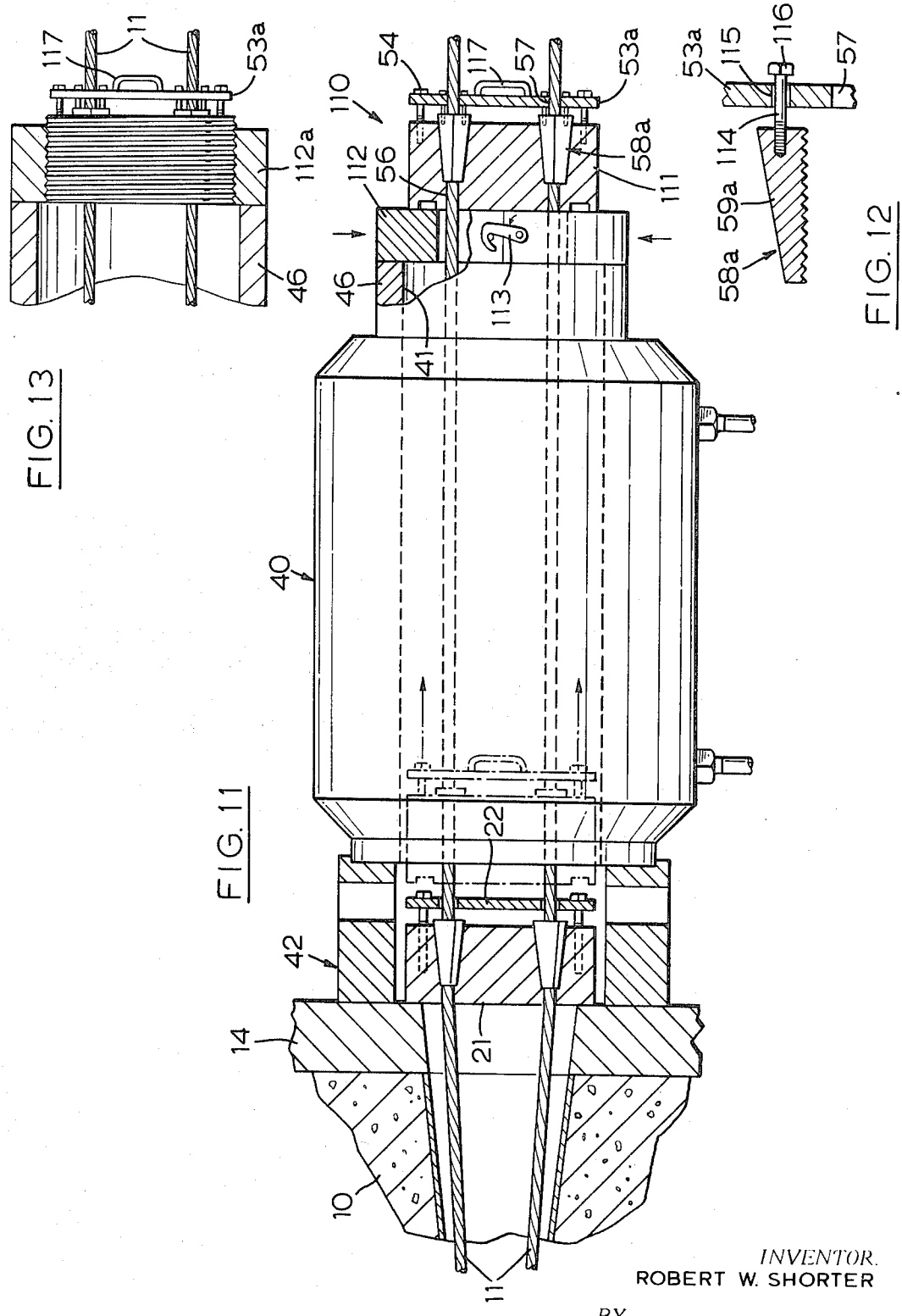

FIG. 13

FIG. 11

FIG. 12

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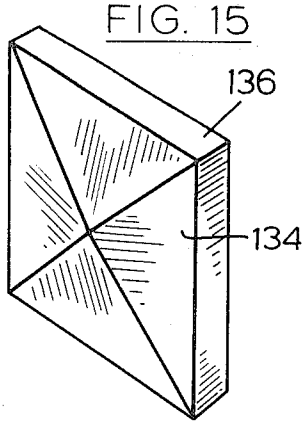
FIG. 15



