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(54) **VERTICAL STAB TENDON BOTTOM CONNECTOR AND METHOD FOR SECURING AND RELEASING THE SAME**

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Filed: **Sep. 26, 1997**

U.S. Applications:

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(51) **Int. Cl.**[7] **E02D 5/54**; F16L 35/00

(52) **U.S. Cl.** **405/223.1**; 405/195.1; 405/224; 403/322.4; 285/307; 166/365; 166/382

(58) **Field of Search** 403/322.1, 322.4, 403/322.3; 405/195.1, 223.1, 224, 224.1, 224.2, 224.3, 224.4; 285/307, 123.9, 123.13; 166/350, 359, 367, 365, 382, 340, 339, 348

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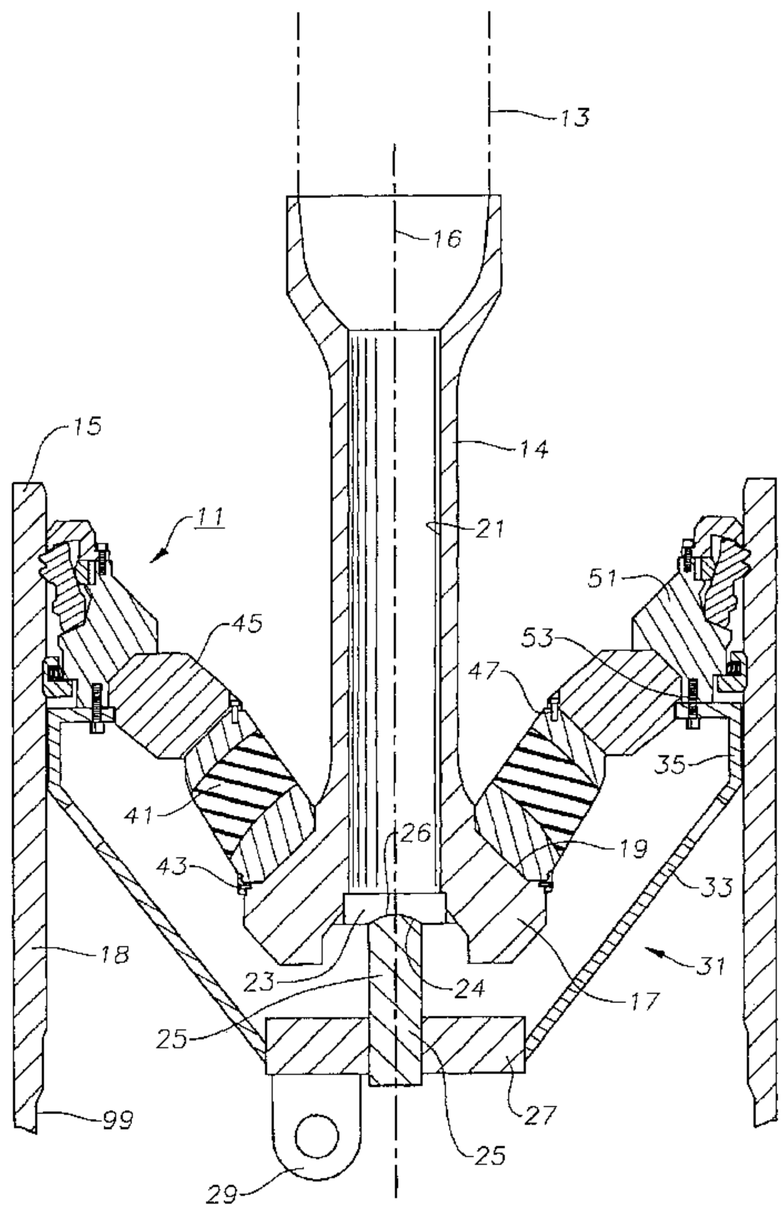
(57) **ABSTRACT**

A bottom connector for the tendon of a tension leg platform uses a latch ring with an outer profile to engage a mating profile in a receptacle on the sea floor. The latch ring moves radially within a housing, relative to the receptacle, between an engaged position and a retracted position. The latch ring engages the receptacle by lowering the connector into the receptacle below the mating profile and then lifting it until the latch ring locks into the receptacle. The latch ring disengages the receptacle by lowering the connector beyond a recess located below the mating profile and then lifting the connector out of the receptacle. As the connector is lifted above the recess, a retaining ring is actuated by the recess to retain the latch ring in its retracted position.

