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(11) Publication number: **0 442 935 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

- (49) Date of publication of patent specification: **06.09.95** (51) Int. Cl.⁶: **D07B 1/00, D07B 7/18, E21D 21/00, B23K 37/04**
- (21) Application number: **89912755.9**
- (22) Date of filing: **14.11.89**
- (86) International application number:
PCT/AU89/00486
- (87) International publication number:
WO 90/05811 (31.05.90 90/12)

(54) **IMPROVED ROCK ANCHOR AND METHOD OF MANUFACTURE.**

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| <p>(30) Priority: 14.11.88 AU 1416/88</p> <p>(43) Date of publication of application:
28.08.91 Bulletin 91/35</p> <p>(45) Publication of the grant of the patent:
06.09.95 Bulletin 95/36</p> <p>(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE</p> <p>(56) References cited:</p> <table border="0"><tbody><tr><td>AU-A- 7 976 382</td><td>AU-B- 4 226 872</td></tr><tr><td>AU-B- 4 273 485</td><td>AU-B- 5 655 986</td></tr><tr><td>CA-A- 1 059 351</td><td>FR-A- 2 378 123</td></tr><tr><td>GB-A- 0 975 642</td><td>GB-A- 1 024 696</td></tr><tr><td>GB-A- 1 591 698</td><td>GB-A- 2 034 623</td></tr><tr><td>GB-A- 2 144 784</td><td>GB-A- 2 165 787</td></tr><tr><td>US-A- 4 492 015</td><td>US-A- 4 722 468</td></tr><tr><td>US-A- 4 750 662</td><td></td></tr></tbody></table> | AU-A- 7 976 382 | AU-B- 4 226 872 | AU-B- 4 273 485 | AU-B- 5 655 986 | CA-A- 1 059 351 | FR-A- 2 378 123 | GB-A- 0 975 642 | GB-A- 1 024 696 | GB-A- 1 591 698 | GB-A- 2 034 623 | GB-A- 2 144 784 | GB-A- 2 165 787 | US-A- 4 492 015 | US-A- 4 722 468 | US-A- 4 750 662 | | <p>(73) Proprietor: GARFORD PTY LTD
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Description

The present invention relates to an apparatus for manufacturing rock anchors.

Rock anchors are generally steel tendons inserted down bore holes in a scree. In use a portion of the tendon is grouted and a plate attached to the tendon. The tendon is then stressed so that the plate bears upon the scree thereby to stabilise the scree. Tendons typically comprise a plurality of steel strands wound together to form the tendon. To secure adequately such tendons in cement, prior art methods as disclosed in CA-A-1059351 and AU-B-42734185 have used machines respectively to unravel and wind oppositely for short lengths the strands in tendons. The purpose of unravelling the strands is to increase the surface area of the tendon in contact with the cement to embed more securely the tendon in the cement. This is a relatively time consuming procedure.

In contrast, in accordance with the present invention, there is provided an apparatus for manufacturing a rock anchor, comprising a tendon having a plurality of strands and at least one bulbous portion in which all the strands are spaced from one another substantially around the periphery of the bulbous portion, the apparatus comprising a pair of spaced clamp means, each arranged to clamp releasably the tendon therebetween at positions spaced apart along the length thereof and being mounted in the apparatus for there to be relative longitudinal displaceability between the clamp means, and clamp displacement means for displacing one clamp means towards the other in order to form a bulbous portion in the tendon between the two clamp means, characterized in that the apparatus also includes tendon displacement means for displacing the tendon in the longitudinal direction thereof relative to the clamp means after a bulbous portion has been formed in the tendon, comprising clamp means arranged releasably to grip the tendon therebetween.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a view of a rock anchor;

Figure 2 is a perspective view of a section taken along the line 2-2 of Figure 1;

Figure 3 is a plan view of apparatus embodying the present invention for manufacturing a rock anchor;

Figure 4 is a further plan view of the apparatus of Figure 4;

Figure 5 is a plan view of a second apparatus embodying the present invention;

Figure 6 is a transverse sectional view along lines 7-7 of Figures 3 to 5;

Figure 7 is a transverse sectional view along lines 8-8 of Figures 3 to 5; and

Figure 8 is a transverse sectional view along line 9-9 of Figure 5.

Shown in Figures 1 and 2 is a rock anchor 10 comprising a steel tendon 12. The tendon 12 is composed of a plurality of outer strands 14 helically wound around a centre strand 15 to form the tendon 12. As shown, there are six outer strands 14 wound around the centre strand. The tendon 12 has a plurality of bulbous portions 16 spaced apart from one another along the length of the tendon. The portions of the strands 14 and 15, in the bulbous portions 16, are spaced apart from each other around the circumference of the bulbous portions 16, as shown. The section line 2-2 has been taken through the fattest part of the bulbous portion 16. As seen in Figure 2, the centre strand 15 is displaced away from the centre of the tendon 12. Each bulbous portion 16 has a bulb diameter defined as the diameter of the smallest tube through which the rock anchor 10 will pass. The bulb periphery is indicated by the broken lines, marked 17 in Figure 2. The outer strands 14 and the centre strand 15 are all located adjacent and within the bulb periphery 17. This enables cement to contact a greater surface area of the strands 14 in use. The rock anchor 10 is thereby firmly embedded in the cement. Furthermore, the centre strand 15 is displaced away from its normal central position, in the bulbous portions 16. When the rock anchor 10 is stressed, the load will be taken more evenly by the strands 14 and 15 than if the centre strand 15 was in its central position. If the centre strand 15 was in its central position, more load would be taken by the centre strand 15 than the outer strands 14. This would then lower the safety factor of the rock anchor 10 which could then fail at a much lower load.

