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Cannon

[11] **3,841,105**

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[54] **METHOD AND APPARATUS FOR ANCHORING UNDERWATER PIPELINES**

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[52] **U.S. Cl.**..... **61/72.3,** 61/53.5, 52/157

[51] **Int. Cl.**..... **F16l 1/00,** E02d 5/80

[58] **Field of Search**..... 61/72.3, 72.1, 72.4; 52/157, 155; 114/206

[56] **References Cited**

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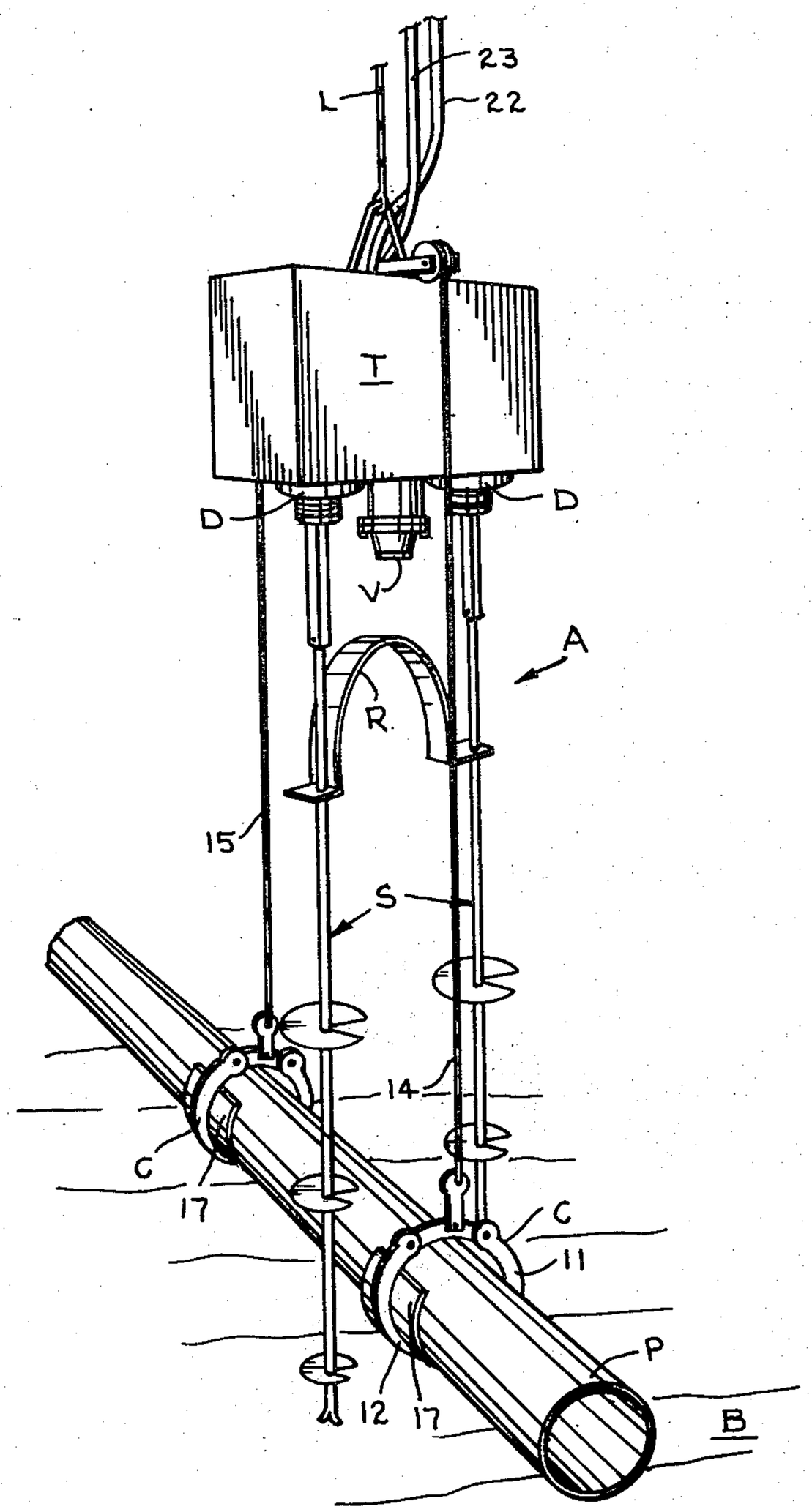
Attorney, Agent, or Firm—Pravel & Wilson