52 Claims, 6 Drawing Sheets



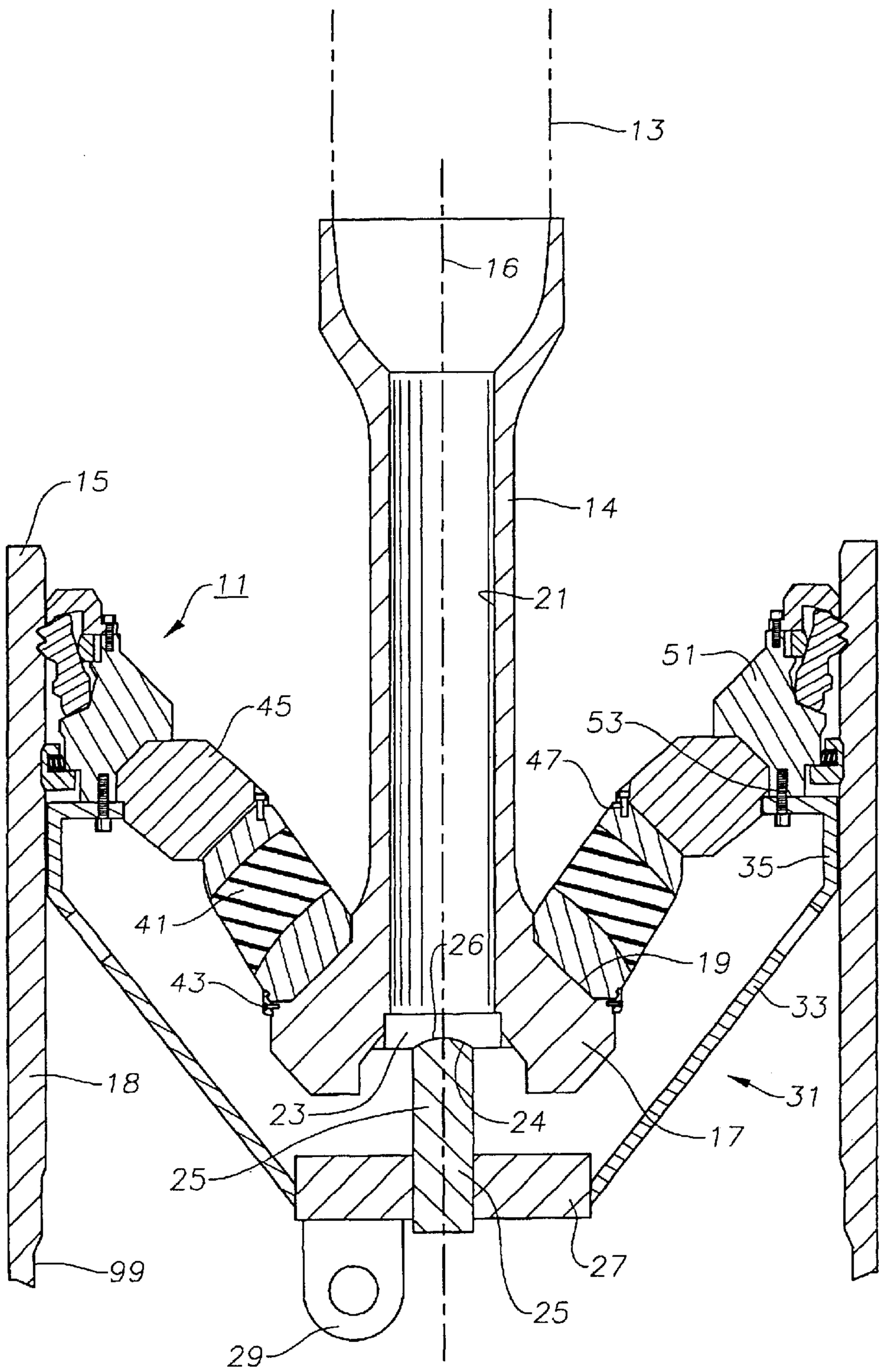

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Fig. 1

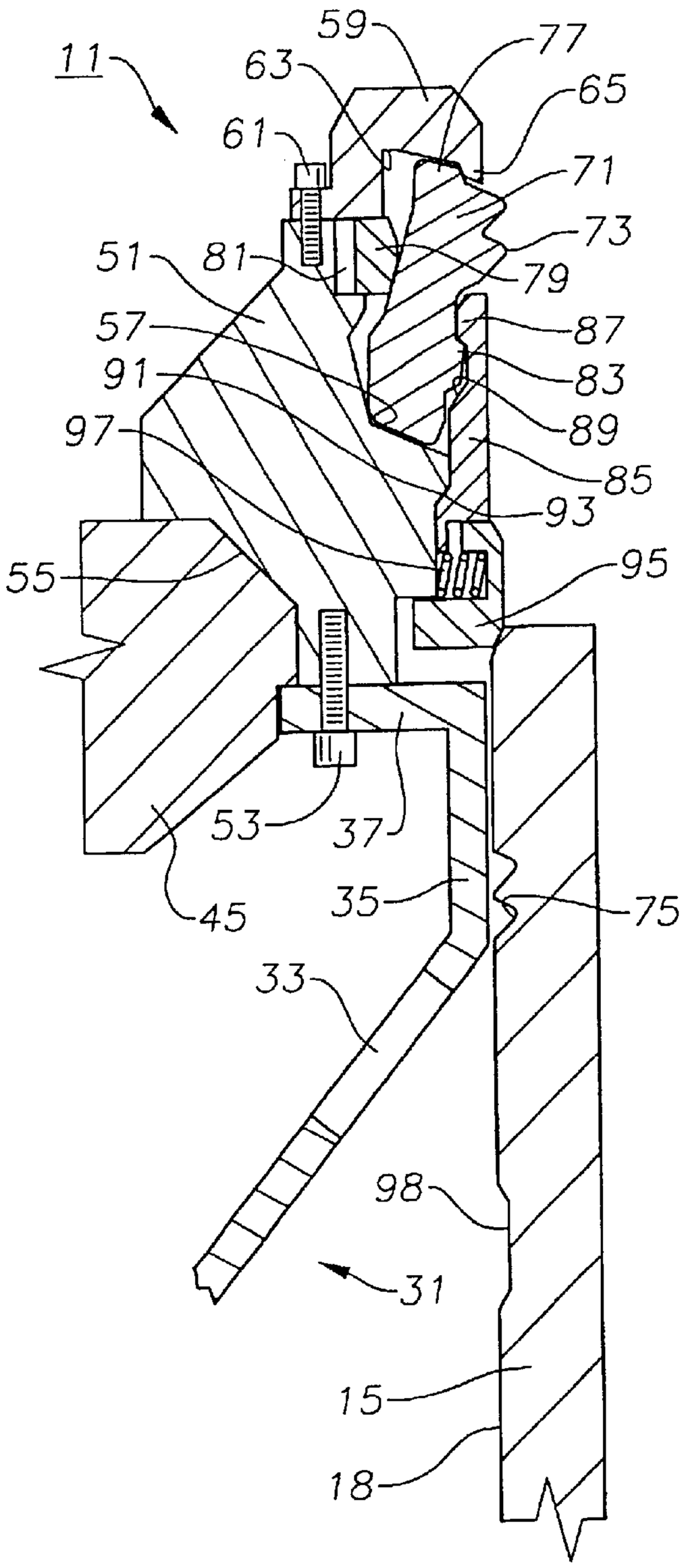


Fig. 2

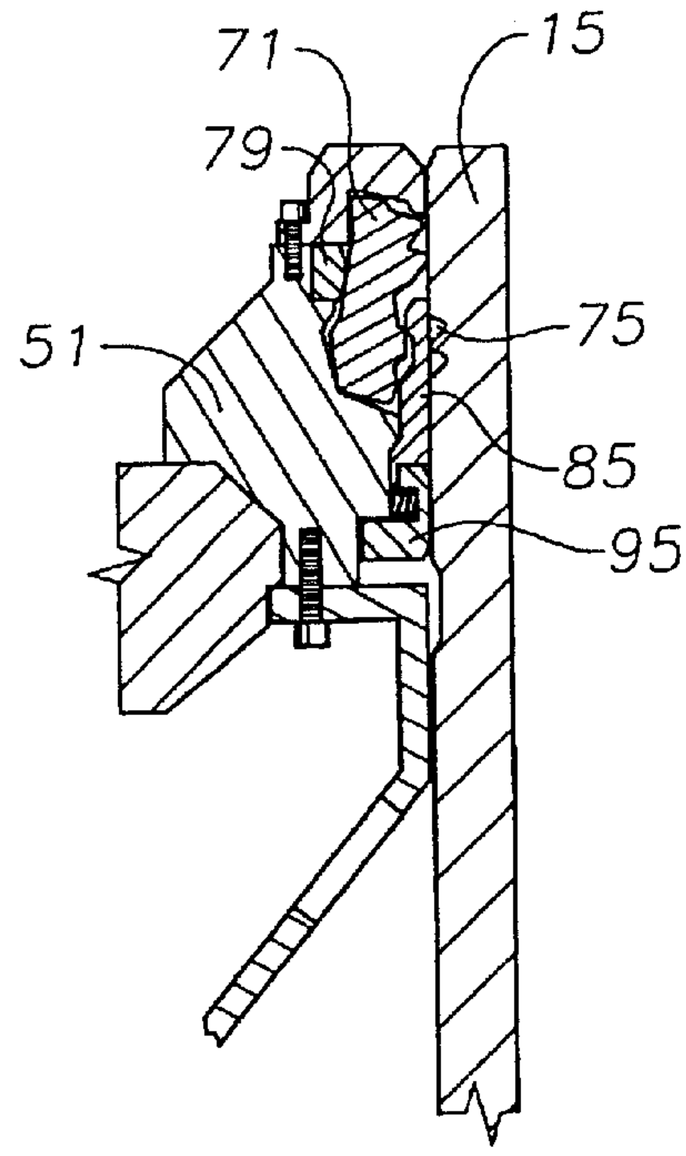


Fig. 3