Shown in Figures 3, 4, 6 and 7 is apparatus 52 of a first embodiment of the present invention for manufacturing a rock anchor 10. There is provided one fixed 22' and one slidable clamp means 22, each having opposed plates 30, 32 to bear on the tendon 12 therebetween and each provided with a hydraulic ram 28 mounted in a frame 24. The slidable clamp means 22 is held in a carriage 54 slidable along the frame 24. The hydraulic ram 28, associated with the fixed clamp means 22', is supplied with hydraulic pressure through a pipe 56. The ram 28, associated with the slidable clamp means 22, is supplied with hydraulic pressure through a separate pipe 58. A clamp displacement means such as an hydraulic ram 44 is fixed to the right hand end of the frame 24 and has a plunger 45 which bears on the slidable clamp means 22. Similarly, the ram 44 of the displacement means, has a separate pipe 60 to supply hydraulic pres-

sure. The pipes 56, 58 and 60 are connected to an hydraulic timer (not shown) which co-ordinates the action of both rams 28 and the ram 44. As shown, the tendon 12 passes through the centre of the ram 44. A straight pipe 61 is disposed to the left of the fixed clamp 22 and is arranged to receive the rock anchor 10. The pipe 61 has a diameter at least that of the bulb diameter.

As seen in Figures 6 and 7, each plate 30 and 32 has a recess 62. The plates 30 and 32 have a centralising pin 64 located below the recesses 62 and extending between the plates 30 and 32. The pin 64 serves to support the tendon 12 and to guide the plates 30 and 32 toward one another so that the tendon 12 is clamped within the recesses 62. Thus, the plate 30 contains a recess (not shown) which receives the pin 64 when the plates 30 and 32 are moved together by the ram 28. In use, a tendon 12 is first fed through the ram 44, between the plates 30 and 32, of the clamp means 22 and 22', and into the pipe 61. The hydraulic timer operates and activates the ram 28 of the fixed clamping means 22'. This results in the clamping means 22' securely holding the tendon 12 by means of the plates 30 and 32. At this point, the ram 28 of the slidable clamp means 22, is deactivated to allow the tendon 12 to slide between its plates 30 and 32. The ram 44 is then activated and causes the plunger 45 to move to the left, toward the fixed clamp means 22'. This moves the carriage 54, with the slidable clamp means 22, to the left, toward the fixed clamp means 22'. When the distance between the clamp means 22 and 22' reaches the first predetermined length, in which there is an uninterrupted length of tendon 12 necessary to form a bulbous portion 16 therebetween, the ram 44 is deactivated.

The ram 28 of the slidable clamp means 22, is then activated to clamp the tendon 12 between the plates 30 and 32.

The ram 44 is then reactivated. This causes the plunger 45 to bear upon the plates 30 and 32, of the slidable clamp means 22, and displace the slidable clamp means 22 towards the fixed clamp means 22'. Such relative displacement causes the bulbous portions 16 to be formed in the tendon 12 between the clamp means 22 and 22'.

When the distance between the clamp means 22 and 22' reaches a second predetermined distance, in which the desired bulbous portion 16 reaches its correct proportions, the ram 28 of the slidable clamp means 22 and the ram 44 are then deactivated to release the tendon 12. The ram 44 then withdraws the plunger 45 away from the fixed clamp means 22'. This moves the carriage 54 with the slidable clamp means 22, to the right, away from the fixed clamp means 22'.

The ram 28, of the slidable clamp means 22 is then activated to clamp the tendon 12 by means of the plates 30 and 32. The ram 28 of the fixed clamp means 22' is then deactivated to release the tendon 12.

The ram 44 is then activated, the plunger 45 extends and moves the carriage 54 and slidable clamp means 22 towards the fixed clamp means 22'. Thus, in this condition, the slidable clamp means 22 and the ram 44 function as a tendon displacement means to move the tendon 12. This also moves the rock anchor 10 to the left and into the straight pipe 61. The pipe 61 generally straightens out any bends that may have occurred when the bulbous portion 16 was formed. When the rock anchor 10 has been moved a distance equal to the spacing between adjacent bulbous portions 16, the ram 44 is then deactivated to prevent any further movement of the tendon 12.

The ram 28 of the fixed clamping means 22' is then activated and the process is repeated as many times as is required.

Shown in Figures 5 and 8 is an apparatus 66 of a second embodiment for manufacturing a rock anchor 10. This apparatus 66 is a modification of the apparatus 52 of Figures 3, 4, 6 and 7. Like numerals denote like parts. The apparatus 66 additionally comprises a separate tendon displacement means 68 to the right of the slidable clamp means 22 in Figure 5. The tendon displacement means 68 comprises a slidable clamp means 70 carried by a carriage 72 slidable along the frame 24. The clamp means 70 comprises an hydraulic ram 74 supplied with hydraulic pressure by a pipe 76. The ram 74 has a plate 78 attached thereto to bear on and thereby clamp the tendon 12 against an opposed plate 80. Each plate 78 and 80 has a recess 82, in a similar manner to the machine 52 of Figures 3, 4, 6 and 7. The plates 78 and 80 have a centralising pin 84 located below the half recesses 82, in a similar manner to the machine 52 of Figures 3, 4, 6 and 7. The tendon displacement means 68 further comprises a clamp displacement means in the form of an hydraulic ram 86 supplied with hydraulic pressure through a pipe 88. The ram 86 has a plunger 90 which bears on the carriage 72 and is arranged to displace the sliding clamp means 70 to the left, as shown in Figure 5.

As is apparent, the tendon displacement means 68 is an element supplementary to those comprised by the tendon displacement means of the apparatus 52.

The pipes 58 and 60 are connected to a common manifold 92 supplied with hydraulic pressure by a pipe 94. Thus, the fixed clamp means 22' and the slidable clamp means 22 are activated simultaneously.

In use, a tendon 12 is first fed through between the plates 78 and 80, through the ram 44, between the plates 30 and 32, of the clamp means 22 and 22' and into the pipe 61. An hydraulic timer operates and simultaneously activates both of the rams 28 so that the clamps 22 and 22' securely hold the tendon 12.

At this point, the ram 74 is deactivated to allow the tendon 12 to slide between the plates 78 and 80. Further, at this stage, the clamp means 22 and 22' are a first predetermined distance apart. The ram 44 is then activated to move the carriage 54 to the left, towards the fixed clamp means 22'. This relative displacement disrupts the tendon 12 and forms a bulbous portion 16. When the distance between the clamp means 22 and 22' reaches a second predetermined distance both rams 28 and the ram 44 are deactivated.