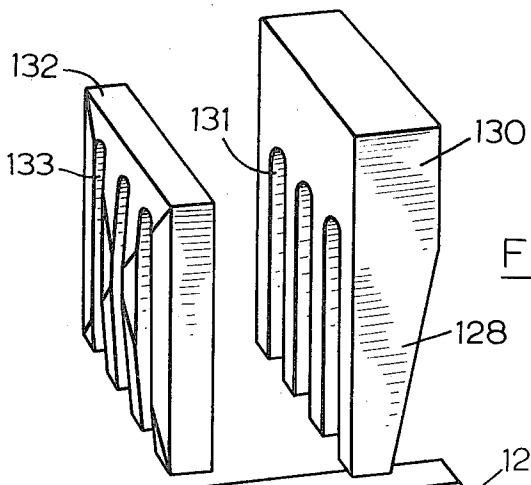


FIG. 14

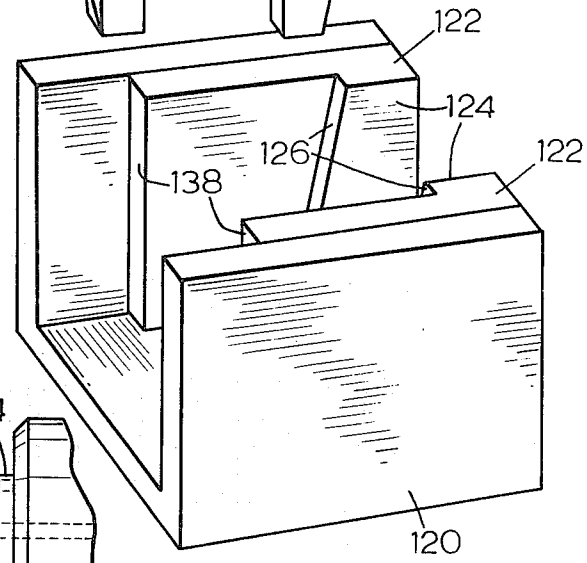


FIG. 19

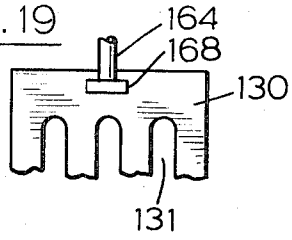
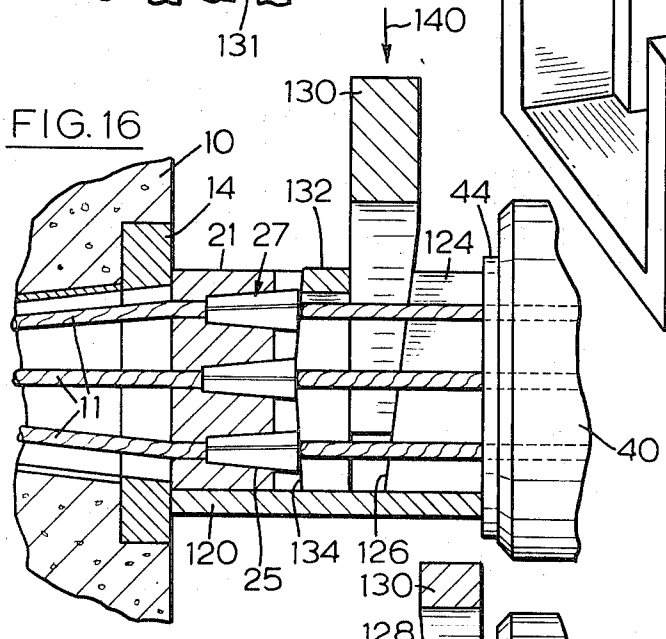


FIG. 16



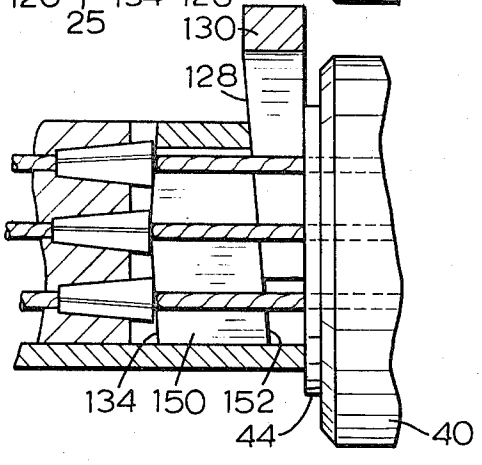


FIG. 17

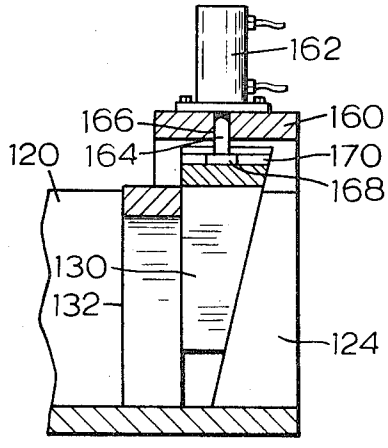


FIG. 18

POST-STRESSING OF REINFORCED CONCRETE STRUCTURES

This is a continuation -in-part of copending U.S. Pat. application No. 873,143 filed Nov. 3, 1969, now abandoned.