[57] **ABSTRACT**

A method and apparatus for installing bottom anchors for anchoring a pipeline on or under a water bottom. Such apparatus includes means for attaching the anchor driving mechanism to the pipe for exerting a downward force on the anchor drive mechanism while the anchors are being driven into the bottom. The present invention also includes means on the anchors for cutting through hard surface formations such as coral or the like.

7 Claims, 7 Drawing Figures



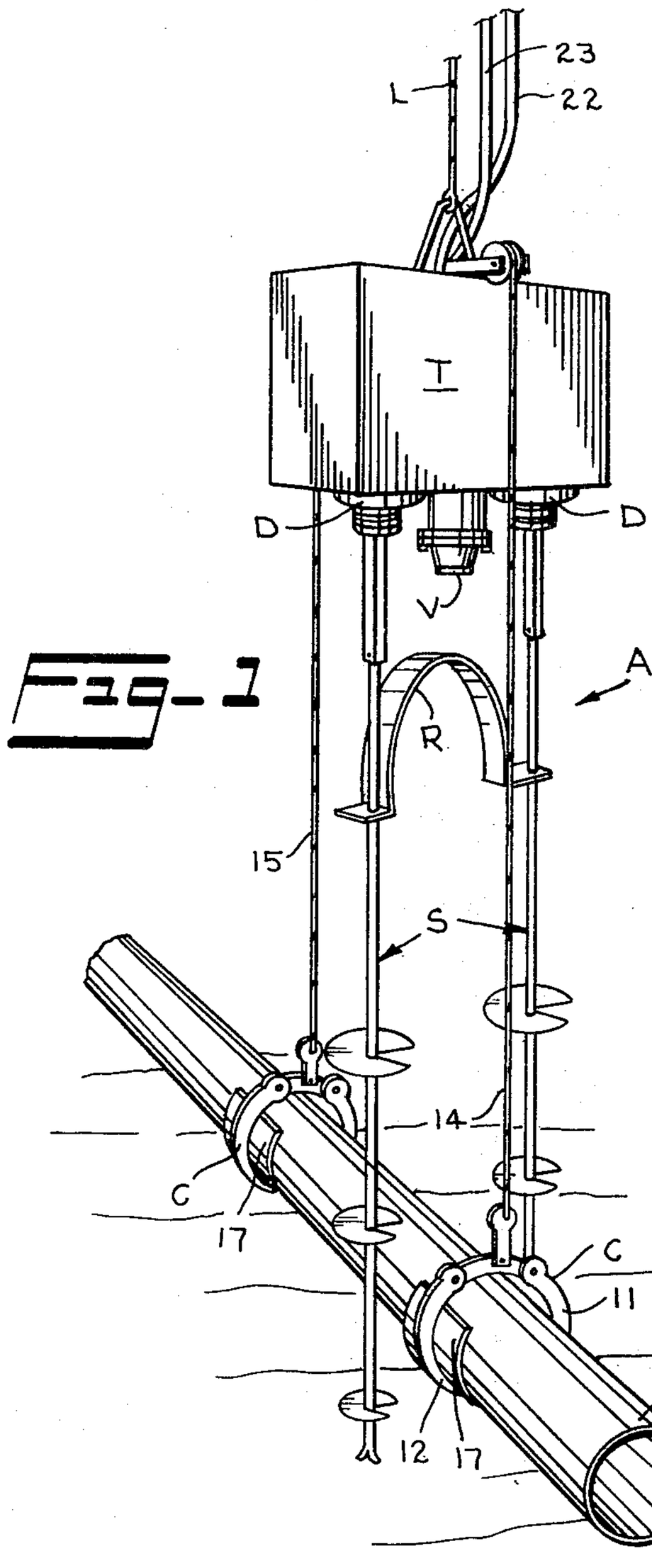


Fig-1

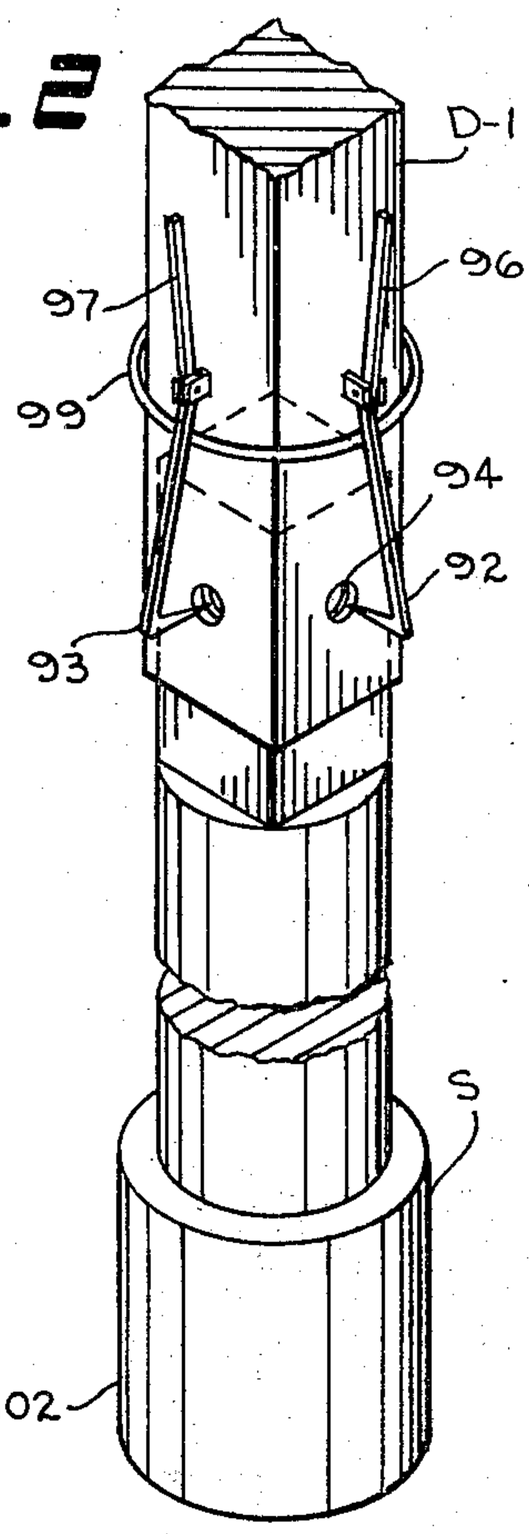


Fig-2

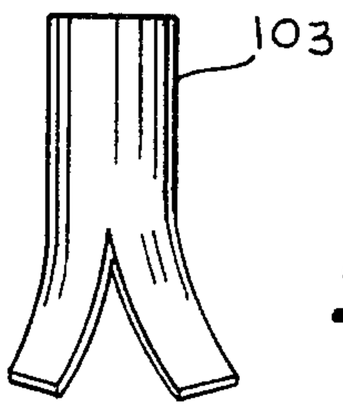