Ram 74 is then activated so that the tendon 12 is securely held in the slidable clamp means 70 by the plates 78 and 80. The ram 86 is then activated and the plunger 90 moves the carriage 72 to the left, towards the fixed clamp means 22'. This also moves the rock anchor 10 to the left and into the straight pipe 61.

When the rock anchor 10 has been moved a distance equal to the spacings between adjacent bulbous portions 16, the rams 74 and 86 are deactivated. Both rams 28 are then simultaneously activated and the process is repeated as many times as desired.

It is envisaged that the tendon displacement means may alternately comprise an electronic motor driving wheel. An idler wheel would bear upon the driven wheel and the tendon would pass between the idler and the driven wheels. A timer would activate an electric motor to rotate the driven wheel and thereby move the tendon. There may also be a number of each of the machines 52 and 66 operating simultaneously together in parallel. Further, the ram 44 may have an adjustment means in the form of a threaded column to vary the position of the ram 44 along the frame.

Claims

1. An apparatus (52, 66) for manufacturing a rock anchor (10), comprising a tendon (12) having a plurality of strands (14, 15) and at least one bulbous portion (16) in which all the strands are spaced from one another substantially around the periphery of the bulbous portion, the apparatus (52, 66) comprising a pair of spaced clamp means (22, 22'), each arranged to clamp releasably the tendon therein at positions spaced apart along the length thereof and being mounted in the apparatus for there to be relative longitudinal displaceability between the

clamp means (22, 22'), and clamp displacement means (44) for displacing one clamp means towards the other in order to form a bulbous portion (16) in the tendon (12) between the two clamp means, characterised in that the apparatus also includes tendon displacement means (44, 68) for displacing the tendon (12) in the longitudinal direction thereof relative to the clamp means after a bulbous portion (16) has been formed in the tendon, comprising clamp means (22; 70) arranged releasably to grip the tendon (12) therebetween.

2. An apparatus (52, 66) according to claim 1, characterised in that the clamp means (22) of the tendon displacement means (44) is one clamp means (22) of the said pair of clamp means (22, 22').

3. An apparatus (66) according to claim 1, characterised in that the clamp means of the tendon displacement means (68) is a clamp means (70) additional to said pair of spaced clamp means (22, 22') and arranged to grip the tendon (12) therein when both of said pair of spaced clamp means (22, 22') is not acting on the tendon.

4. An apparatus (52, 66) according to claim 1, 2 or 3, characterised in that only one clamp means (22) of the said pair of clamp means (22, 22') is displaceable in said longitudinal direction.

5. An apparatus (52, 66) according to any one preceding claim, characterised in that the clamp means (22, 70) of the tendon displacement means (44) is displaceable by hydraulic ram means (44, 86).

6. An apparatus (52, 66) according to claim 2, 3 4 or 5, characterised in that the displaceable clamp means (22) is carried in a carriage (54) slidable along a frame (24) of the apparatus.

7. An apparatus (52, 66) according to any one preceding claim, characterised in that each clamp means has a pair of opposed plates (30, 32; 78, 80) and hydraulic ram means (28; 74) bearing on one said plate (30; 78) to bring it into opposition against the other said plate (32; 80).

8. An apparatus (52, 66) according to any one of claims 1 to 7, characterised in that each clamp means (22, 22'; 70) has a plate (30, 32; 78, 80) with a recess (62; 82) arranged to receive the

tendon (12) therebetween.

9. An apparatus (52, 66) according to claim 8, characterised in that a centralising pin (64; 84) is associated with the plates (30, 32; 78, 80) of the clamp means (22, 22'; 70) to support the tendon (12) and to guide recess (62; 82) of the plates (30, 32; 78, 80) towards one another.

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10. An apparatus (52, 66) according to any one of claims 1 to 9, characterised in that the clamp displacement means is operable to space said pair of clamp means (22, 22') by a first predetermined distance prior to forming the bulbous portion (16) and by a second predetermined distance after forming the bulbous portion (16).

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11. An apparatus (52, 66) according to any one of claims 1 to 10, characterised in that a substantially straight pipe (61) is provided to receive and substantially to straighten the rock anchor (10) as it emerges from the clamp means (22, 22') after formation of the bulbous portion (16).

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Patentansprüche

1. Vorrichtung (52,66) zum Herstellen eines Felsankers (10), mit einem Drahtseil (12), welches eine Vielzahl von Litzen (14,15) und wenigstens einen knollenförmigen Bereich (16) aufweist, in welchem alle Litzen entlang des Umfangs des knollenförmigen Bereiches räumlich getrennt voneinander angeordnet sind, wobei die Vorrichtung (52,66) ein Paar räumlich voneinander getrennter Klemmeinrichtungen (22,22') aufweist, welche so vorgesehen sind, daß sie das Drahtseil lösbar zwischen sich in Positionen entlang des Drahtseiles festklemmen und in der Vorrichtung befestigt sind, um das Drahtseil relativ in Längsrichtung zwischen den Klemmeinrichtungen (22,22') zu versetzen, und wobei eine Klemmenversetzungseinrichtung (44) zum Versetzen einer Klemmeinrichtung in Richtung zu der anderen hin vorgesehen ist, um einen knollenförmigen Bereich (16) in dem Drahtseil (12) zwischen den beiden Klemmeinrichtungen herzustellen, **dadurch gekennzeichnet**, daß die Vorrichtung weiterhin Drahtseilversetzungseinrichtungen (44,68) zum Versetzen des Drahtseiles (12) in Längsrichtung desselben relativ zu den Klemmeinrichtungen aufweist, nachdem ein knollenförmiger Bereich (16) in dem Drahtseil hergestellt wurde, mit einer Klemmeinrichtung (22;70) die lösbar vorgesehen ist, um zwischen den Klemmeinrichtungen das Drahtseil (12) zu greifen.

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2. Vorrichtung (52,66) nach Anspruch 1, **dadurch gekennzeichnet**, daß die Klemmeinrichtung (22) der Drahtseilversetzungseinrichtung (44) eine Klemmeinrichtung (22) des Paares von Klemmeinrichtungen (22,22') ist.