The present invention relates to reinforced concrete structures and more particularly to the post-tensioning or stressing of multiple strand cables which reinforce concrete structures such as slabs, beams or columns.

In the post-stressing of reinforced concrete structures a plurality of separate strands, forming a cable, extend through an embedded conduit or sleeve in the structure and are tensioned at one or both ends of the structure and anchored. One type of anchorage consists of a cylindrical main anchor head having individual apertures or passages to accommodate each separate strand. The anchor head rests against, or is cast into, a bearing plate embedded in the face of the concrete structure. Each strand is held in the anchor head by a tapered and segmented grip resting in a flared portion of the aperture. The strands are tensioned as a group by a hydraulic centre-holed jack bearing against the anchor or against a bearing cup or stool which sits over the anchor head with the strands passing through the stool, the jack, and auxiliary anchor head which is similar to the main anchor head and which bears against the piston of the jack remote from the bearing cup or is threaded onto a pull rod adjacent the anchor head. The stressing of the strands is effected by extending the piston of the jack, re-seating the grips in the auxiliary anchor head, retracting the piston of the jack, and repeating these steps until the required stress in the strands has been achieved. The jack and stool are then removed, the cable grouted in the conduit, the strands projecting from the anchor head are cut off, and the face of the structure is capped with concrete about the anchor head.

In carrying out the above mentioned operation the grips may be maintained close to the apertures in the main anchor head by the inside face of the stool and reseated by the strands when the piston of the jack is retracted. To achieve this the inside face of the stool must be kept close to the outer face of the anchor head in order to keep the grips from losing substantial frictional contact with the strands and this decreases the efficiency of the stressing operation. Also, the grips have a tendency to be reseated unevenly.

It is an object of the present invention to provide a simplified apparatus for post-stressing multiple strand cables in a reinforcing structure whereby the grips are allowed to withdraw from the anchor head out of substantial frictional contact with the strands and are reseated more evenly.

Example embodiments of the invention are shown in the accompanying drawings in which:

FIG. 1 is an exploded view in perspective of an anchor assembly, a stool, and a centre-hole jack in association with a multi-strand reinforcing cable;

FIG. 2 is a view in perspective of a grip used in the main anchor assembly of FIG. 1;

FIG. 3 is a sectional side view showing the assembly and jack of FIG. 1, after stressing of the strands;

FIG. 4 is a view similar to FIG. 3 showing the piston of the jack extended to stress the strands again;

FIG. 5 is a sectional side view of the wedge used in the auxiliary anchor assembly associated with the jack of FIG. 4;

FIG. 6 is a sectional side view similar to FIG. 4 but showing a drift wedge driven through the stool;

FIG. 7 is an alternate embodiment of the anchor assembly with an anchor head cap;

FIG. 8 is an end view of a coupling anchor head with reinforcing strands;

FIG. 9 is a view in cross-section taken along the line 11—11 of FIG. 8; and

FIG. 10 is a view in perspective of the wedging means shown in FIGS. 8 and 9;

FIG. 11 is a sectional side view showing an alternate embodiment of the anchor assembly shown in FIG. 1;

FIG. 12 is a fragmentary view in cross-section of the auxiliary grip shown in FIG. 11;

FIG. 13 is a fragmentary cross-section view of an alternate embodiment of the auxiliary anchor head shown in FIG. 11;

FIG. 14 is an exploded perspective view of an alternate embodiment to the template, stool and wedge shown in FIGS. 1 to 6 of the drawings;

FIG. 15 is a perspective view of the template of FIG. 14 before machining;

FIG. 16 is a plan view of the device shown in FIG. 15, mounted for operation;

FIG. 17 is a plan view of a modification of the embodiment shown in FIG. 14;

FIG. 18 is a view in cross-section of a further modification of the embodiment shown in FIG. 14; and

FIG. 19 is a fragmentary face view of the drift wedge of FIG. 18.