Fig-3

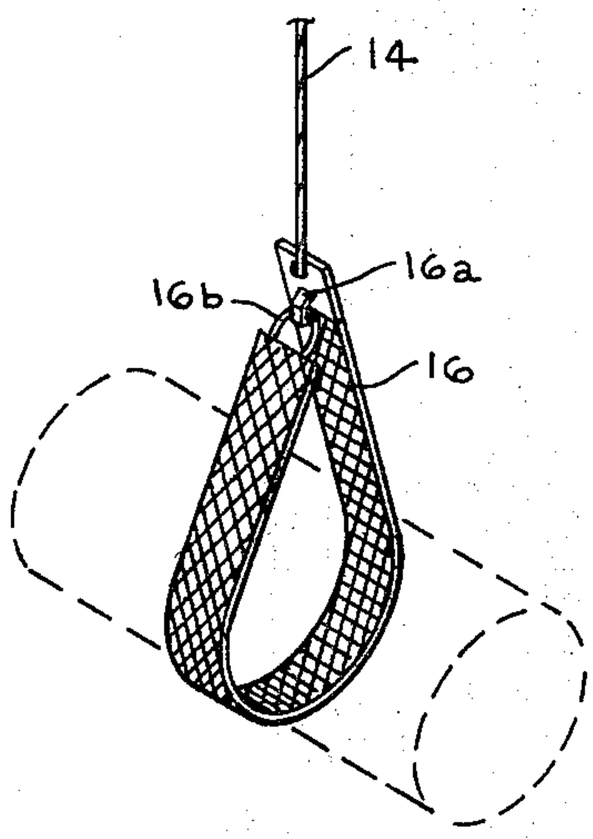


Fig-7

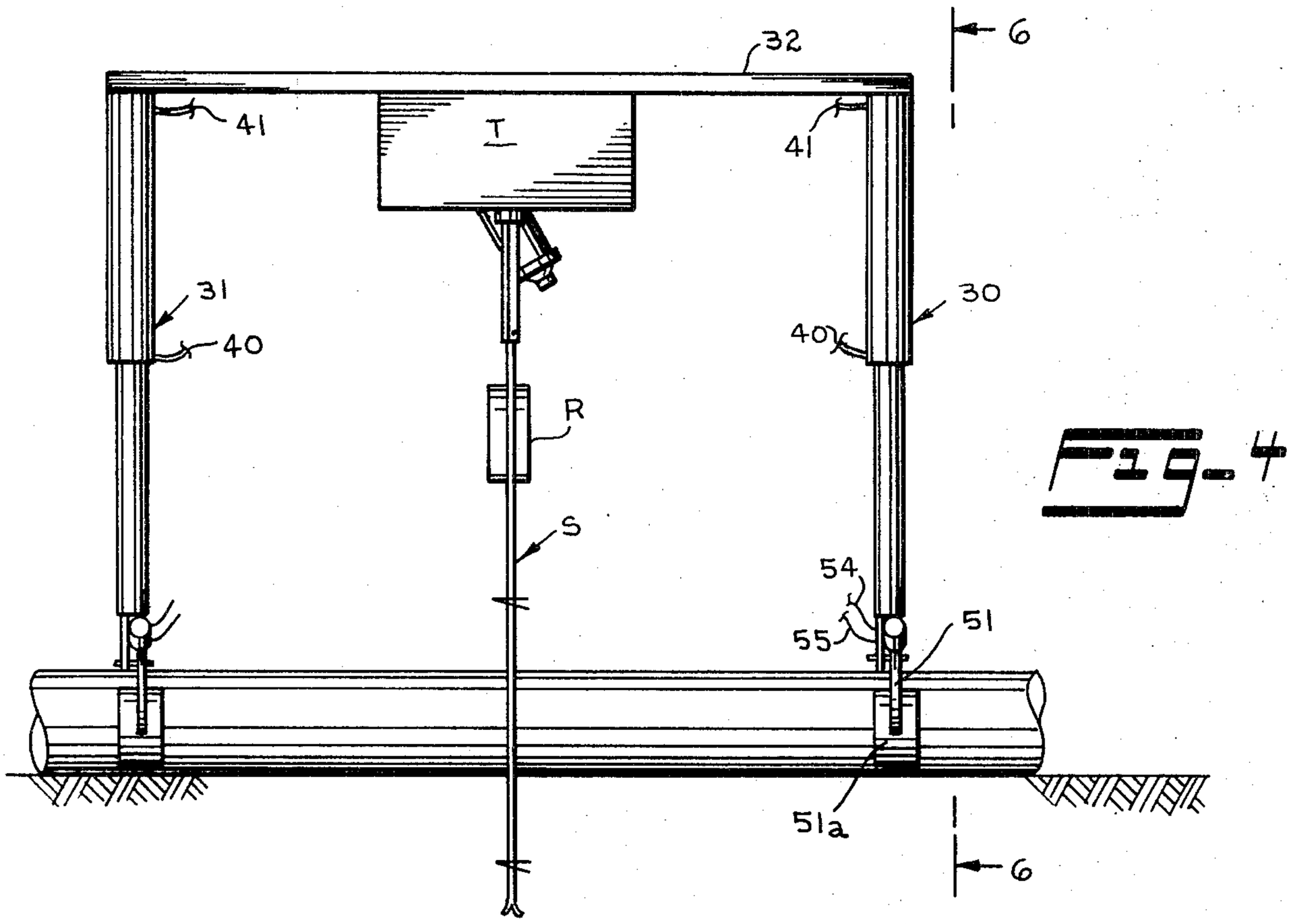


Fig-4

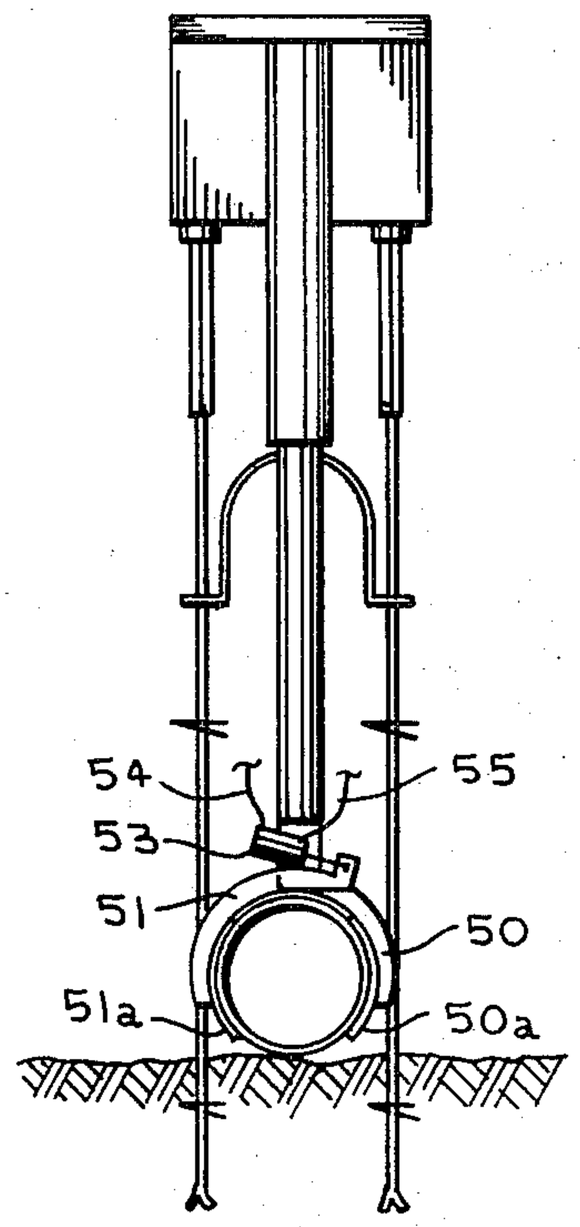
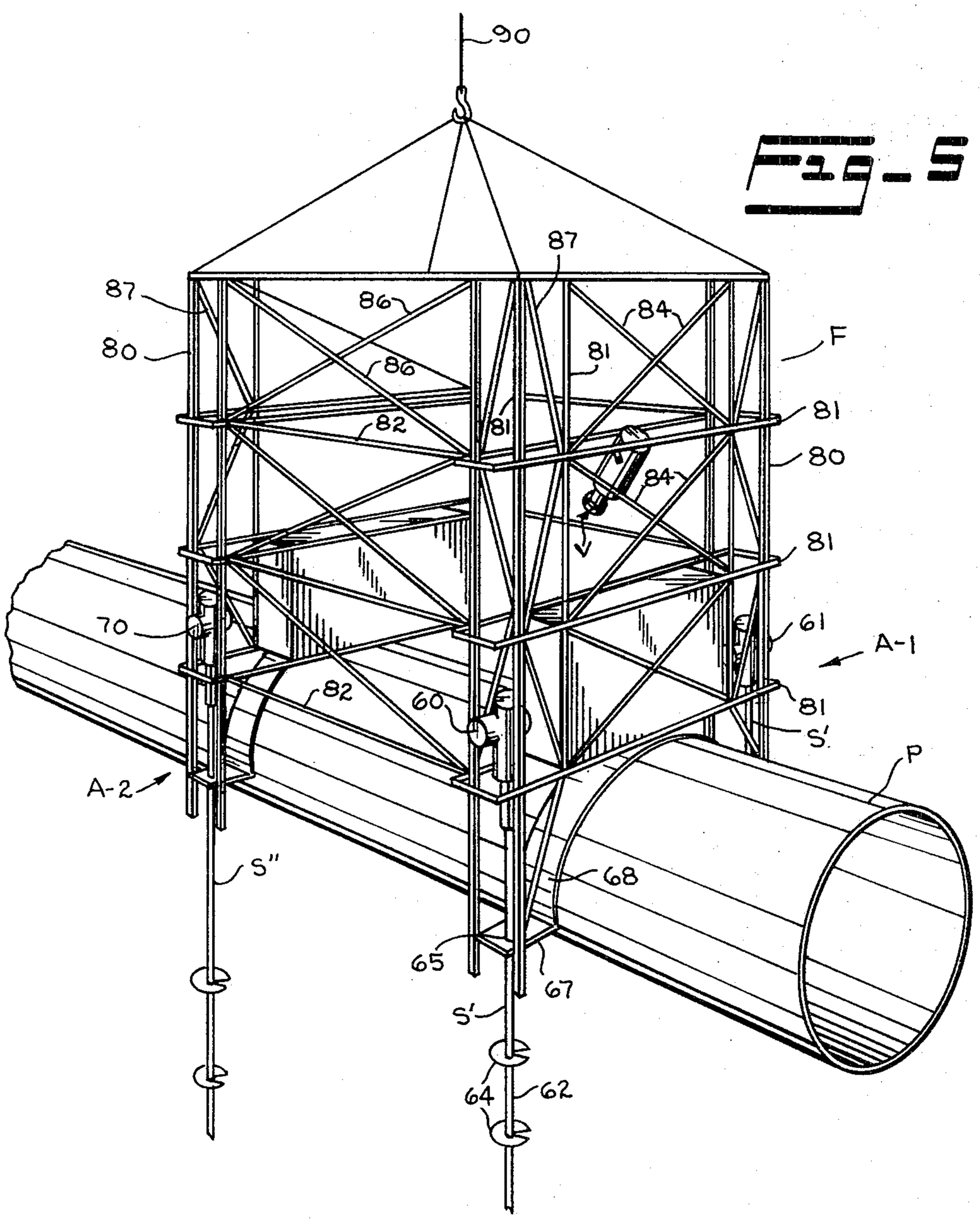