3. Vorrichtung (66) nach Anspruch 1, **dadurch gekennzeichnet**, daß die Klemmeinrichtung der Drahtseilversetzungseinrichtung (68) eine zusätzlich zu dem Paar räumlich voneinander getrennter Klemmeinrichtungen (22,22') vorgesehene Klemmeinrichtung (70) ist, welche so angeordnet ist, daß sie das Drahtseil (12) zwischen dem Paar räumlich voneinander getrennter Klemmeinrichtungen (22,22') greift, wenn diese nicht an dem Drahtseil angreifen.

4. Vorrichtung (52,66) nach Anspruch 1, 2 oder 3, **dadurch gekennzeichnet**, daß nur eine Klemmeinrichtung (22) des Paares von Klemmeinrichtungen (22,22') in Längsrichtung versetzbar ist.

5. Vorrichtung (52,66) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die Klemmeinrichtung (22,70) der Drahtseilversetzungseinrichtung (44) mittels Hydraulikzylindern (44, 68) versetzbar ist.

6. Vorrichtung (52,66) nach Anspruch 2, 3, 4 oder 5, **dadurch gekennzeichnet**, daß die versetzbare Klemmeinrichtung (22) in einem Schlitten (54) angeordnet ist, welcher entlang eines Rahmens (24) der Vorrichtung verschiebbar ist.

7. Vorrichtung (52,66) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß jede einzelne Klemmeinrichtung ein Paar sich gegenüberliegender Platten (30,32;78,80) und einen Hydraulikzylinder (28;74) aufweist, welcher mit einer der Platten (30;78) verbunden ist, um diese in Gegenstellung zu der anderen Platte (32;80) zu bringen.

8. Vorrichtung (52,66) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet**, daß jede einzelne Klemmeinrichtung (22,22';70) eine Platte (30,32;78,80) mit einem Rücksprung (62;82) aufweist, welcher zwischen den Platten das Drahtseil (12) aufnimmt.

9. Vorrichtung (52,66) nach Anspruch 8, **dadurch gekennzeichnet**, daß ein Zentrierbolzen (64; 84) mit den Platten (30, 32;78,80)

der Klemmeinrichtungen (22,22';70) zusammenwirkt, um das Drahtseil (12) abzustützen und eine Führung für die Rücksprünge (62;82) der Platten (30,32;78,80) für die Bewegung aufeinanderzu zu bilden.

10. Vorrichtung (52,66) nach einem der Ansprüche 1 bis 9,

dadurch gekennzeichnet, daß die Klemmenversetzungseinrichtung so ausgeführt ist, daß das Paar von Klemmeinrichtungen (22,22') vor dem Herstellen des knollenförmigen Bereiches (16) auf einen ersten vorherbestimmten Abstand und nach dem Herstellen des knollenförmigen Bereiches (16) auf einen zweiten vorherbestimmten Abstand versetzbar ist.

11. Vorrichtung (52,66) nach einem der Ansprüche 1 bis 10,

dadurch gekennzeichnet, daß ein im wesentlichen gerade verlaufendes Rohr (61) vorgesehen ist, um den Felsanker (10) nach dem Austreten aus den Klemmeinrichtungen (22,22') nach der Herstellung des knollenförmigen Bereiches (16) aufzunehmen und gerade-zuziehen.

Revendications

1. Appareil (52, 66) pour fabriquer une ancre de roche (10), comprenant un élément de précontrainte (12) ayant une multiplicité de torons (14, 15) et au moins une partie bulbiforme (16) dans laquelle tous les torons sont espacés les uns des autres sensiblement sur la périphérie de la partie bulbiforme, l'appareil (52, 66) comprenant une paire de moyens de serrage (22, 22') espacés, disposés chacun pour serrer à l'intérieur l'élément de précontrainte de manière amovible en des positions espacées les unes des autres sur sa longueur et étant montés dans l'appareil pour qu'il y ait une possibilité de déplacement longitudinal relatif entre les moyens de serrage (22, 22'), et un moyen de déplacement de moyen de serrage (44) pour déplacer un moyen de serrage vers l'autre afin de former une partie bulbiforme (16) dans l'élément de précontrainte (12) entre les deux moyens de serrage, caractérisé en ce que l'appareil comprend aussi un moyen de déplacement d'élément de précontrainte (44, 68) pour déplacer l'élément de précontrainte (12) dans sa direction longitudinale par rapport aux moyens de serrage après qu'une partie bulbiforme (16) a été formée dans l'élément de précontrainte, comprenant un moyen de serrage (22 ; 70) disposé de manière amovible pour saisir l'élément de précontrainte (12).

2. Appareil (52, 66) selon la revendication 1, caractérisé en ce que le moyen de serrage (22) du moyen de déplacement d'élément de précontrainte (44) est un moyen de serrage (22) de ladite paire de moyens de serrage (22, 22').
3. Appareil (66) selon la revendication 1, caractérisé en ce que le moyen de serrage du moyen de déplacement d'élément de précontrainte (68) est un moyen de serrage (70) additionnel à la dite paire de moyens de serrage (22, 22') espacés et disposé pour saisir l'élément de précontrainte (12) lorsque les deux moyens de serrage de ladite paire de moyens de serrage (22, 22') espacés n'agissent pas sur l'élément de précontrainte.
4. Appareil (52, 66) selon la revendication 1, 2 ou 3, caractérisé en ce qu'un seul élément de serrage (22) de ladite paire d'éléments de serrage (22, 22') est déplaçable dans ladite direction longitudinale.
5. Appareil (52, 66) selon l'une quelconque des revendications précédentes, caractérisé en ce que le moyen de serrage (22, 70) du moyen de déplacement d'élément de précontrainte (44, 68) est déplaçable par un moyen à vérin hydraulique (44, 86).
6. Appareil (52, 66) selon la revendication 2, 3, 4 ou 5, caractérisé en ce que le moyen de serrage déplaçable (22) est porté dans un chariot (54) qui peut coulisser le long d'un cadre (24) de l'appareil.
7. Appareil (52, 66) selon l'une quelconque des revendications précédentes, caractérisé en ce que chaque moyen de serrage comporte une paire de plaques opposées (30, 32 ; 78, 80) et un moyen à vérin hydraulique (28 ; 74) portant sur l'une (30 ; 78) desdites plaques pour l'amener en opposition contre l'autre (32 ; 80) desdites plaques.
8. Appareil (52, 66) selon l'une quelconque des revendications 1 à 7, caractérisé en ce que chaque moyen de serrage (22, 22' ; 70) comporte une plaque (30, 32 ; 78, 80) munie d'un évidement (62 ; 82) conçu pour recevoir l'élément de précontrainte (12).
9. Appareil (52, 66) selon la revendication 8, caractérisé en ce qu'une tige de centrage (64 ; 84) est associée aux plaques (30, 32 ; 78, 80) des moyens de serrage (22, 22' ; 70) pour soutenir l'élément de précontrainte (12) et pour guider l'un vers l'autre les évidements (62 ; 82)