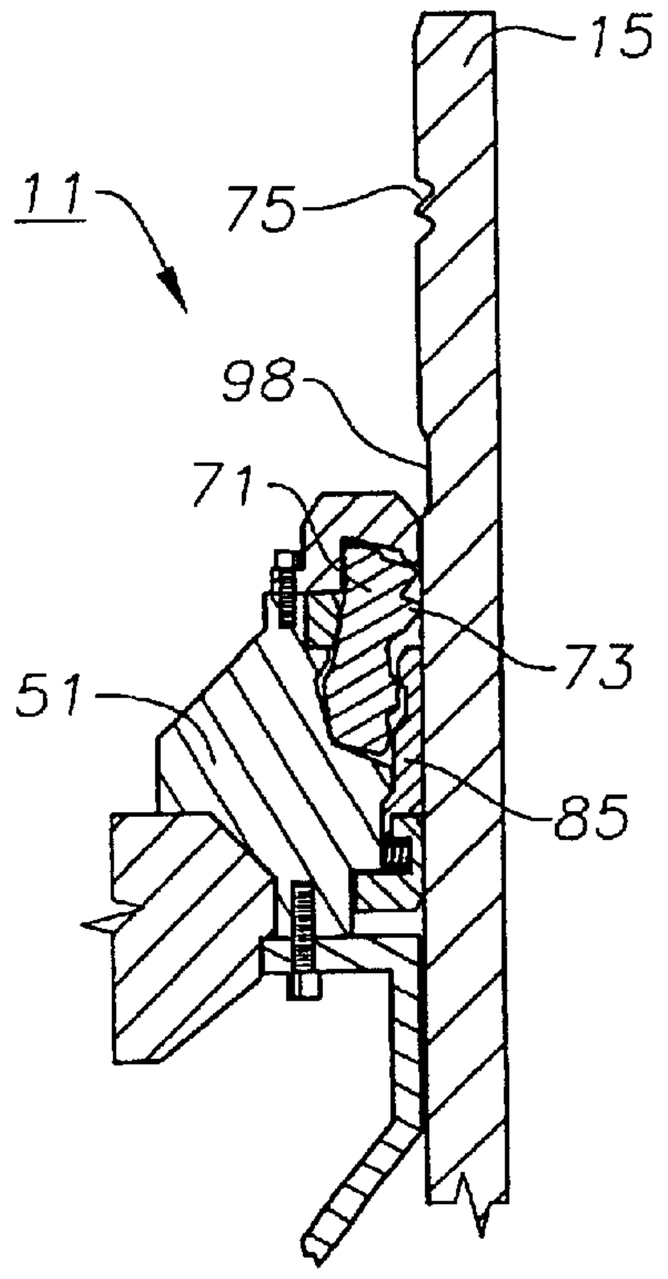


Fig. 4

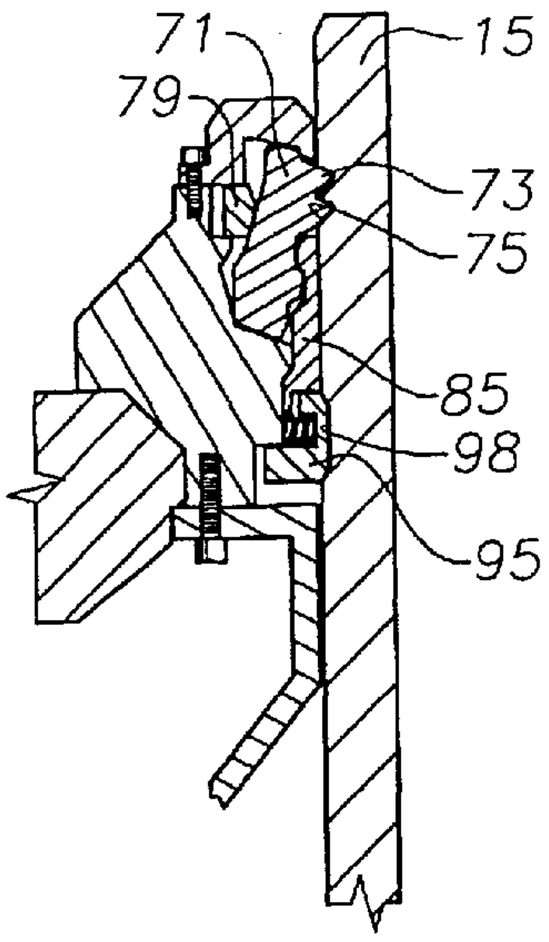


Fig. 5

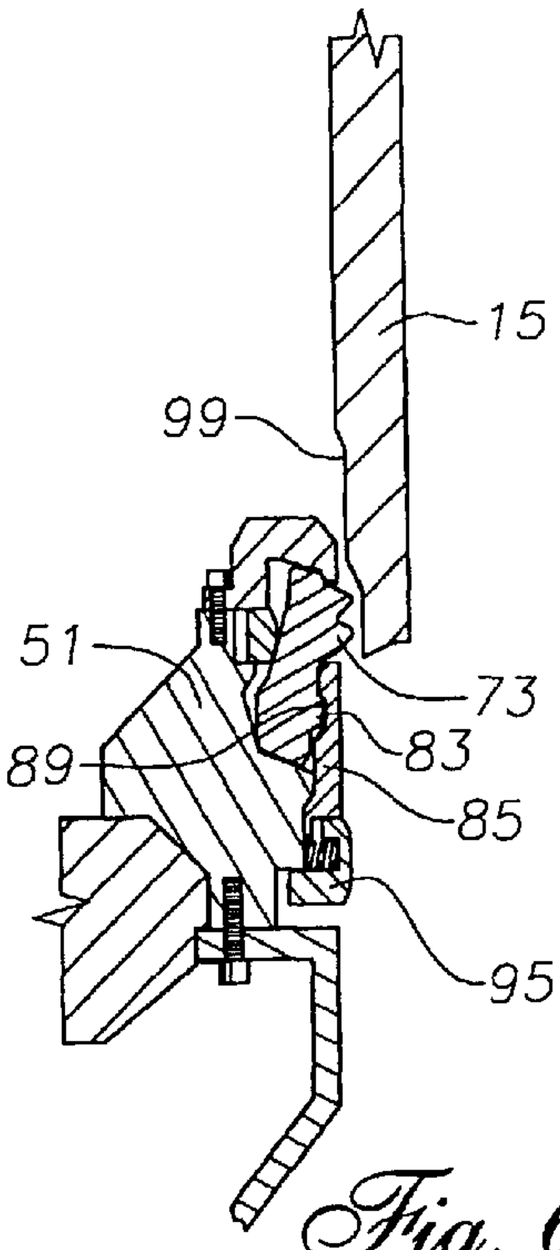


Fig. 6

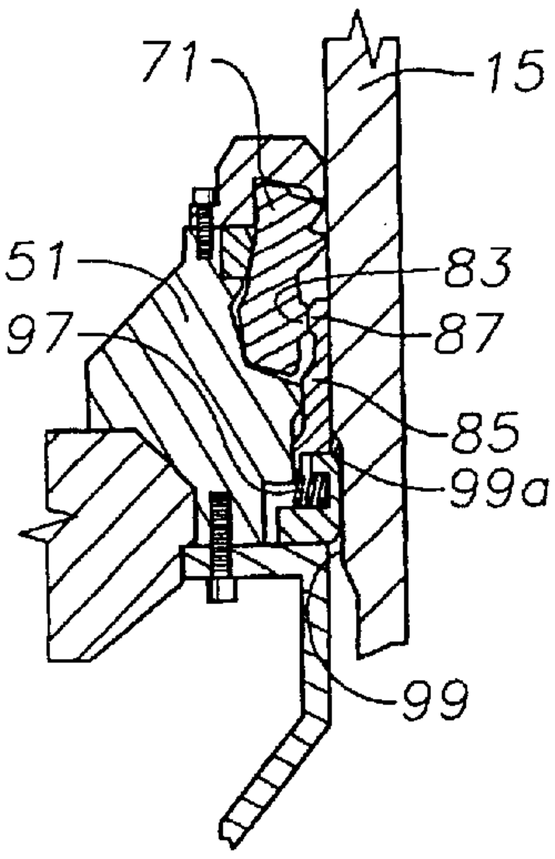


Fig. 7

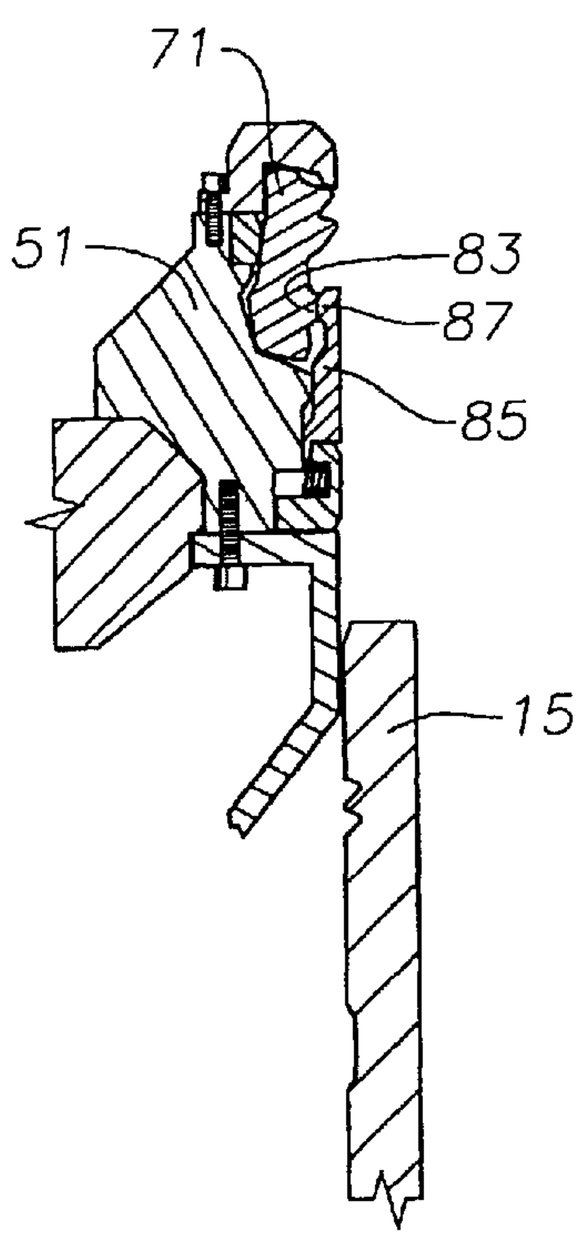


Fig. 8