Fig-6

Fig_5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S'
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METHOD AND APPARATUS FOR ANCHORING UNDERWATER PIPELINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention provides a new and improved method and apparatus for anchoring pipelines on or under a submerged water bottom.

2. Description of the Prior Art

Prior devices and methods for anchoring underwater pipelines include structures such as those disclosed in the following U.S. Letters Pat. No. 2,355,086, 3,014,984 3,324,239, 3,427,812 and 3,411,306. Although such devices generally provide a means for anchoring pipelines on or under the ocean floor or the bottom of some other water body, the downward force imposed on the anchors during the installation procedure is limited to the negative buoyance of the anchor driving apparatus and does not include means for urging such apparatus downwardly relative to the pipe during the anchor installing operation.

SUMMARY OF THE INVENTION

Briefly, the present invention provides a new and improved method and apparatus for anchoring a pipeline in or under a submerged water bottom. The invention includes apparatus for rotating two or more helically shaped anchors simultaneously in the same or opposite directions to set the anchors in the bottom and also includes cutting and drilling tip means on the lower ends of the respective anchors to facilitate penetration of hard bottom formations or stratas such as coral or the like. Further, the present invention provides a means for creating a positive pull-down on the anchor driving apparatus to urge the apparatus downwardly when driving the anchors into the sub-soil or other bottom formation.

Also, the present invention includes an apparatus whereby more than a single pair of anchors may be installed simultaneously to anchor the pipeline. For example, the present invention includes an apparatus for installing two or more longitudinally spaced pairs of anchors simultaneously.