des plaques (30, 32 ; 78, 80).

10. Appareil (52, 66) selon l'une quelconque des revendications 1 à 9, caractérisé en ce que le moyen de déplacement de moyen de serrage est actionnable pour écarter ladite paire de moyens de serrage (22, 22') d'une première distance prédéterminée avant la formation de la partie bulbiforme (16) et d'une seconde distance prédéterminée après la formation de la partie bulbiforme (16).

11. Appareil (52, 66) selon l'une quelconque des revendications 1 à 10, caractérisé en ce qu'un tube sensiblement rectiligne (61) est prévu pour recevoir et sensiblement pour redresser l'ancre de roche (10) lorsqu'elle émerge des moyens de serrage (22, 22') après la formation de la partie bulbiforme (16).

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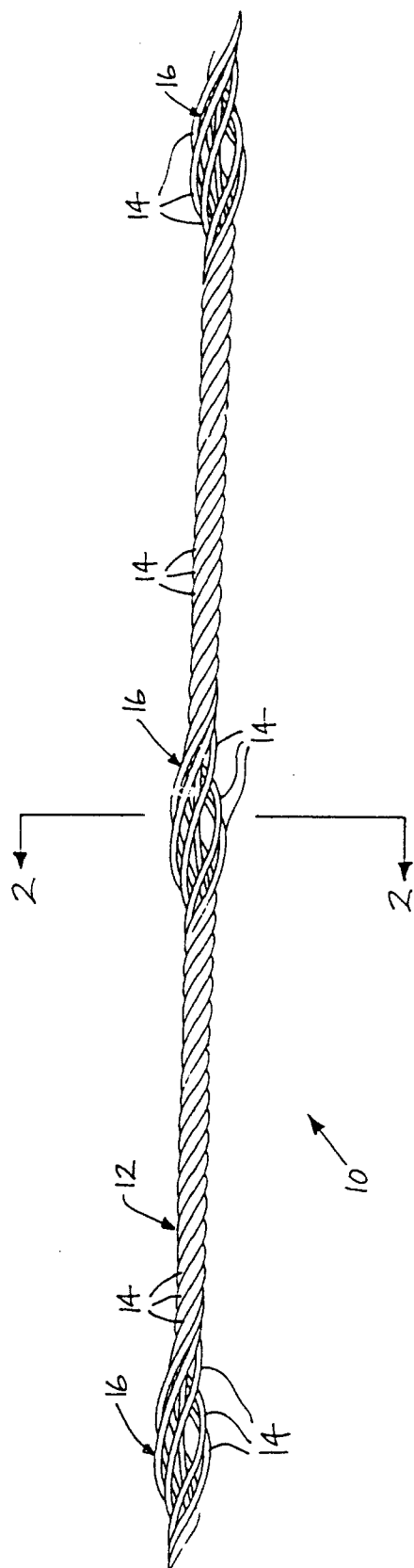
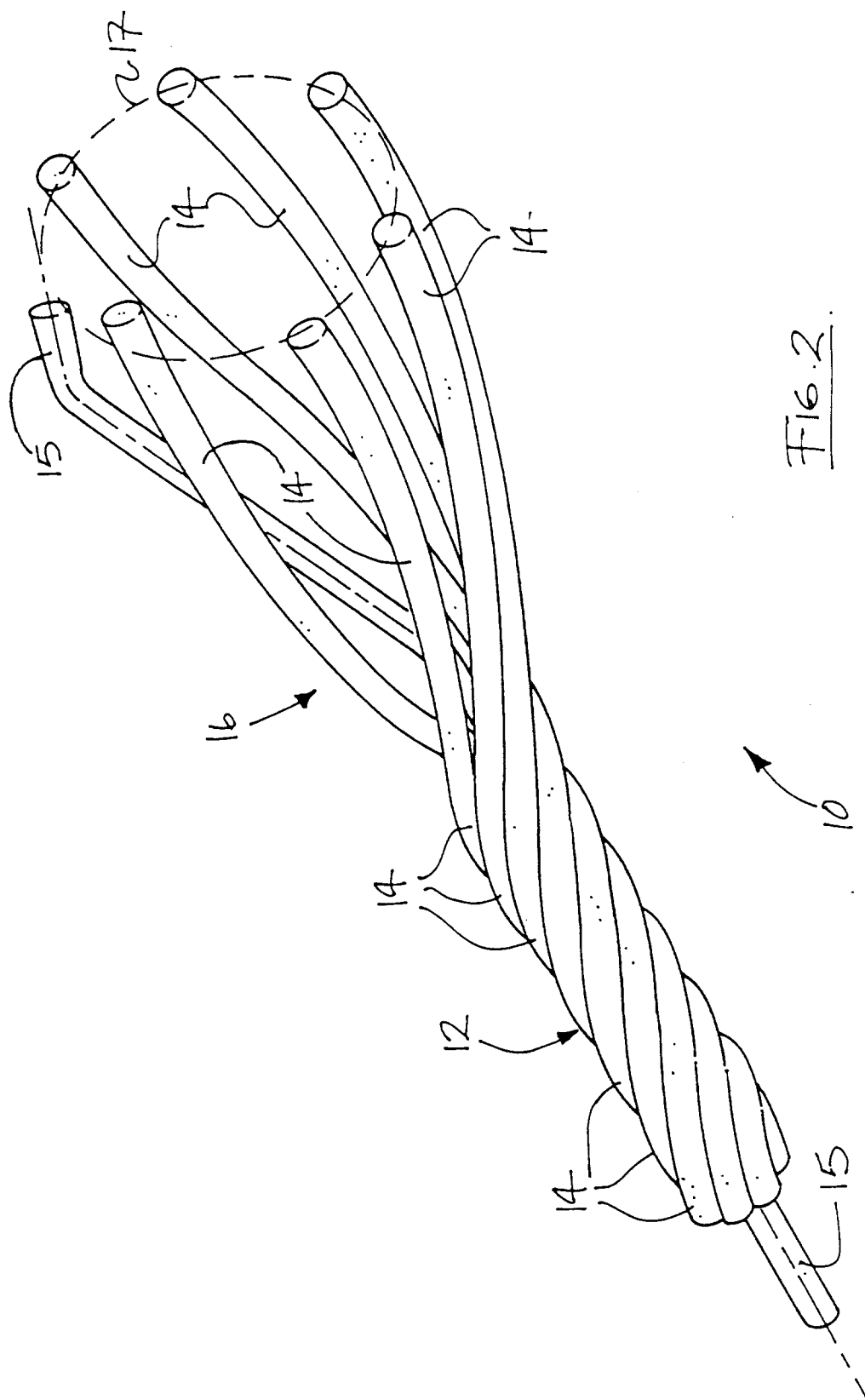
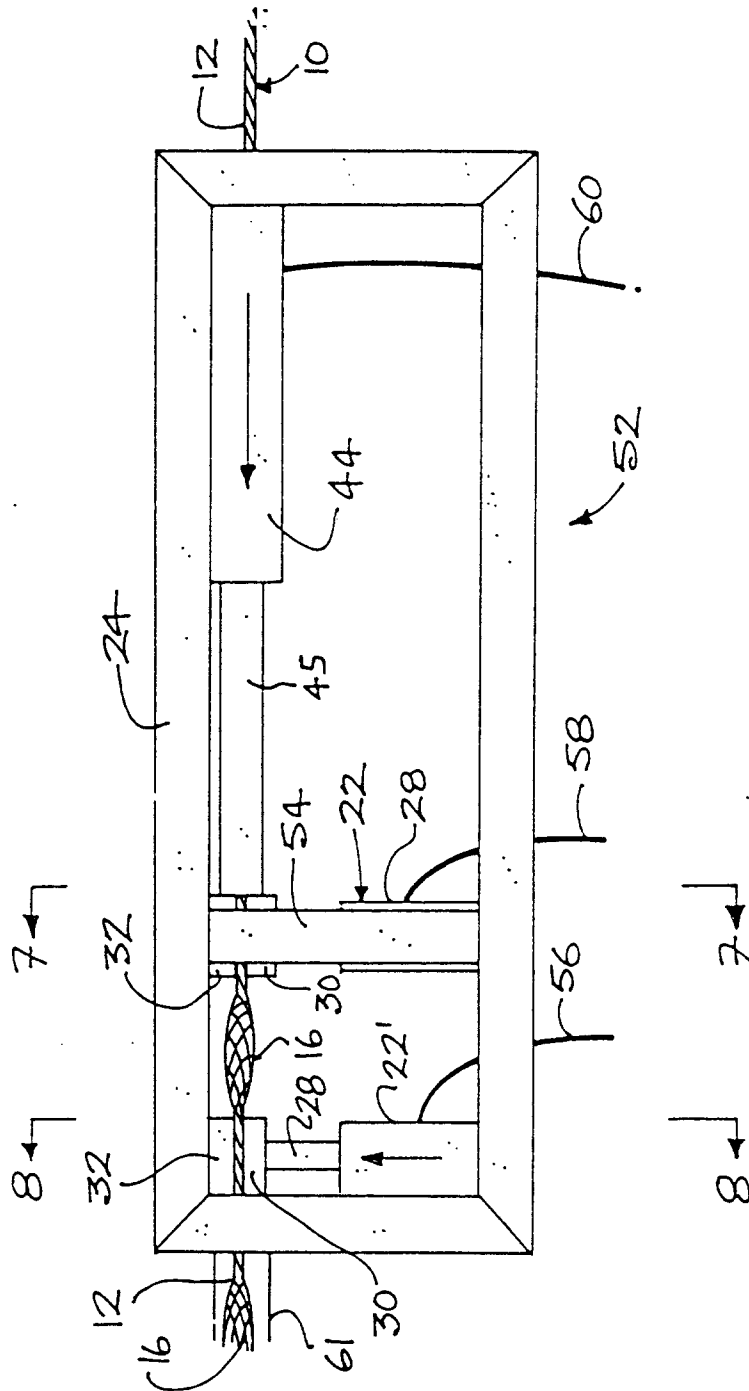