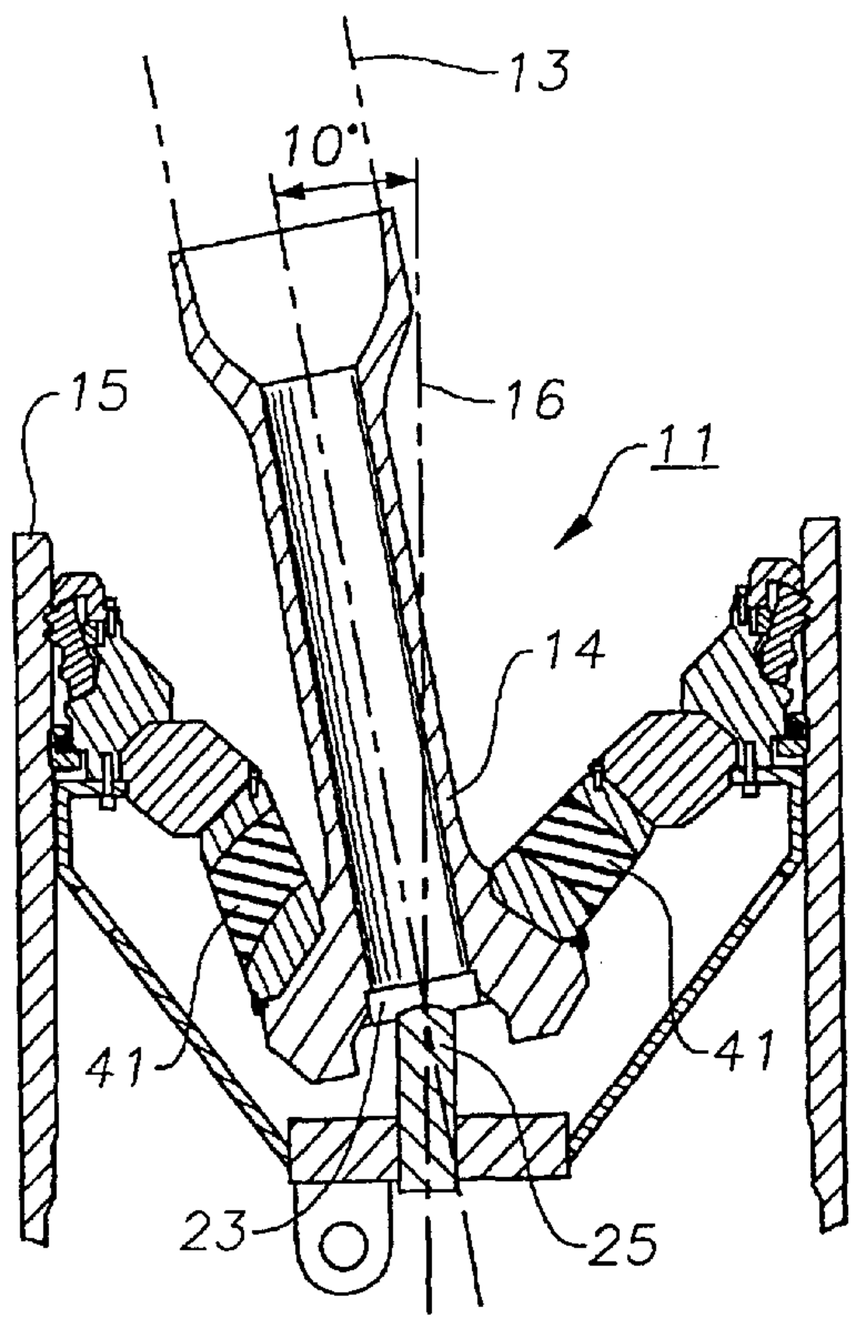


Fig. 9

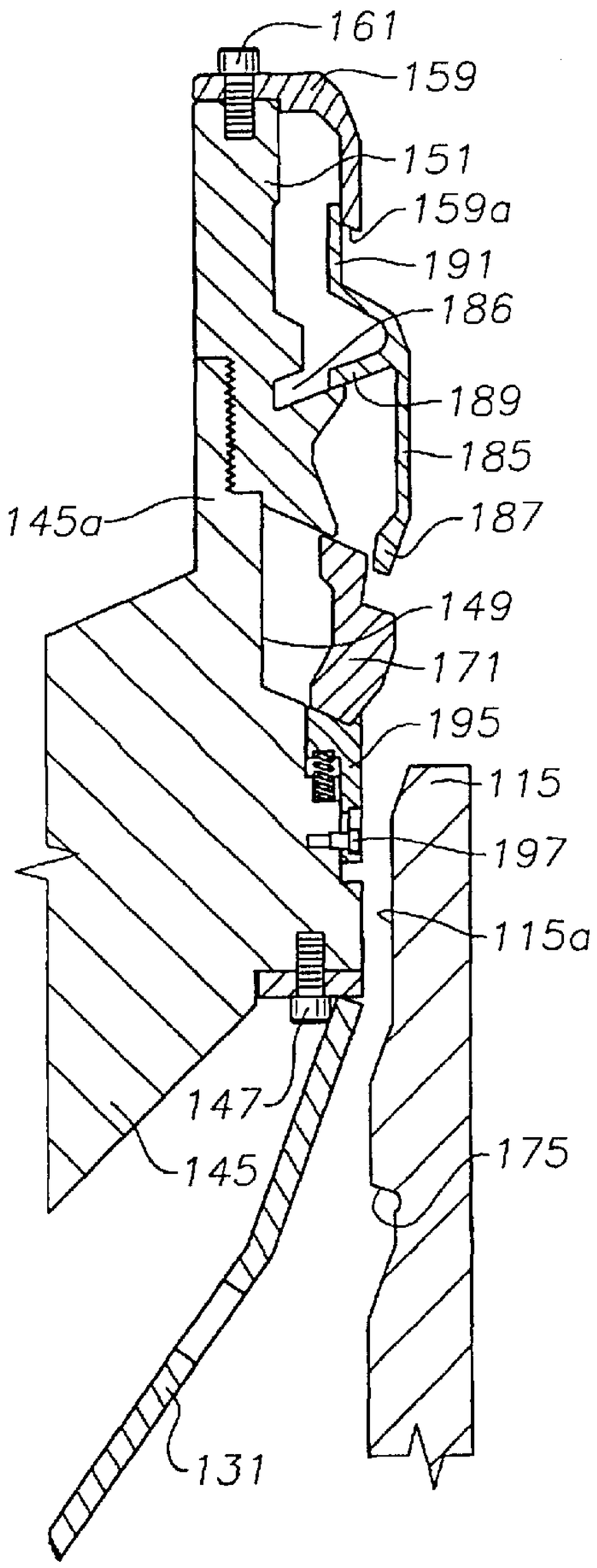


Fig. 10A

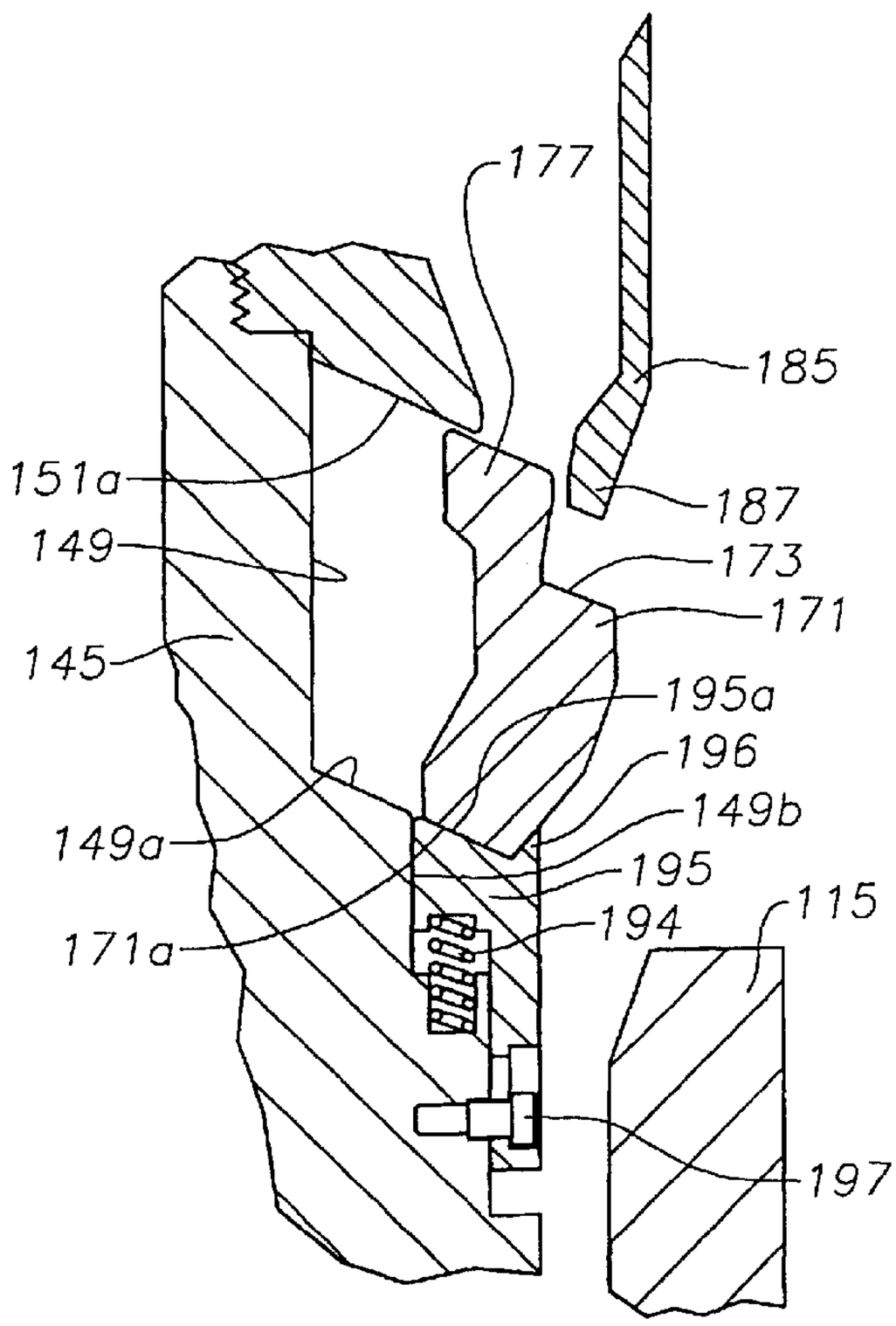


Fig. 10B

Fig. 11

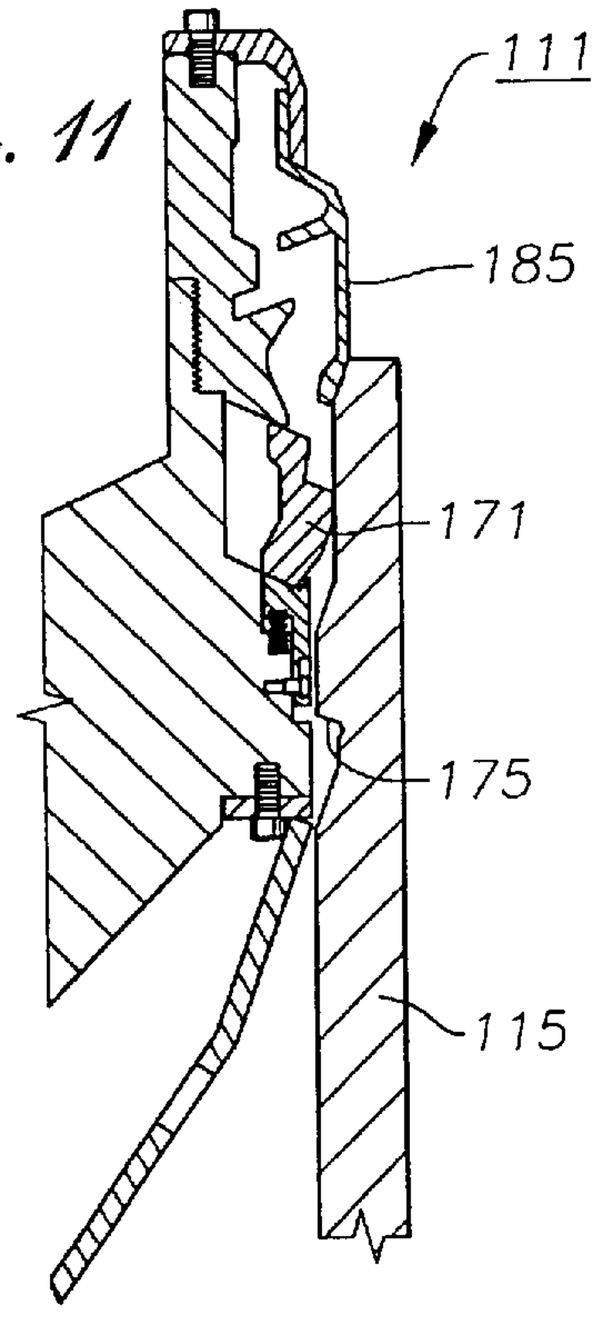
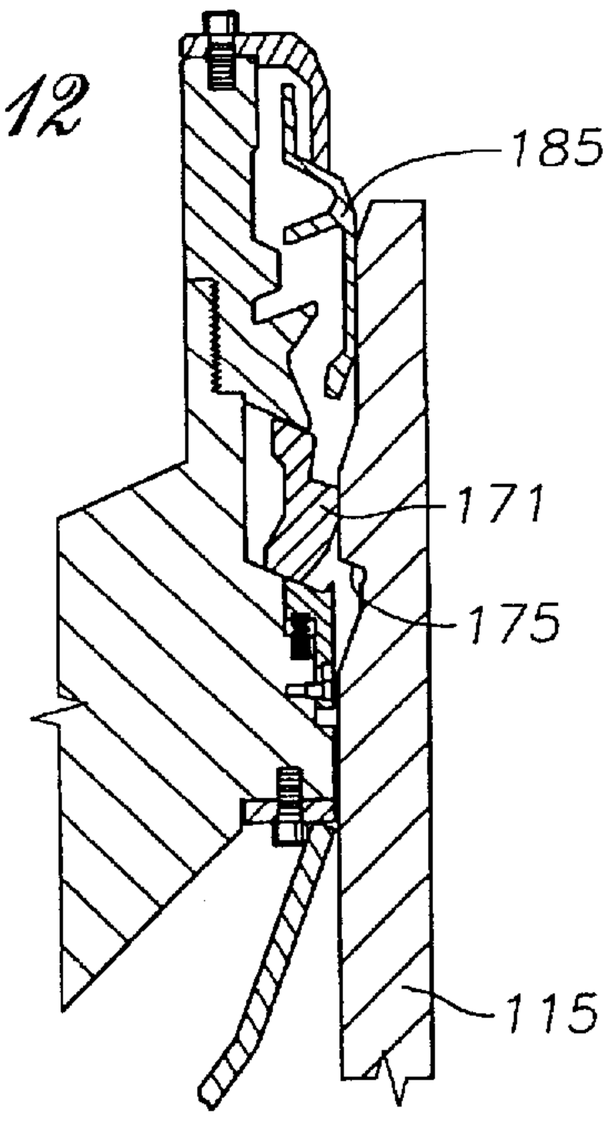