In the embodiment shown in FIG. 1 of the drawings, a concrete beam or slab **10** is reinforced with a plurality of cable strands **11** passing loosely through a conduit or sleeve **12** embedded in the beam. Strands **11** emerge from beam **10** through a trumpet **13** connecting sleeve **12** with a bearing plate **14** embedded in the face of the beam and having a central opening **15**. Reinforcing rods **16**, anchored in bearing plate **14** and extending into beam **10** parallel to the axis of trumpet **13**, hold an embedded reinforcing spiral **17** about the trumpet. At the other end of beam **10** (not shown), strands **11** may be anchored in any suitable manner, including the manner to be described below.

To anchor strands **11** where they emerge from beam **10**, an anchor assembly **20** is employed consisting of a cylindrical anchor head **21** and a template **22** which is positioned parallel to face **23** of the anchor head remote from bearing plate **14** slidably mounted on bolts **24** threaded into the anchor head. Anchor head **21** and template **22** have a plurality of aligned apertures **25** and **26** respectively, the aligned apertures providing passages corresponding to the number of strands **11** in the reinforcing cable. Each aperture **25** in anchor head **21** is flared outwardly toward template **22** to accommodate a tapered or conical grip **27** which is divided circumferentially into segments **28** and carries internal serrations **29**, as shown in FIG. 2 of the drawings. Apertures **26** in template **22** are smaller in diameter than the larger end diameter of grips **27**.

Also associated with anchor assembly **20** is a guide template **33** having apertures **34** which are aligned with apertures **26** and **25** in template **22** and anchor head **21** respectively. In practice, template **33** is releasibly tied to template **22**.

To tension strands 11 of the reinforcing cable, an hydraulic centre-hole jack assembly is used, comprising a jack 40 having a longitudinal bore 41 which is axially co-extensive with the axis of an annular bearing stool 42 circumscribing anchor assembly 20 and resting against bearing plate 14. A slot 43 traverses stool 42 normal to the center axis of the stool with its plane in the region of template 22. One end 44 of jack 40 bears against stool 42 and is centered on the stool by raised shoulder 45 circumscribing the face of the stool. A piston 46 projects from end 47 of jack 40 opposite from end 44.

An auxiliary anchor assembly 40 is seated on the end of annular piston 46 and consists of an auxiliary cylindrical anchor head 51 which is centered on the end of the piston by a circumferential shoulder 52 on the anchor head, and a template 53 adjustably fastened to the auxiliary anchor head by bolts 54, the template being positioned parallel to and spaced from face 55 of the anchor head remote from the piston. A plurality of aligned apertures 56 and 57, the number of pairs of apertures corresponding to the number of strands 11 of the reinforcing cable (as in anchor assembly 20), are located in auxiliary anchor head 51 and template 53 respectively, providing passages parallel to the central axis of auxiliary anchor assembly 50. Apertures 56 flare outwardly in the direction of template 53 and seated in the flaired portion of each aperture is a conical or tapered grip 58 which is circumferentially divided into segments 59. As shown in FIG. 5 of the drawings, each grip 58 is recessed at its larger end to form a shoulder 60 and a collar 61 which is slightly smaller in diameter than aligned aperture 57 in template 53 and slides in that aperture. An annular spring 62 seated within collar 61 urges segments 59 of each grip 58 outwardly to open the smaller end of the grip. An outwardly projecting annular flange 63 on the free end of collar 61 is located adjacent the rim of aperture 57.

In the operation of the apparatus, strands 11 leading from opening 15 in bearing plate 14 are threaded through apertures 25 in anchor head 21 and apertures 26 in template 22 of anchor assembly 20 and at the same time through apertures 34 of template 33. Template 22 is then drawn away from anchor head 21, by loosening bolts 24, a distance sufficient to allow insertion of segments 28 of grips 27 into apertures 25 about strands 11, after which bolts 24 are tightened to give a desired clearance between anchor head 21 and template 22. Anchor head 21 is placed against bearing plate 14 and centered on opening 15. Template 33 is then disengaged from anchor assembly 20 (for example by cutting tie wires) and that template is slipped along strands 11 away from the anchor assembly. Bearing stool 42 is subsequently placed over anchor assembly 20 and against bearing plate 14, and end 44 of jack 40 is then placed against the bearing stool and centered by shoulder 45 on the stool. When positioning stool 42 and jack 40, strands 11 are passed through the stool and bore 41 of the jack while being held apart adjacent their free ends by template 33. When cup 42 and jack 40 are positioned, the free ends of strands 11 project from piston 46 and to complete the assembly of the tensioning apparatus, the free ends of the strands are threaded through apertures 56, grips 58 and apertures 57 in auxiliary anchor assembly 50. When the apparatus is thus assembled, as shown in FIG. 3 of the drawings, it is now ready for stressing strands 11.