Fig. 1





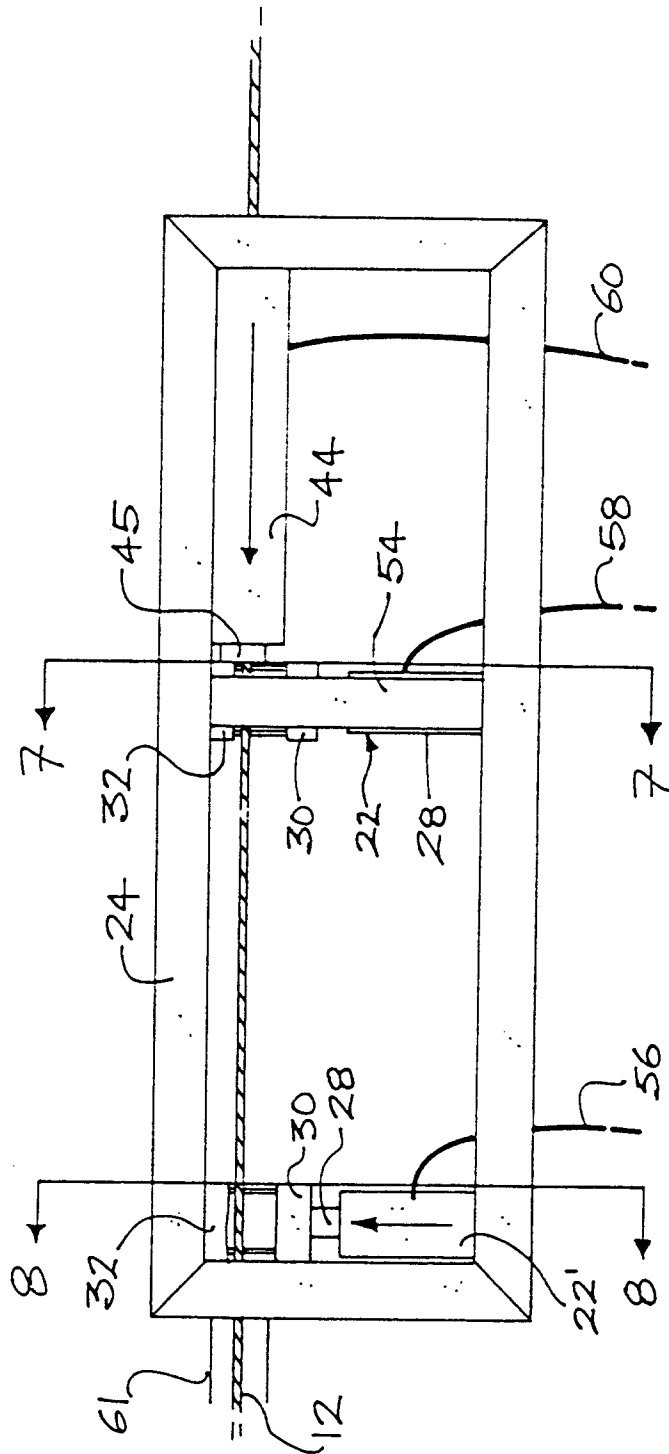


Fig. 4.

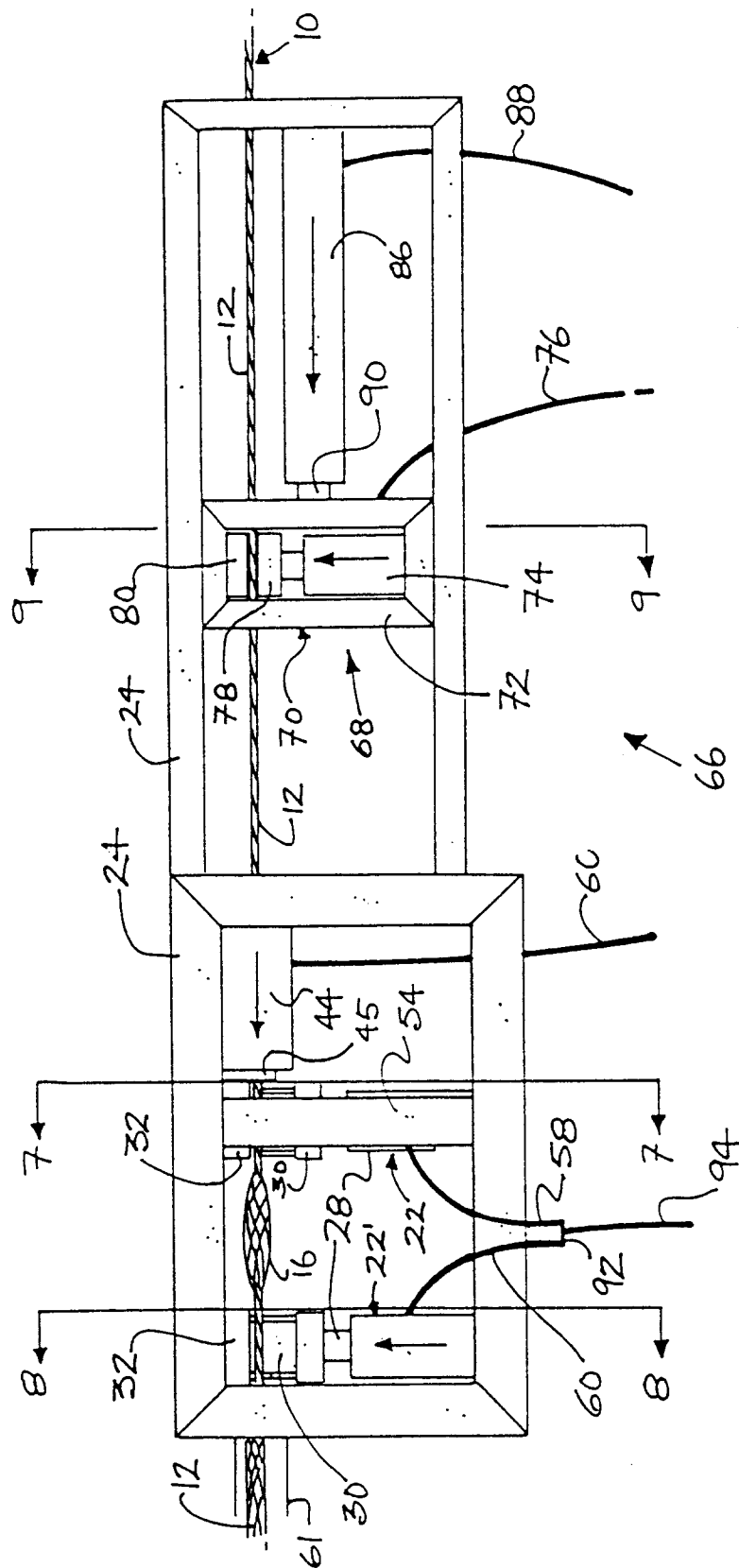


Fig. 5.