DESCRIPTION OF THE DRAWING

FIG. **1** is an isometric view showing the anchor drive mechanism suspended above a pipe with the anchor drive pull-down apparatus positioned for urging the anchor drive downwardly during the installation of the anchors;

FIG. **2** is an enlarged view showing a core type bit which is positioned at the lower end of the anchor for cutting or drilling hard surfaces, strata or formation;

FIG. **3** is an enlarged view of a fishtail type bit positioned at the lower end of the anchor to facilitate formation penetration in the installation of the anchor;

FIG. **4** is an isometric view showing an alternate embodiment employing hydraulic pistons for exerting a downward force on the anchor driving apparatus;

FIG. **5** is a side elevation view showing an apparatus for installing two pair of longitudinally spaced anchors simultaneously;

FIG. **6** is an end view of the alternate embodiment shown in FIG. **5** and

FIG. **7** is an isometric illustration of a web-belt device for connecting the anchor drive apparatus to the pipe.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Briefly, as shown in FIG. **1** of the drawings, the apparatus for anchoring the pipe P is designated generally A. Such apparatus A includes a buoyant tank T supported above pipe P by a load line L. The buoyant tank T includes drive heads D which rotate the anchors S to insert them into the bottom B. Such anchors S secure the bracket R which extends transversely across the pipe P in position to thereby anchor the pipe P on the ocean bottom B.

Also, as shown in FIG. **1** of the drawings, the present invention includes a pair of pipe clamps C which are longitudinally spaced on the pipe and which are connected by means of suitable lines or chains to a winch drive mechanism W carried on the tank T for urging such tank T downwardly relative to the pipe P.

As shown in the drawings, the pipe clamps C preferably include a pair of jaws **11** and **12** which extend beneath the pipe P and engage it on opposite sides so as to exert a clamping or gripping force on the pipe beneath its axis when the line **14** is pulled upwardly by the winch W. It will be appreciated that various types of devices may be used for connecting line **14** to pipe P so as to enable a downward force to be exerted on the anchor drive apparatus A. For example, a woven strap **16** of wire mesh, nylon or the like is shown in FIG. **6** which is provided for releasably connecting the line **14** to the pipe P. As shown, the woven strap **16** is provided with suitable hook **16***a* and eye **16***b* quick release connecting means for connecting opposite ends of the strap together to form a sling to connect to the pipe P. Also, as shown in FIG. **1** of the drawings, suitable pads **17** are provided for protecting the surface of the pipe P against scaring or denting by virtue of the forces imposed upon the pipe by the jaws **11** and **12.**

The line **14** preferably is carried over suitable sheaves or pulleys **20** mounted on arms **21** on the buoyant tank T. A similar arm and pulley arrangement (not shown) is provided for the line **15** which is also connected to a winch for exerting the pull-down force on the anchor drive apparatus A.

Also as shown in FIG. **1** of the drawings, hydraulic fluid supply and return lines **22** and **23,** respectively, extend upwardly from the anchor drive apparatus A to a suitable power supply source at the surface of the water body. Such hydraulic supply lines are connected to a hydraulic pump which provides the hydraulic fluid pressure for driving the hydraulic winch W which exerts the pull-down force on the anchor drive apparatus A and which also drives the heads D for driving or rotating the anchors S.

An alternate embodiment shown in FIG. **4** of the drawings includes a pair of hydraulic piston assemblies **30** and **31** which are mounted on a support arm **32** which extends axially of the pipe P and which is secured to the buoyant tank T and which are arranged so as to extend substantially axially of the pipe P. The upper end of the hydraulic piston assemblies **30** and **31** are connected to the support arm **32** and the lower end of such hydraulic piston assemblies and provided with clamps C′ which are used for connection to the pipe P. As best seen in FIG. **6** of the drawings the pipe clamp

C′ includes a fixed jaw **50** and a pivoted movable jaw **51** which is operated by a piston in a cylinder **53** which is moved by hydraulic fluid or air, or the movable jaw can be operated mechanically or electrically if desired. Also, it will be appreciated that the clamp C′ could be substantially identical to the clamp C shown in FIG. **1** of the drawings or, that other connecting devices such as a nylon web strap **16** or some other suitable device will be used for securing the hydraulic system apparatus to the pipe P.