Turning now to FIG. 4 of the drawings, jack 40 is operated to move piston 46 outwardly in the direction of arrow 65. Grips 58 in auxiliary anchor assembly 50, having their shoulders 60 bearing against template 53, are seated in apertures 56 of auxiliary anchor head 51 and clamp against strands 11. The continued outward movement of piston 46 stresses strands 11 and attenuates them. As strands 11 are initially elongated, grips 27 of anchor assembly 20 which are initially abutting against template 22, allow the strands to slip through them. In subsequent stressing steps, grips 27 are unseated from apertures 25 to abut against template 22 and allow strands 11 to slip through them. The clearance between anchor head 21 and template 22 should be sufficient to allow grips 27 to withdraw sufficiently from apertures 25 to be out of substantial frictional contact with strands 11 but not sufficiently to fall completely away from the strands out of registration with the apertures. On completion of the outward stroke of piston 46, a drift wedge 70 is passed laterally through slot 43 of bearing stool 42. Drift wedge 70 may be of any suitable configuration; in the embodiments shown in the drawings the wedge is bifurcated and passed between strands 11 emerging from template 22. Wedge 70 is tapered at the free ends 71 of its forks 72 which are forced into stool 42 between template 22 and wall 73 of slot 43, as shown in FIG. 4 of the drawings. Continued movement of wedge 70 through stool 42 forces template 22 towards anchor head 21 by the wedging action, partially reseating grips 27 in apertures 25 and bringing the grips into substantial frictional contact with strands 11, as shown in FIG. 6 of the drawings. The pressure in jack 40 is released and piston 46 is retracted to its original position of rest in the jack. As the force on the ends of strands 11 is released, grips 27 are further carried back by strands 11 to seat themselves firmly in apertures 25 and the stress in the strands is maintained. Wedge 70 is then withdrawn from stool 42. Auxiliary anchorage 50 may then be slipped along strands 11 and re-seated on the end of piston 46, grip 58 becoming unseated from apertures 56 in anchor head 51 but prevented from becoming disassociated from the apertures by the presence of template 53.

Auxiliary anchor assembly 50 operates in a manner similar to that of anchor assembly 20 except that the outward movement of piston 46 seats grips 58 in auxiliary anchor head 51, as shown in FIG. 4 of the drawings. On release of the hydraulic pressure in jack 40, and retraction of piston 46, auxiliary anchor assembly 50 is separated from the piston, i.e., the assembly remains stationary on strands 11 and is spaced from the jack and the piston. For the next stroke of piston 46, auxiliary anchor assembly 50 must be reseated on piston 46 and this is effected merely by applying pressure normally against template 53 which unseats grips 58 from apertures 56 and allows the assembly to slide along strands 11 towards jack 40 until shoulder 52 of auxiliary anchor head 51 is seated on bore 41 of piston 46. As auxiliary anchor assembly 50 moves towards piston 46, template 53 maintains grips 58 in registry with apertures 56 of auxiliary anchor head 51 as shoulders 60 of the grips abut the template. If it is desired to save on stroke length of piston 46, grips 58 can be seated in apertures 56 prior to operation of the jack by tapping the free ends of collars 61 which project from template 53 or by loosening the template from bolts 54 and moving the template towards anchor head 51. It will be seen

from the structure of auxiliary anchor assembly **50** that it eleminates the laborious work of re-seating the grips individually in the auxiliary anchor head, which has been the practice to date.

It should be noted that during the operation of jack **40**, template **33** remains suspended on strands **11** within bore **41** of jack **40** but performs no further function after it has aligned the strands for threading through auxiliary anchor assembly **50**. Also, while guide template **33** may be constructed to align apertures **34** with apertures **26** of template **22**, the guide template may alternately be constructed to align apertures **34** with apertures **56** of auxiliary anchor head **51** where apertures **56** are not in alignment with apertures **25** of anchor head **21**. Of course template **33** may be extended in thickness to accommodate the ends of strands **11** of different lengths.

After the required stress has been applied to strands **11** and grips **27** have been seated in apertures **25**, then auxiliary anchorage **50**, jack **40**, stool **42** and template **33** are removed, the free ends of strands **11** projecting from anchor assembly **20** are severed, the cable is grouted in sleeve **12** if desired, and the anchorage is capped with concrete before or after grouting. Template **22** is removed before capping.