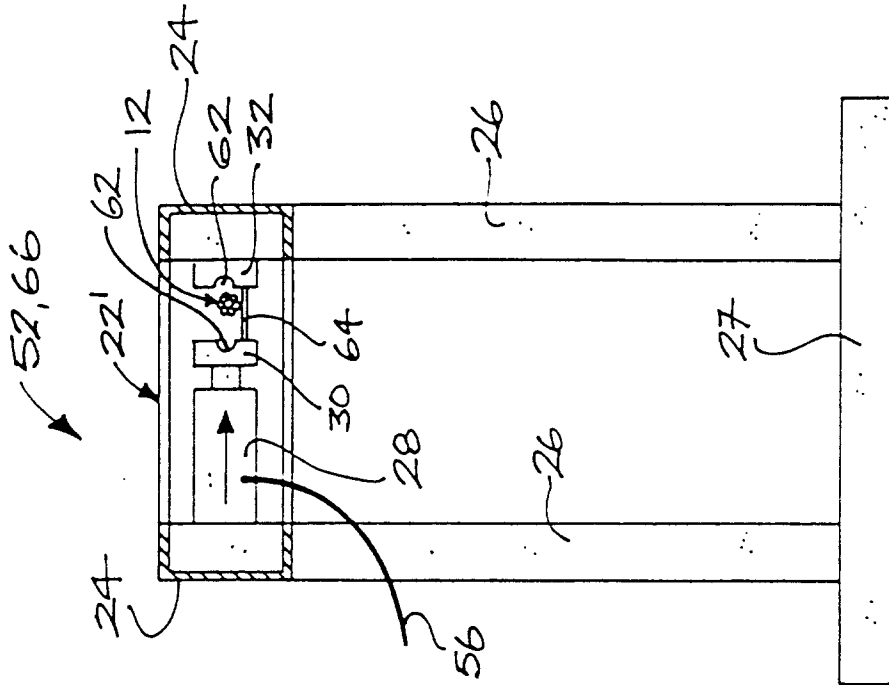


Fig. 6

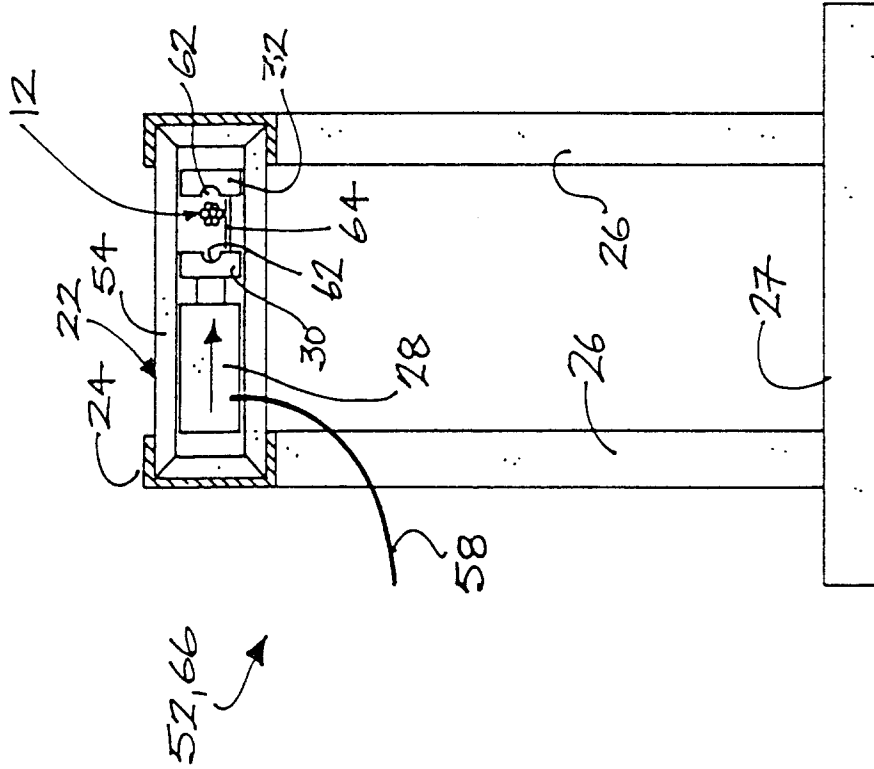


Fig. 7

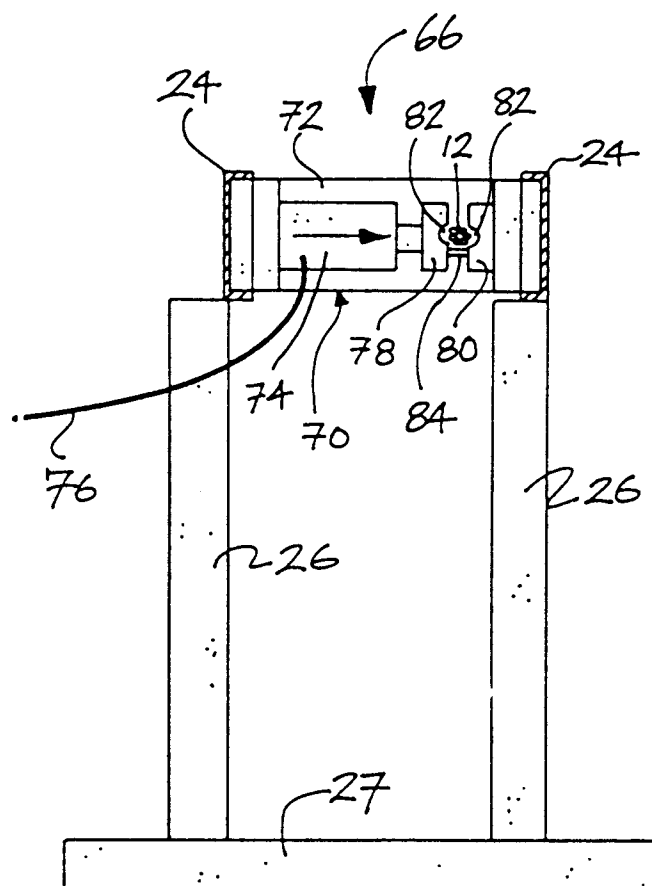


Fig. 8.