Fig. 12



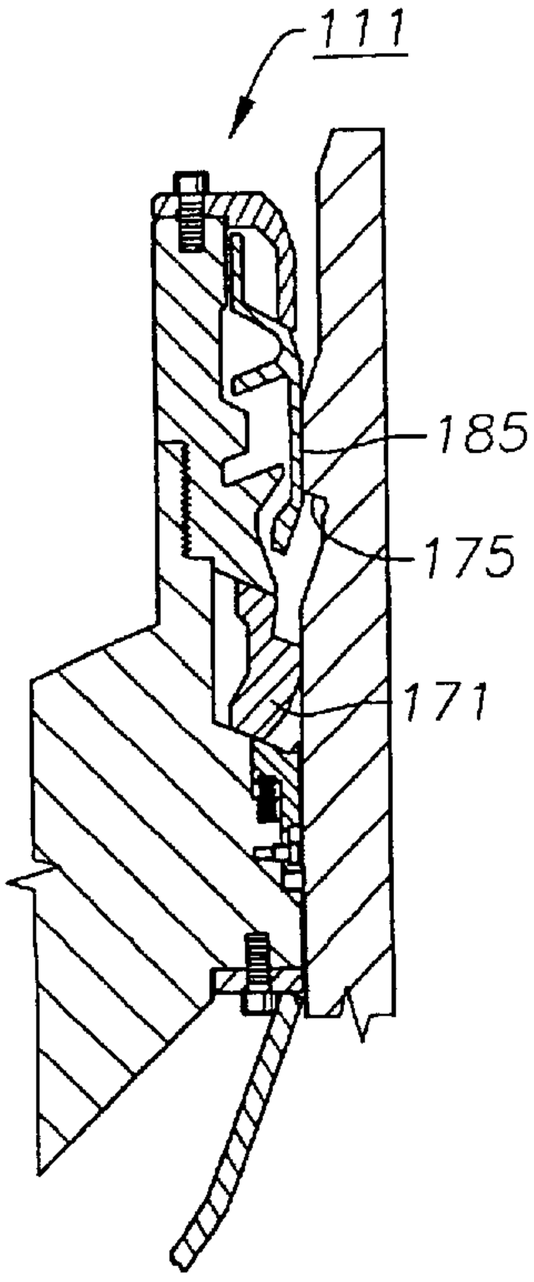


Fig. 13

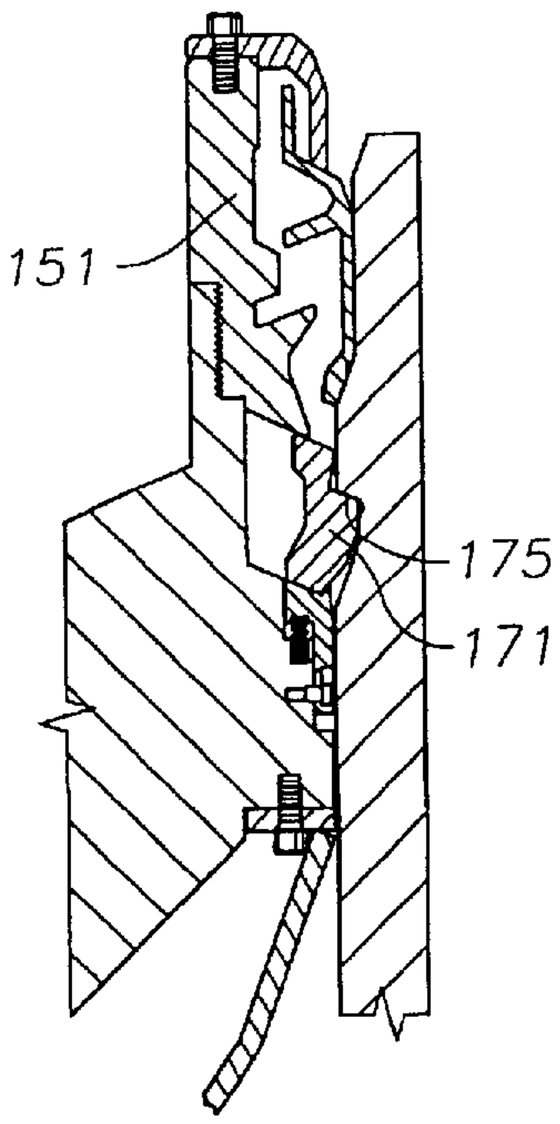


Fig. 14

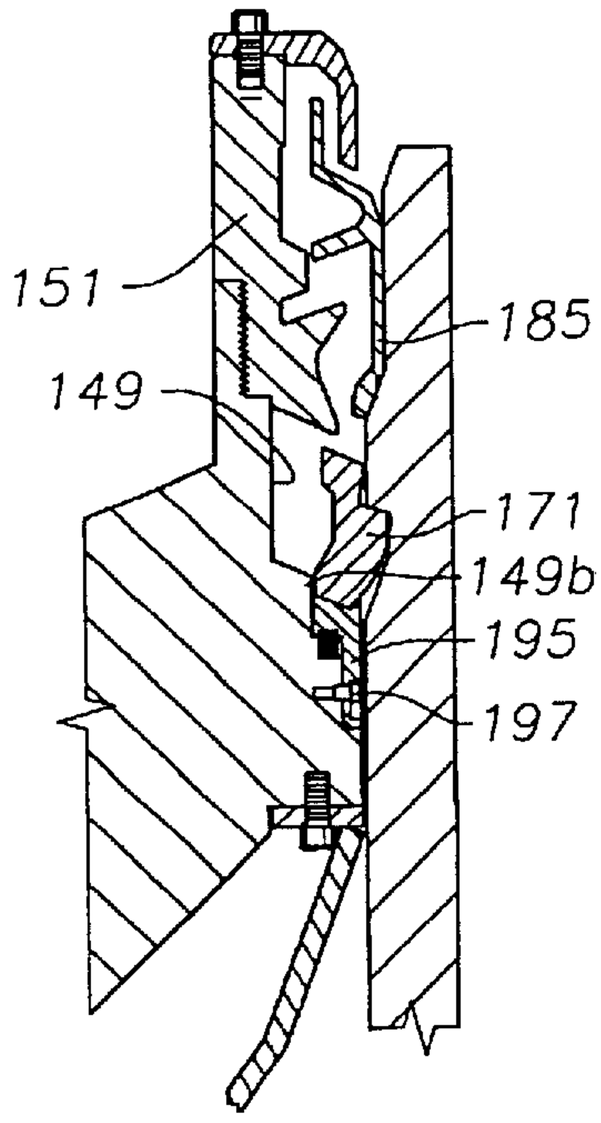


Fig. 15

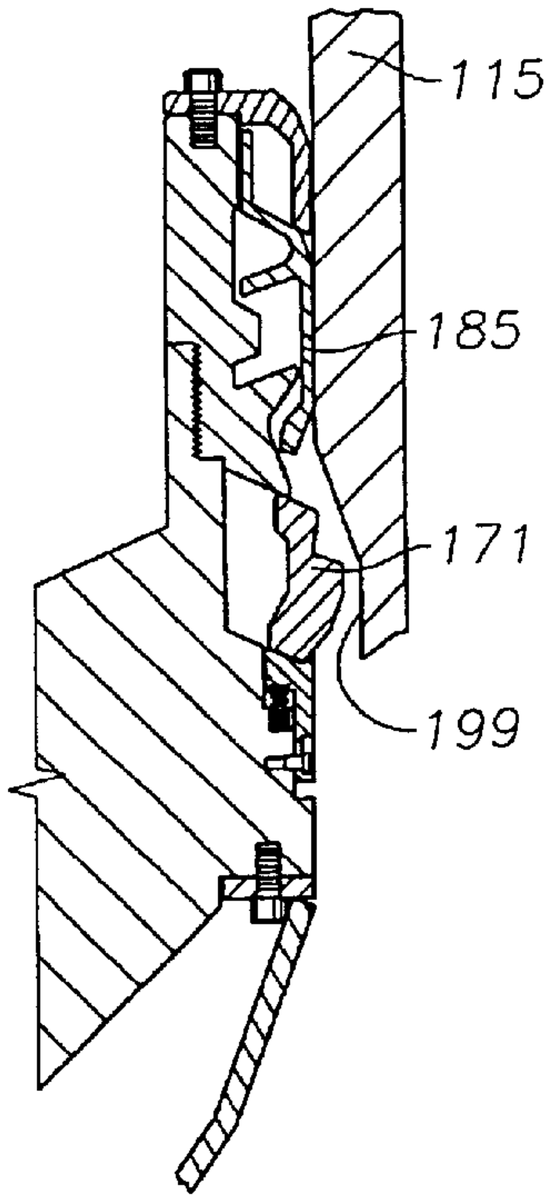


Fig. 16

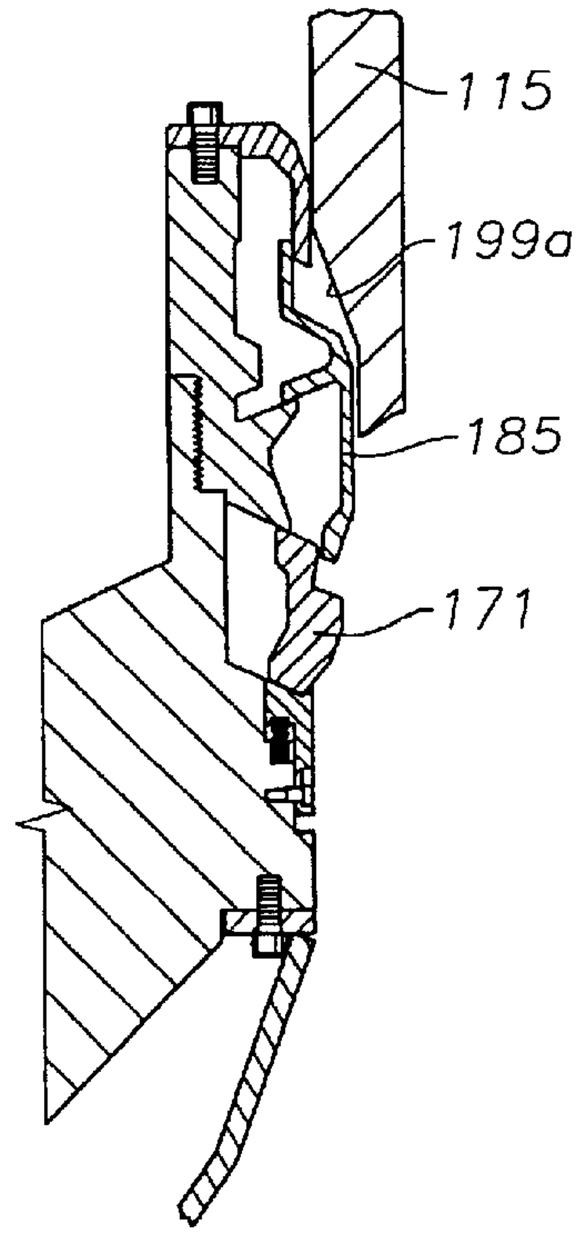


Fig. 17

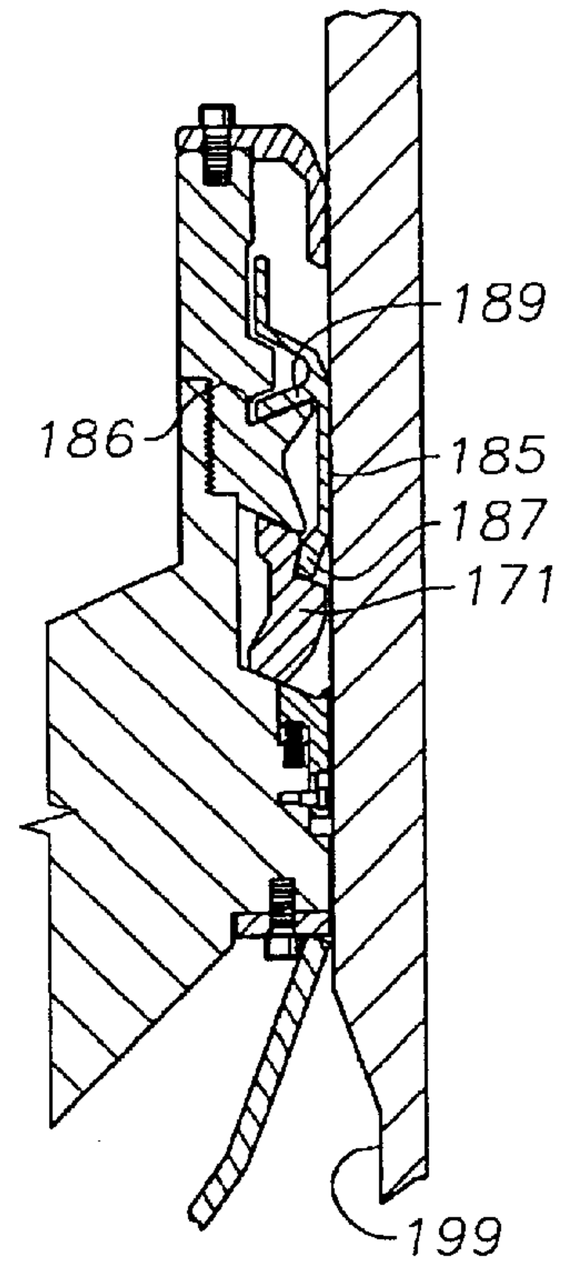


Fig. 18

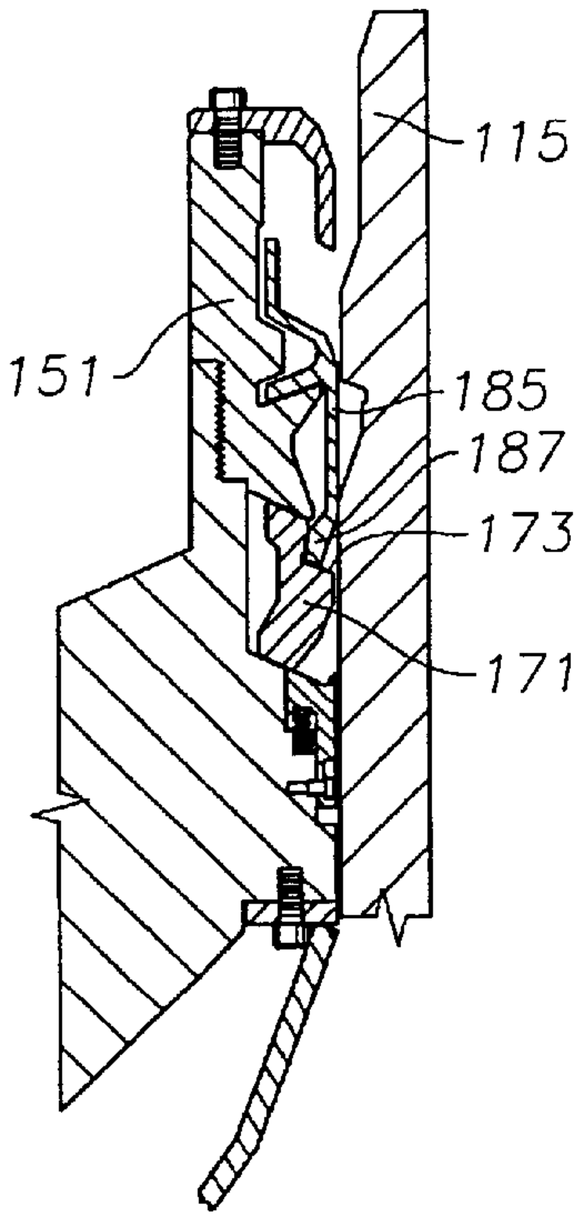


Fig. 19

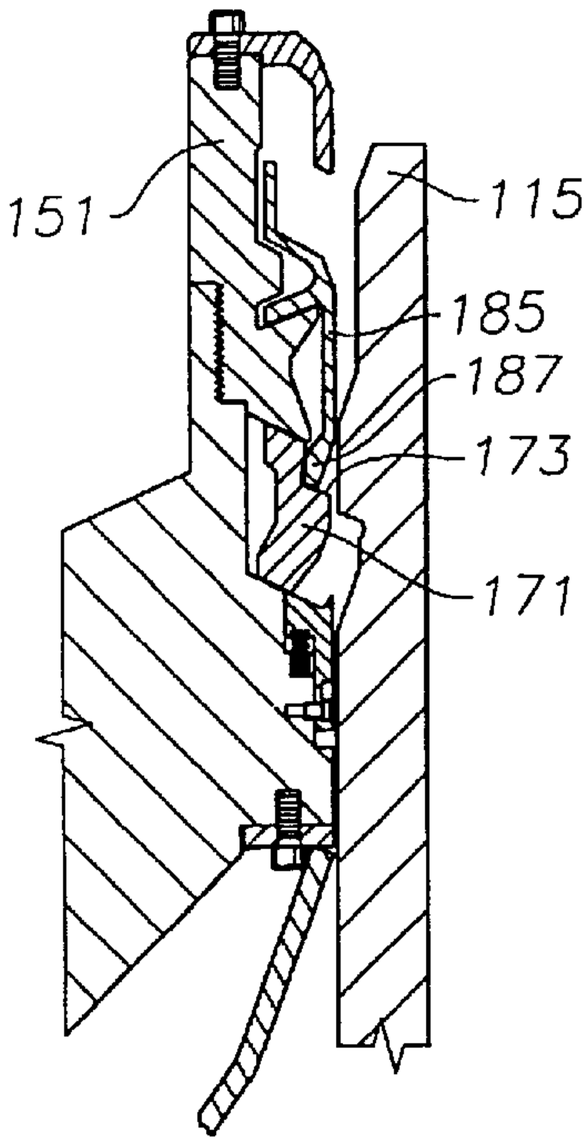


Fig. 20

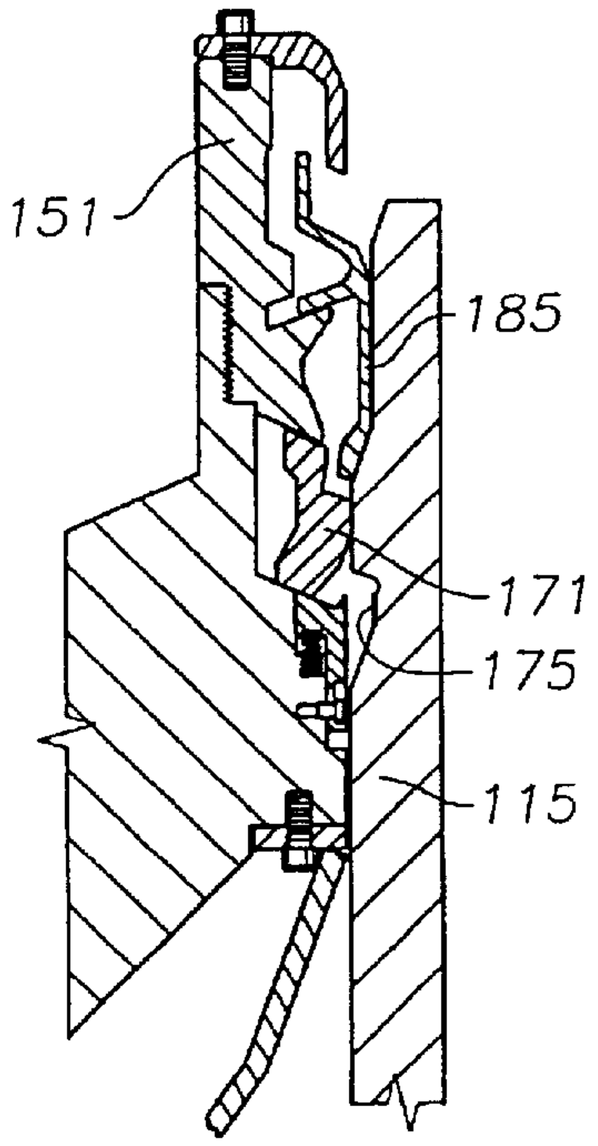


Fig. 21

VERTICAL STAB TENDON BOTTOM CONNECTOR AND METHOD FOR SECURING AND RELEASING THE SAME

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application claims benefit of provisional application 60/027,490, filed Sep. 27, 1996.

TECHNICAL FIELD

This invention relates in general to remotely operable connectors and in particular to an improved vertical entry bottom connector for the tendon of a tension leg platform.

BACKGROUND ART

The bottom connector of a tension leg platform (TLP) tendon connects the lower end of the tendon to an anchor template or pile on the sea floor in order to transfer tendon loads into the anchor structure.

There are two primary types of bottom connectors. Side entry bottom connectors are installed into a tendon bottom receptacle by inserting the connector through a slot in the side of the receptacle. Vertical entry bottom connectors are inserted downward through the top of the receptacle.

Typically, vertical entry bottom connectors are large and expensive to manufacture. Some prior art versions require rotation to engage and disengage the receptacle. Other versions require landing on a shoulder within the receptacle to release the connector. These latter devices have the additional, potential disadvantage of subjecting the tendons of the TLP to compressive forces.

DISCLOSURE OF INVENTION

In this invention, the receptacle on the sea floor has a bore with an inner profile and a recess located below the inner profile. A connector body is secured to the lower end of a tendon and lowered into the receptacle. An outwardly-biased latch is carried by the body and has an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body. The latch also has a retracted position wherein the latch is retracted out of engagement with the inner profile.

A retainer is mounted to the body and has a released position relative to the latch which allows the latch to move to the engaged position. The retainer has a locked position which holds the latch in the retracted position. Lowering the body until the retainer engages the recess causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a sectional side view of a first embodiment of a bottom connector shown engaged to a receptacle for the tendon of a tension leg platform and is constructed in accordance with the invention.

FIGS. **2–8** are half-sectional views of the bottom connector and receptacle of FIG. **1** at various stages of engagement.

FIG. **9** is a sectional side view of the bottom connector, tendon and receptacle of FIG. **1** undergoing deflection.

FIG. **10A** is a half-sectional views of a second embodiment of the bottom connector and receptacle of FIG. **1** prior to engagement.

FIG. **10B** is an enlarged portion of the half-sectional view of FIG. **10A**.

FIGS. **11–21** are half-sectional views of the embodiment of FIG. **10A** at various stages of engagement.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to FIG. **1**, a bottom connector **11** for a tension leg platform tendon **13** is shown. Connector **11** has an inner tubular body **14** which is secured to a lower end of tendon **13**. Connector **11** is provided for anchoring tendon **13** to a cylindrical receptacle **15** located on the sea floor (not shown). Once connector **11** is installed, tendon **13** and body **14** are in tension; no downward-directed force is applied to the assembly. Inner body **14** has a central axis **16** and a hub or flange **17** on a lower end with an upward-facing shoulder **19** on an outer side, and a coaxial bore **21**.

Connector **11** has three substructures: a lower portion which is used to facilitate entry into a bore **18** in receptacle **15**, an intermediate portion which accommodates for extraneous movement of tendon **13**, and an upper portion which interfaces with bore **18** of receptacle **15**.

The lower portion of connector **11** comprises an end plate **23** which is welded to the lower end of inner body **14** over bore **21** perpendicular to axis **16**. End plate **23** has a coaxial, concave recess **24** on a lower side which receives a convex upper end **26** of a pivot member **25**. Pivot member **25** extends upward into engagement with end plate **23** from a bottom plate or brace **27**. End plate **23** is pivotal relative to pivot member **25** as shown in FIG. **9**. A tow eye **29** extends downward from a lower side of bottom plate **27**. The lower end of connector **11** also comprises a rigid guide funnel **31**. Guide funnel **31** has a lower frustoconical portion **33** and an upper cylindrical portion **35**. A lower end of frustoconical portion **33** is welded to bottom plate **27**. Cylindrical portion **35** is concentric with axis **16** and has an outer diameter that is slightly less than the inner diameter of receptacle **15**. The upper end of cylindrical portion **35** is welded to an annular retainer plate **37** which is perpendicular to axis **16**.