The embodiment of FIG. **7** of the drawings shows an alternate type of capped anchor head **21***a* for use where it is desired to re-stress, from time to time, losses in stress in strands **11** due to ageing. Cylindrical anchor head **21***a* carries circumferential threads **80**. A cap **81**, in the form of a cup **82**, is fixed onto face **23** of anchor head **21***a*. Cup **82** carries laterally projecting spouts **83** and is held on anchor head **21**a for example by a plurality of bolts **84**. To affix sealing cap **81** to anchor head **21**a, the free ends of strands **11** projecting from grips **26** are severed and template **22** is removed together with bolts **24**. Cup **82** is then fastened onto face **23** of anchor head **21***a* by bolts **84**, after which the cup is filled with epoxy resin **85** or other suitable hard setting material through one of spouts **84**, the other spout acting as a vent. To restore a loss in stress in strands **11** due to ageing, anchor head **21***a* is drawn outwardly from bearing plate **14** by means of a jack **86** engaging threads **80**. A threaded collar **87** or a shim (not shown) is then inserted between anchor head **21**a and bearing plate **14** and jack **86** is removed.

In the alternate embodiment shown in FIGS. **8** to **10** of the drawings, an anchor head **21**b is used in the anchorage of a slab **91**, having a laterally projecting annular flange **91** which defines an annular recess **93** when the head is positioned against bearing plate **14**. Flange **92** carries a plurality of apertures **101**.

Reinforcing strands **11**b of slab **91** are post-tensioned and anchored in head **21**b in the manner previously described. Reonforcing strands **11***a*, projecting from a precast slab **90** in the example embodiment, are encompassed by a trumpet **102** having its mouth **103** of a size to accommodate anchor head **21***b* and meet bearing plate **14** of slab **91**. The neck **104** of trumpet **102** slides telescopically inside the end portion of conduit **12** of slab **90** and is of a length to allow for clearance of mouth **103** to pass over anchor head **21***b*. Where slab **90** is not precast trumpet **102** may slide outside conduit **12**, which allows the trumpet greater flexibility movement.

When trumpet **102** has been placed over strands **11***a* the latter strands are anchored in flange **92**, grips **27***a* (of the same construction as grips **27**) being seated in apertures **101** and facing into recess **93** (opposite in direction to grips **27** seated in apertures **25** holding strands **11**b of slab **91**). After strands **11***a* of slab **90** are severed and threaded through apertures **101**, grips **27***a* are seated in the conical portions of the apertures facing bearing plate **14** by tapping short wedges (not shown) laterally into the recess to bear against the bearing plate and the grips simultaneously or by using a single strand hydraulic jack bearing against the outside face of flange **92** to pull each strand **11***a* and thereby seat the grips. When grips **27***a* have been seated in apertures **101**, pairs of wedges **105** shown in FIG. **12** are inserted into recess **93** on each side of the main body portion of anchor head **21***b*. Wedges **105** bear both against grips **27***a* and against bearing plate **14** and are forked to accommodate the ends of strands **11***a* projecting from grips **27***a*. Wedges **105** are preferably fixed to bearing plate **14** by bolts **106** passing through apertures **107** adjacent the free end of one fork of each wedge. As an alternative to wedges **105**, epoxy resin may be used to fill recess **93**, with a suitable covering first placed over the ends of grips **27***a* to prevent the resin from infiltrating the grips.

After strands **11***a* have been anchored in head **21***b* and wedges **105** have been fixed in recess **93**, trumpet **102** is brought forward from slab **90** against bearing plate **14** of slab **91**, thus enclosing all the exposed anchoring elements between the two slabs. Grout injected into conduit **12** of slab **90** or **91** will flow into trumpet **102** to secure the elements and trumpet permanently in position.

In the embodiment of the invention shown in FIGS. **11** to **13** of the drawings, an auxiliary anchor assembly **110** is provided which is similar in construction to auxiliary anchor assembly **50** but which has an auxiliary anchor head **111**, carrying apertures **56**, which is smaller in diameter than the diameter of bore **41** of cylinder **46** in jack **40**. A split collar **112** is used to engage auxiliary anchor head **111** with cylinder **46**, the inner diameter of the collar being less than the diameter of the auxiliary anchor head and the outer diameter of the collar being larger than the diameter of bore **41**. Suitable means such as a latch **113** is used to hold collar **112** together when positioned between head **111** and piston **46**. Although template **53** and grips **58** may be used in the auxiliary anchor assembly of this embodiment, FIGS. **11** to **13** show a further embodiment in which each segment **59***a* of grips **58***a* carry a threaded bolt **114** which is engaged loosely in an aperture **115**, in a template **53***a*, having apertures **57**, which has a diameter less than the diameter of a head **116** on bolt **114**. A handle **117** is fixed centrally to template **53***a*.

In the operation of this embodiment, the free ends of strands **11** are threaded through apertures **56**, grips **58***a* and apertures **57** of auxiliary anchor assembly **110** after having been threaded through main anchor assembly **20** and before bearing stool **42** and jack **40** are positioned over the main anchor assembly. After stool **42** and jack **40** are in position, auxiliary anchor assembly **110** is drawn through bore **41** of the jack beyond piston **46**, whereupon collar **112** is placed in position between the piston and auxiliary anchor head **111**, as seen in FIG. **11**. The operation of the device then proceeds as in the previous embodiment. To prevent grips **58***a* from binding strands **11** in apertures **56**, bolts **114** may be

tightened to draw segments 59*a* towards template 53*a* and later loosened.

In the alternate embodiment shown in FIG. 13, an auxiliary anchor head 111*a* is threaded externally and accepts a threaded collar 112*a* which bears against piston 46 to perform the same function as collar 112.

It will be appreciated that the method and apparatus of the invention would be equally applicable to a single strand cable-reinforced concrete structure. Also, the embodiments of FIGS. 1 to 6, and 11 to 14 would be applicable to an anchorage where the anchor head is embedded in the face of the structure and used also as a bearing plate.

In the alternate embodiment shown in FIGS. 14 to 16 of the drawings a stool 120 is provided of U-shaped cross-section. A pair of opposed plates 122 are located flush against the inner side walls of stool 120 and each plate carries a shoulder having a sloping bearing edge 126 adapted to cooperate with the sloping face 128 a drift wedge 130 inserted into stool 120 between plates 122. Drift wedge 130 is provided with parallel apertures 131 in the form of slots positioned in the drift wedge to accommodate strands 11 when the drift wedge is inserted into stool 120. A template 132 is also provided for insertion into stool 120 between plates 122. Template 132 is also provided with parallel apertures 133 in the form of slots positioned in the template to accommodate strands 11 when the template is inserted into stool 120, in the same manner as drift wedge 130. Before machining, a shallow pyramidal face 134 is formed on the template blank 136 as seen in FIG. 15.

In the operation of the embodiment shown in FIGS. 14 to 16, stool 120 is placed against anchor plate 14, as seen in FIG. 16, with ends 138 of plates 122 adjacent anchor head 21. Next, end 44 of jack 40 is placed on the free end of stool 120 and if desired, plates 122 may be shimmed to bear against anchor head 21. Grips 27 are then placed loosely in apertures 25 about strands 11 and template 132 is inserted into stool 120, strands 11 being accommodated in apertures 133, with conical face 134 abutting laterally against grips 27. Finally, drift wedge 130 is inserted into stool 120, strands 11 being accommodated in apertures 131, with face 128 the drift wedge abutting against shoulders 126 of plates 122. When jack 40 first stresses strands 11, grips 27 are kept in registration with apertures 25 by template 132 but are substantially disengaged frictionally from strands 11, whereby the stressing of the strands is substantially unhindered. When the first stressing stroke of jack 40 is completed drift wedge 130 is forced into stool 120 in the direction of arrow 140 and urges template 132 against grips 27 to bring the grips into substantial frictional contact with strands 11 whereby the grips are seated in apertures 25 when the stress on the strands is released by the jack. In subsequent stressing strokes of jack 40, grips 27 are permitted by template 132 to withdraw from apertures 25 of anchor head 21 sufficiently to allow the grips again substantially to disengage frictionally from strands 11 but again keeping the grips loosely in registration with the apertures of the anchor head. Since the outer members of the group of strands 11 are angled at anchor head 21 to bring all the strands into parallel relationship, conical face 134 of template 132 enables grips 27 to travel out farther adjacent the outer periphery of the anchor head to compensate for an increased frictional resistance between the anchor head and the angled strands.

FIG. 17 shows a modification of the embodiment of FIGS. 14–16, in which shoulders 126 are removed from plate 122 and a template 150 has a sloping face 152 opposite face 134. In the operation of this embodiment, drift wedge 130 is reversed to have its sloping face 128 abutting template 150 and its flat face abutting end 44 of jack 40.