The intermediate portion of connector **11** comprises a flexible element **41** which is landed on shoulder **19** of flange **17**. Flexible element **41** extends upward from shoulder **19** and is fastened to tendon **13** with an annular clip **43**. A spacer ring **45** is fastened to an upper end of flexible element **41** with bolts **47**.

Referring to FIG. **2**, the upper portion of connector **11** has an outer body **51** which is fastened to spacer ring **45** and retainer plate **37** with bolts **53**. The lower inside and the upper outside portion of body **51** are generally concave recesses **55**, **57**, with the lower inside portion **55** receiving spacer ring **45**. A retainer cap **59** is fastened to the upper end of body **51** with bolts **61**. Cap **59** has a generally V-shaped groove **63** and a lip **65** along an outer edge.

A latch **71** is located within recess **57** and groove **63**. In the embodiment shown in FIG. **2**, latch **71** comprises a plurality of segmented latches. Each segment of latch **71** is outwardly pivotal about a pivot point on a lower end. Latch **71** has a pair of external teeth or grooves **73** which are designed to mate with an inner profile **75** at the upper end of receptacle **15**. Grooves **73** have outer flanks which are inclined upward. Latch **71** also has a small step or shoulder **77** on an upper end which engages lip **65** in cap **59**. An outwardly-biased split ring spring **79** locates within a recess **81** between cap **59** and body **51**. Spring **79** engages an inner side of latch **71**. A rib **83** extends outward from latch **71** just below grooves **73**.

Latch **71** is retained within bottom connector **11** by an annular blocking sleeve or retainer **85**. Retainer **85** is a solid ring and is axially movable relative to body **51**. Retainer **85** has an inner profile which generally mates with the outer surface of latch **71**, including a lip **87** which lies between lower groove **73** and rib **83**, and an internal groove **89** which engages rib **83**. Retainer **85** also has an upward facing shoulder **91** which mates with a downward facing shoulder **93** on body **51** located just below recess **57**. Retainer **85** is sliclably movable along body **51** from the upper released position shown in FIGS. **1–6**, to the lower locked position shown in FIGS. **7–8**. A lock member **95** is located below and is part of retainer **85** for restricting its movement relative to body **51** and latch **71**. Lock member **95** is an outwardly-biased split ring. An entrapment pin **97** lies between lock member **95** and retainer **85** for maintaining the position of retainer **85**. Pin **97** is spring-biased and releasable from a detent in a lower portion of retainer **85**. Lock member **95** has an outer profile which is designed to mate with an intermediate groove **98** located below inner profile **75** in receptacle **15**. In its expanded position of FIG. **1**, lock member **95** has an outer diameter which is greater than the outer diameter of retainer **85**. Referring back to FIG. **1**, receptacle **15** also has a recess **99** on a lower end.

In operation, connector **11** is secured to tension leg platform tendon **13** and receptacle **15** is anchored to the sea floor. As shown in FIG. **2**, the lower end of connector **11** is lowered into receptacle **15**. If the axes of connector **11** and receptacle **15** are slightly misaligned, frustoconical portion **33** will assist in their proper alignment. Once the axes are aligned, cylindrical portion **35** drops into receptacle **15**. As the upper portion of connector **11** enters receptacle **15**, lock member **95** is collapsed radially inward, with its outer diameter flush with the inner diameter of receptacle **15** (FIG. **3**). Latch **71** is pivoted radially inward, thereby collapsing spring **79** inward. Latch **71** is now in a retracted position.

During its descent, the upward inclined flanks of grooves **73** prevent latch **71** from engaging inner profile **75**. Retainer **85** slides over inner profile **75** and does not engage it since retainer **85** has an axial dimension which is longer than the axial dimension of inner profile **75**. As shown in FIG. **4**, connector **11** continues its descent into receptacle **15**, generally unimpeded. Once grooves **73** are below inner profile **75**, connector **11** is raised upward until latch **71** springs outward under the influence of spring **79** and grooves **73** engage inner profile **75** (FIG. **5**). Once this step occurs, latch **71** is in an engaged position and prevents the upward movement of body **51**. Lock member **95** snaps into intermediate recess **98**, releasably preventing downward movement of connector **11** in receptacle **15**. In this figure, retainer **85** is in a released position relative to latch **71** which allows latch **71** to move to the engaged position.