FIGS. 18 and 19 show a further modification of the embodiment of FIGS. 14–16, in which a bridge 160 is fixed onto stool 120 above drift wedge 130. An hydraulic jack 162 is mounted on bridge 160 with piston 164 of the jack projecting through an aperture 166 in the bridge. The free end of piston 164 carries a bearing cap 168 which is located slidably in an inverted T-shaped slot 170 located transversely in drift wedge 130 and opening upwardly, as seen in FIG. 19. The actuation of jack 140 forces drift wedge 130 against shoulders 124 of stool 120 and forces template 132 laterally against grips 27 registered in apertures 25 of anchor head 21. Alternately, jack 162 could be positioned within bridge 160 and fed by lateral fluid lines, and the bridge could be given a lower profile over stool 120, in locations where clearance is minimal. Again, jack 162 could be replaced by a screw jack threaded through bridge 160.

It will be appreciated that the term "aperture" used in this disclosure includes either a bore accommodating a single strand defined as a "separate aperture," or a transverse slot accommodating a plurality of strands lying in a common plane. I claim:

1. An assembly for use in post-stressing the strands of a cable-reinforced concrete structure, in which an anchor head is employed having a separate aperture therethrough to pass each strand, each aperture being flared towards its outer face and having a segmented and tapered strand grip in registration therewith, comprising:

a bearing stool constructed to and arranged to circumscribe the anchor head at least partially and to receive a centre-hole jack thereon;

a first template locatable in the bearing stool parallel to the outer face of the anchor head and freely movable normally therefrom, the template having a plurality of apertures alignable with the apertures in the anchor head; and

a drift wedge locatable, in the bearing stool on that side of the first template remote from the anchor head and substantially parallel thereto, (1) to limit movement of the first template normally away from the anchor head to maintain loose registration of the grips in their associated apertures but out of substantial frictional contact with the strands and (2) on lateral movement of the drift wedge into the bearing stool to move the first template towards the outer face of the anchor head to urge each grip into seating engagement with its associated aperture and into full frictional contact with the strands.

2. An assembly as claimed in claim 1 in which the first template is mounted on the anchor head and freely movable a predetermined distance therefrom.

3. An assembly as claimed in claim 1 including a guide template having a plurality of apertures alignable with the apertures in the first template, the guide template having a diameter less than the bore diameter of the centre-hole jack whereby the second template is slidable, along the strands emanating from the anchor head and the first template, through the jack bore.

4. An assembly as claimed in claim 1 including an auxiliary assembly comprising:

an auxiliary anchor head having a separate aperture therethrough to pass each strand, each aperture being flared towards its outer face to seat a segmented and tapered strand grip; and

a further template mounted on the auxiliary anchor head parallel to said outer face and spaced therefrom, each grip seated in the auxiliary anchor head being retained loosely in registration with its associated aperture by the further template.

5. An assembly as claimed in claim 4 in which each segment of each grip in the auxiliary anchor assembly is connected loosely with the further template, whereby on unmounting the further template the grips are removable from their associated apertures.

6. An assembly as claimed in claim 4 in which the auxiliary anchor assembly has a transverse diameter less than the bore diameter of the jack whereby the auxiliary anchor is slidable along the strands passing through the bore, and means to engage the auxiliary anchor head with the piston of the jack.

7. An assembly as claimed in claim 6 in which the engaging means comprises a split collar having an inner diameter less than the auxiliary anchor head and an outer diameter greater than the bore of the jack.

8. An assembly as claimed in claim 6 in which the engaging means comprises a collar removably threaded onto the auxiliary anchor head and having an outer diameter greater than the bore of the jack.

9. An assembly as claimed in claim 1 in which the stool carries a pair of spaced shoulders sloped to co-operate with the sloping face of the drift wedge for lateral movement of the drift wedge on longitudinal movement of the drift wedge into the stool.

10. An assembly as claimed in claim 1 in which the face of the first template opposing the anchor head is contoured in a shallow conical or pyramidal configuration.

11. An assembly as claimed in claim 1 in which the face of the template remote from the anchor head is sloped to cooperate with the sloping face of the drift wedge for lateral movement of the template on longitudinal movement of the drift wedge into the stool.

12. An assembly as claimed in claim 1 in which the stool is open on one side thereof, a bridge fixed to the stool and straddling said side opening, and means mounted on the stool adapted to co-operate with the drift wedge for longitudinal movement of the drift wedge within the stool.

13. An assembly as claimed in claim 12 in which the means mounted on the bridge slidably engages a transverse slot in the head of the drift wedge.

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