Referring to FIG. **9**, once connector **11** is anchored into receptacle **15**, it is capable of accommodating a significant amount of pivotal movement by tendon **13**. By pivoting between end plate **23** and spacer plug **25**, and flexing about flexible elements **41**, connector **11** allows tendon **13** to pivot up to ten degrees relative to axis **16**.

To disengage connector **11**, it is once again lowered (FIG. **6**). As described above, the inclined flanks of grooves **73** do not impede the downward motion of connector **11**. The resistance to downward movement by retainer **85** and lock member **95** is overcome with a selected weight applied in a downward direction. The downward motion of connector **11** is stopped when retainer **85** is located in or below recess **99** of receptacle **15** (FIG. **6**). Connector **11** is then lifted upward. When lock member **95** engages recess **99** (FIG. **7**) it engages a downward-facing shoulder **99**a, which causes pin **97** to release from the detent on retainer **85**. Continued upward movement causes body **51** to move upward relative to retainer **85** and lock member **95**. With this motion, lip **87** of retainer **85** is moved onto a radially outer surface of rib **83**, thereby shifting retainer **85** from the released position to a locked position which holds latch **71** in the retracted position. Latch **71** is axially movable relative to retainer **85** while retainer **85** engages recess **99**. Rib **83** engages internal groove **89** when retainer **85** is in the released position (FIGS. **5–6**), and disengages from groove **89** when retainer **85** is in the locked position (FIGS. **7–8**). As shown in FIG. **8**, continued upward movement of body **51** moves latches **71** past inner profile **75**, thereby allowing connector **11** and tendon **13** to be withdrawn from receptacle **15** with latch **71** being held in the retracted position.

A second embodiment of the invention is shown in FIGS. **10**A and **10**B. A bottom connector **111** for a tension leg platform tendon (not shown) is provided for anchoring the tendon to a cylindrical receptacle **115** located on the sea floor (not shown). The tendon is substantially similar to tendon **13** of FIG. **1**. Like connector **11**, connector **111** has lower, intermediate and upper portions.

The lower and intermediate portions of connector **111** are very similar to those of connector **11**. A rigid guide funnel **131** has an outer diameter which is slightly less than the inner diameter of receptacle **115**. The upper end of funnel **131** is fastened to an annular outer body **145** with bolts **147**. Connector **111** also has an inner body (not shown) which attaches to a tendon and preferably mounts to outer body **145** with flex elements.

The upper outside portion of outer body **145** is a generally concave recess **149** with a downward sloping lower surface. An uppermost portion **145**a of outer body **145** extends vertically and is threaded on an outer surface. A generally L-shaped housing **151** is threadingly fastened along its lower, inner surface to uppermost portion **145**a. A retainer cap **159** is fastened to the upper end of housing **151** with bolts **161**. Cap **159** has a generally downward facing U-shape with a lower outer edge **159**a.

A latch **171** is located in recess **149** below an inclined, lower side **151**a of housing **151**. Side **151**a is generally parallel to the lower surface of recess **149**. In the embodiment shown in FIG. **10**B, latch **171** comprises a split ring which is biased in a radially outward direction. Latch **171** is radially movable within recess **149** between an outer position shown in FIG. **10**B and a contracted position shown in FIG. **18**. Latch **171** has an upward-facing shoulder **173** which is designed to mate with an inner profile **175** at the upper end of receptacle **115**. Latch **171** also has neck **177** on an upper end which engages side **151**a.

Latch **171** may be retained within recess **149** in a retracted position by a split ring retainer **185**. Retainer **185** is axially and radially movable relative to housing **151** and latch **171**. Retainer **185** has an outer profile which generally mates with an upper profile **115**a located above inner profile **175** in receptacle **115**. Retainer **185** also has a lip **187** which extends downward toward latch **171**, and an internal rib **189** which extends diagonally downward and inward and engages a slot **186** in housing **151**. Retainer **185** also has an upper vertical portion **191** which engages edge **159**a on cap **159**.

A release spring or lock member **195** is located along an outer edge of outer body **145** below latch **171** for accommodating its movement relative to outer body **145**, housing **151** and retainer **185**. A spring **194** extends between a lower

portion of lock member **195** and outer body **145** for biasing lock member **195** in an upward direction. A positioner pin **197** extends between lock member **195** and outer body **145** for maintaining the position of lock member **195**. The head of pin **197** locates in an elongated slot in lock member **195** to allow limited axial movement of lock member **195** relative to outer body **145**. Lock member **195** has an upper surface **195**a which is designed to engage the lower surface **171**a of latch **171** and is flush with the lower surface **149**a of recess **149** while in the upper position of FIGS. **10–14**. Surface **195**a and surface **171**a have the same radial thickness and are inclined at the same angle as surface **149**a. Lock member **195** has an upper, outer lip **196** for limiting the outward movement of latch **171**. Like receptacle **15**, receptacle **115** also has a recess **199** on a lower end (FIGS. **16–18**).

Connector **111** operates very similarly to connector **11**. As shown in FIG. **11**, connector **111** is lowered into receptacle **115**. As the upper portion of connector **111** enters receptacle **115**, latch **171** and retainer **185** are collapsed radially inward until they have an outer diameter that is flush with the inner diameter of receptacle **115** (FIG. **12**). Latch **171** is shown in a retracted position.

During its descent, the outer profile of latch **171** prevents it from locking into inner profile **175**. Retainer **185** slides over inner profile **175** (FIG. **13**) and does not engage it since retainer **185** has an axial dimension which is longer than the axial dimension of inner profile **175**. Retainer **185** is compressed axially upward and radially inward during the descent. As shown in FIG. **13**, connector **111** continues its descent into receptacle **115**, generally unimpeded. Once latch **171** is below inner profile **175**, the tendon and connector **111** are raised upward until latch **171** springs outward and engages inner profile **175** (FIG. **14**). Once this step occurs, latch **171** is in an engaged position and prevents the upward movement of housing **151**. Referring to FIG. **15**, additional upward pull is then applied to the tendon which moves body **145** upward slightly relative to lock member **195**. An outer edge **149**b of recess **149** abuts an inner lower edge of latch **171** to prevent it from moving inward. Housing **151** moves upward slightly relative to lock member **195**, compressing spring **194**. Lock member **195** releasably prevents radially inward movement of latch **171** and, thus, downward movement of connector **111**. In this figure, retainer **185** is in a released position relative to latch **171** which allows latch **171** to move to the engaged position.

To disengage connector **111**, it is once again lowered (FIG. **16**). Latch **171** and retainer **185** do not impede the downward motion of connector **111**. The resistance to downward movement by these components is overcome with a selected downward weight on the tendon. After being compressed upward and radially inward during the descent, retainer **185** springs downward and outward into recess **199** at the bottom of receptacle **115**. The diagonal portion of retainer **185** located below vertical portion **191** slides along edge **159**a to assist in this propagation. The downward motion of connector **111** is stopped when retainer **185** is located in or below recess **199** of receptacle **115** (FIG. **17**). Latch **171** is axially and radially slidable relative to retainer **185** while retainer **185** engages recess **199**. Connector **111** is then lifted upward. When retainer **185** engages recess **199** (FIG. **17**), it springs outward relative to housing **151** and latch **171**. Recess **199** has a downward-facing shoulder **199**a which contacts retainer **185** as housing **151** is lifted. With this motion, lip **187** of retainer **185** is moved onto a radially outer surface of shoulder **173** on latch **171**, thereby shifting retainer **185** from the released position to a locked position which holds latch **171** in the retracted position (FIG. **18**). Rib **189** is simultaneously placed within slot **186** to prevent further axial movement of retainer **185**. Lip **187** does not engage shoulder **173** when retainer **185** is in the released position (FIGS. **10–17**), and engages shoulder **173** when retainer **185** is in the locked position (FIGS. **18–20**). Lowering housing **151** until retainer **185** engages recess **199** causes retainer **185** to assume the locked position, thereby allowing connector **111** and the tendon to be withdrawn from receptacle **115** with latch **171** being held in the retracted position (FIGS. **19–21**). Like connector **11**, connector **111** is similarly capable of accommodating up to ten degrees of deflection by the tendon relative to its vertical axis.

The invention has several advantages. This vertical entry bottom connector does not require rotation or bottoming-out on a shoulder within the receptacle to disengage it. The invention employs a compact design, has very few moving parts and has a pivotal lower end which allows limited deflection of the connector inner body relative to the receptacle.

While the invention has been shown or described in only two of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of the invention.

We claim:

1. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer slidably mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position.

2. The bottom connector of claim **1** wherein the body is axially movable relative to the retainer, the retainer having an upper portion which engages the latch while the retainer is in the locked position.

3. The bottom connector of claim **2**, further comprising an internal groove in the retainer; and wherein

the latch has a rib which engages the internal groove in the retainer when the retainer is in the released position, and is disengaged from the groove in the retainer when the retainer is in the locked position.

4. The bottom connector of claim **1** wherein the latch is a split ring.

5. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position; and

wherein the latch is axially movable relative to the retainer while the retainer engages the recess, causing the retainer to assume the locked position.

6. The bottom connector of claim **5** wherein the latch and the body move upward relative to the retainer while the retainer engages the recess to move from the released position to the locked position.

7. The bottom connector of claim **5** wherein the retainer has a portion located radially outward of and engaging an outer surface of the latch while the retainer is in the locked position.

8. The bottom connector of claim **5**, further comprising a spring mounted to the body for biasing the latch outward; and wherein

the latch comprises a plurality of segments, each of which is outwardly pivotal about a pivot point on a lower end.

9. The bottom connector of claim **5**, further comprising a split ring mounted to the body for biasing the latch outward; and wherein

the latch comprises a plurality of segments, each of which is outwardly pivotal about a pivot point on a lower end.

10. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position; and wherein the body comprises:

an inner body portion which is adapted to be secured to the lower end of the tendon;

an annular outer body portion surrounding the inner body portion; and

a flexible element located between the inner body portion and the outer body portion for accommodating a limited amount of pivotal movement between the inner and the outer bodies.

11. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position; and

wherein the retainer is mounted to the body for limited axial movement relative to the body; and wherein

the recess has a downward-facing shoulder which contacts the retainer as the body is lifted, moving the body upward relative to the retainer.

12. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position;

an intermediate groove in the receptacle between the inner profile and the recess; and

a lock member on a lower part of the retainer, the lock member engaging the intermediate groove in the receptacle when the latch engages the inner profile to releasably prevent downward movement of the body in the receptacle.

13. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position; and

wherein the body has a downward-inclined shoulder and the latch is slidably movable along the inclined shoulder.

14. The bottom connector of claim **13**, further comprising a lock member mounted to the body for limited axial movement relative to the body, the lock member having an upper side that is flush with the inclined shoulder while in an upper position, the upper side of the lock member being in engagement with a lower side of the latch, wherein an upward poll on the tendon while the latch is in engagement with the inner profile causes the body to move slightly upward relative to the lock member and the latch to hold the latch outward in the engaged position.

15. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position; and

wherein the retainer is a split ring located above the latch, the split ring having a lower portion which extends downward over the latch when in the locked position.

16. The bottom connector of claim **15** wherein the retainer is a split ring located above the latch, the split ring having a lower portion which extends downward over the latch when in the locked position, and a rib which extends into a slot in the body for holding the split ring in the locked position, the rib being spaced above the slot and the lower portion being spaced above the latch in the released position.

17. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer sleeve mounted to the body which is axially movable relative to the sleeve, the sleeve having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position, the latch moving upward relative to the sleeve as the sleeve moves from the released position to the locked position; and

wherein lowering the body until the sleeve engages the recess and then lifting the body causes the sleeve to assume the locked position.

18. The bottom connector of claim **17** wherein the sleeve has a portion located outward of and engaging an outer surface of the latch while the sleeve is in the locked position.

19. The bottom connector of claim **17**, further comprising a spring for biasing the latch outward; and wherein

the latch comprises a plurality of segments, each of which is outwardly pivotal about a pivot point on a lower end.

20. The bottom connector of claim **17**, further comprising an internal groove in the sleeve; and wherein

the latch has a rib which engages the internal groove in the sleeve when the sleeve is in the released position, and is disengaged from the groove in the sleeve when the sleeve is in the locked position.

21. The bottom connector of claim **17** wherein the sleeve has a lock member portion mounted to the body for limited axial movement relative to the body; and wherein

the recess has a downward-facing shoulder which is contacted by the lock member portion of the sleeve to cause the body to move upward relative to the sleeve while the body is lifted.

22. The bottom connector of claim **17**, further comprising:

an intermediate groove in the receptacle between the inner profile and the recess; and

a lock member on a lower part of the sleeve, the lock member engaging the intermediate groove in the receptacle when the latch engages the inner profile to releasably prevent downward movement of the body in the receptacle.

23. The bottom connector of claim **17** wherein the body has a downward-inclined shoulder and the latch is a split ring which is slidably movable along the inclined shoulder.

24. The bottom connector of claim **17**, further comprising a split ring lock member mounted to the body in engagement with the sleeve for releasably holding the sleeve to the body for axial movement therewith, the lock member being engagable with the recess, the body being movable axially relative to the lock member, wherein an upward pull on the tendon while the lock member is engaging the recess causes the latch and the body move upward relative to the sleeve to cause the sleeve to hold the latch in the retracted position.

25. The bottom connector of claim **17** wherein the sleeve comprises a split ring located above the latch, the split ring having a lower portion which extends downward over the latch when in the locked position, and a rib which extends into a slot in the body for holding the split ring in the locked position, the rib being spaced above the slot and the lower portion being spaced above the latch in the releasably position.

26. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and lowered with the tendon into the receptacle;

a plurality of latch segments, each of which is outwardly pivotal about a pivot point on a lower end, the latch segments being carried by the body and having an outer profile which engages the inner profile of the receptacle in an outward engaged position to limit upward movement of the body, and an inward retracted position wherein the latch segments are retracted out of engagement with the inner profile;

a split ring mounted to the body for biasing the latch segments in an outward direction;

an axially movable retainer sleeve mounted to the body and having a released position relative to the latch segments which allows the latch segments to move outward to the engaged position, and a locked position wherein an upper portion holds the latch segments in the retracted position; and wherein

lowering the body until the sleeve engages the recess and then lifting upward causes the latch segments to move upward relative to the sleeve, placing the sleeve in the locked position.

27. The bottom connector of claim **26**, further comprising:

an internal groove in the sleeve; and wherein

each of the latch segments has a rib which engages the internal groove in the sleeve when the sleeve is in the released position, and is disengaged from the internal groove in the sleeve when the sleeve is in the locked position.

28. The bottom connector of claim **26** wherein the sleeve has a lock member portion mounted to the body for limited axial movement relative to the body; and wherein

the recess has a downward-facing shoulder which contacts the lock member portion of the sleeve as the body is lifted for moving the body upward relative to the lock member and the sleeve.

29. The bottom connector of claim **26**, further comprising an intermediate groove in the receptacle between the inner profile and the recess; and

a split ring lock member on a lower part of the sleeve, the lock member engaging the intermediate groove in the receptacle when the latch segments engage the inner profile to releasably prevent downward movement of the body in the receptacle.

30. A bottom connector for a tension leg platform tendon, comprising:

a receptacle adapted to be mounted on the sea floor, the receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be secured to the lower end of the tendon and having a slot and a downward-inclined shoulder;

an outwardly-biased, split ring latch carried by the body on the shoulder and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a split ring retainer mounted to the body above the latch for axial movement relative to the body and the latch, the retainer having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position wherein a lower portion of the split ring extends downward over the latch to hold the latch in the retracted position;

a rib on an inner portion of the retainer which extends into the slot in the body for holding the split ring in the locked position, the rib being in disengagement with the slot and above the slot while the retainer is in the released position; and wherein

lowering the body until the retainer engages the recess and then lifting the body upward causes the retainer to assume the locked position.

31. The bottom connector of claim **30**, further comprising a lock member mounted to the body for limited axial movement relative to the body, the lock member having an upper side flush with the inclined shoulder while in an upper position, the upper side of the lock member being in engagement with a lower side of the latch, wherein an upward pull on the tendon while the latch is in engagement with the inner profile causes the body to move slightly upward relative to the lock member and the latch to hold the latch in the engaged position.

32. A method for securing and releasing a bottom connector on a tension leg platform tendon, comprising:

(a) providing a receptacle on the sea floor with a bore having an inner profile and a recess located below the inner profile;

(b) securing a body to a lower end of the tendon, the body having a retainer mounted thereto and an outwardly-biased latch with an outer profile for engaging the inner profile of the receptacle, the retainer being in a released position relative to the latch which allows the latch to move to an engaged position;

(c) lowering the body into the receptacle and engaging the latch with the inner profile of the receptacle to limit upward movement of the body; and then to disengage the bottom connector,

(d) lowering the body until the retainer is located in the recess in the receptacle; and then

(e) lifting the body out of the receptacle, causing the retainer to move to a locked position which holds the latch in a retracted position out of engagement with the inner profile.

33. The method of claim **32** wherein step (c) comprises lowering the latch below the inner profile, then raising the body and the latch until the latch engages the inner profile.

34. The method of claim **32** wherein step (e) comprises moving a portion of the retainer into engagement with an outer surface of the latch while the retainer is in the locked position.

35. A method for securing and releasing a bottom connector on a tension leg platform tendon, comprising:

(a) providing a receptacle on the sea floor with a bore having an inner profile and a recess located below the inner profile;

(b) securing a body to a lower end of the tendon, the body having a retainer and an outwardly-biased latch with an outer profile for engaging the inner profile of the receptacle, the retainer being in a released position relative to the latch which allows the latch to move to an engaged position;

(c) lowering the body into the receptacle and engaging the latch with the inner profile of the receptacle to limit upward movement of the body; and then to disengage the bottom connector.

(d) lowering the body until the retainer is located in the recess in the receptacle; and then

(e) lifting the body out of the receptacle, causing the retainer to move to a locked position which holds the latch in a retracted position out of engagement with the inner profile; and wherein step (e) comprises

moving the body and the latch upward relative to the retainer while the retainer is in the recess.

36. The method of claim **35**, further comprising:

retaining the body against downward movement up to a selected downward force after step (c) and before step (d); and wherein step (d) comprises

applying a downward force on the body which is greater than said selected downward force.

37. A connector comprising:

a receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer slidably mounted to the body and having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position; and

wherein lowering the body until the retainer engages the recess and then lifting the body causes the retainer to assume the locked position, thereby allowing the body to be withdrawn from the receptacle with the latch being held in the retracted position.

38. The connector of claim 37 wherein the body is axially movable relative to the retainer, the retainer having an upper portion which engages the latch while the retainer is in the locked position.

39. The connector of claim 37, further comprising an internal groove in the retainer; and wherein

the latch has a rib which engages the internal groove in the retainer when the retainer is in the released position, and is disengaged from the groove in the retainer when the retainer is in the locked position.

40. The connector of claim 37 wherein the latch is a split ring.

41. A connector comprising:

a receptacle having a bore with an inner profile and a recess located below the inner profile;

a body adapted to be lowered into the receptacle;

an outwardly-biased latch carried by the body and having an outer profile which engages the inner profile of the receptacle in an engaged position to limit upward movement of the body, and a retracted position wherein the latch is retracted out of engagement with the inner profile;

a retainer sleeve mounted to the body which is axially movable relative to the sleeve, the sleeve having a released position relative to the latch which allows the latch to move to the engaged position, and a locked position which holds the latch in the retracted position, the latch moving upward relative to the sleeve as the sleeve moves from the released position to the locked position; and

wherein lowering the body until the sleeve engages the recess and then lifting the body causes the sleeve to assume the locked position.

42. The connector of claim 41 wherein the sleeve has a portion located outward of and engaging an outer surface of the latch while the sleeve is in the locked position.

43. The connector of claim 41, further comprising a spring for biasing the latch outward; and wherein

the latch comprises a plurality of segments, each of which is outwardly pivotal about a pivot point on a lower end.

44. The connector of claim 41, further comprising:

an internal groove in the sleeve; and wherein

the latch has a rib which engages the internal groove in the sleeve when the sleeve is in the released position, and is disengaged from the groove in the sleeve when the sleeve is in the locked position.

45. The connector of claim 41, wherein the sleeve has a lock member portion mounted to the body for limited axial movement relative to the body; and wherein

the recess has a downward-facing shoulder which is contacted by the lock member portion of the sleeve to cause the body to move upward relative to the sleeve while the body is lifted.

46. The connector of claim 41, further comprising:

an intermediate groove in the receptacle between the inner profile and the recess; and

a lock member on a lower part of the sleeve, the lock member engaging the intermediate groove in the receptacle when the latch engages the inner profile to releasably prevent downward movement of the body in the receptacle.

47. The connector of claim 41 wherein the body has a downward-inclined shoulder and the latch is a split ring which is slidably movable along the inclined shoulder.

48. The connector of claim 41, further comprising a split ring lock member mounted to the body in engagement with the sleeve for releasably holding the sleeve to the body for axial movement therewith, the lock member being engagable with the recess, the body being movable axially relative to the lock member, wherein an upward pull on the body while the lock member is engaging the recess causes the latch and the body move upward relative to the sleeve to cause the sleeve to hold the latch in the retracted position.

49. The connector of claim 41 wherein the sleeve comprises a split ring located above the latch, the split ring having a lower portion which extends downward over the latch when in the locked position, and a rib which extends into a slot in the body for holding the split ring in the locked position, the rib being spaced above the slot and the lower portion being spaced above the latch in the released position.

50. A method for securing and releasing a connector comprising:

(a) providing a receptacle on the sea floor with a bore having an inner profile and a recess located below the inner profile;

(b) providing a body having a retainer mounted thereto and an outwardly-biased latch with an outer profile for engaging the inner profile of the receptacle, the retainer being in a released position relative to the latch which allows the latch to move to an engaged position;

(c) *lowering the body into the receptacle and engaging the latch with the inner profile of the receptacle to limit upward movement of the body, and then to disengage the connector;*

(d) *lowering the body until the retainer is located in the recess in the receptacle; and then*

(e) *lifting the body out of the receptacle, causing the retainer to move to a locked position which holds the latch in a retracted position out of engagement with the inner profile.*

51. The method of claim 50 wherein step (c) comprises lowering the latch below the inner profile, then raising the body and the latch until the latch engages the inner profile.

52. The method of claim 50 wherein step (e) comprises moving a portion of the retainer into engagement with an outer surface of the latch while the retainer is in the locked position.

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