The hydraulic piston apparatus is applied by hydraulic fluid under pressure through the hydraulic lines **40** and **41** which extend upwardly to a hydraulic pressure source at the surface and the piston **53** is also connected to a suitable fluid pressure supply source at the surface (not shown) by fluid lines **54** and **55.** Also, the jaws **50** and **51** are preferably provided with arcuate pipe engaging members **50***a* and **51***a*, respectively. With this embodiment of the pull-down apparatus of the present invention hydraulic fluid supplied to the hydraulic cylinders **30** and **31** is used to force the anchor drive apparatus downwardly while the anchors S are rotated or driven into the sub-soil beneath the pipe P. After such anchors have been buried to the desired depth the hydraulic pressure in the cylinders is reversed to open the movable jaw **51** and the pressure in the piston apparatus **30** and **31** is reversed to lift the clamps from the pipe P and the apparatus A is moved along the pipe for the reconnection of the clamps C and installation of additional anchors along the line of the pipe P.

It will also be appreciated that the hydraulic fluid supplied to the pistons may be coordinated or synchronized with the hydraulic fluid driving the heads H so as to coordinate the driving of the anchors S with the pull-down force applied on the hydraulic drive apparatus.

FIG. **5** illustrates another alternate embodiment of the apparatus of the present invention comprising a frame work F for supporting two pair of anchor drive assemblies A1 and A2 spaced apart axially of the pipe P. As shown in the drawings the anchor drive assembly A-**1** includes anchor drive devices **60** and **61** which are positioned on opposite sides of pipe P for driving the anchors S′. Such anchors S′ include a shaft **62** having one or more helically shaped flanges **64** thereon for insertion into the soil. Such shaft **62** extends through a suitable opening **65** in the flange member **67** attached to one end of the arcuate shaped strap or band **68** which extends transversely of the pipe P between the anchors S′ for holding such pipe P in position.

Similarly, the anchor drive assembly A-**2** includes a pair of anchor drive heads **70,** one of which is not seen in the isometric view, for driving an additional pair of anchors at S″, one each on either side of the pipe P. It will be appreciated that the anchor drive assembly A-**2** is substantially identical to the anchor drive assembly A-**1** and that such anchor drive assemblies are carried or mounted in the frame work F which includes a plurality of vertical support members **80** which are positioned at the four corners of the rectangular frame F adjacent to the anchor drive heads **60, 61, 70** and the fourth anchor drive head which is not shown in FIG. **5.** Such vertical support members **80** are joined together by horizontally extending support members **81** which extend transversely of the pipe P and horizontal connecting members **82** which extend parallel to the pipe P. Similarly, diagonally extending braces or truss members **84** extend between the vertical members **81** on opposite sides of the pipe P and diagonally extending braces or trusses **86** are provided which extend between the vertical members **80** which are on the same side of the pipe P. Further, additional knee braces or corner braces **87** are provided for connecting the vertically extending members **81** at the corners of the frame F.

Further, it will be appreciated that suitable hydraulic controls (not shown) are provided with each of the anchor drive members **60, 61** and **70** for providing hydraulic fluid or other motive power to each of such drives for rotating the anchors S′ or S″ as the case may be for setting such anchors in the soil to hold the pipeline P in place. Such frame F is shown supported by means of a support line **90** which runs to a suitable winch or other lifting apparatus at the surface for lifting and moving the frame F along the pipe P as desired.

Also, it will be appreciated that the number of pairs of anchor drive assemblies can be increased as desired so that three, four or more pairs or sets of anchors can be driven or installed simultaneously. Each of the pair of anchor dirve devices will be the same as the anchor drives A-**1** and A-**2.** Shown in FIG. **1** and FIG. **5,** one or more remote control TV cameras can also be used to monitor the various anchor drive operations and apparatus.

As shown in FIG. **2** of the drawings, a quick connect or disconnect device is provided for quickly releasing the kelly drive D-**1** from the shaft S of the anchor. The quick connect apparatus includes connecting pins **92** and **93** which extend transversely of the axis of the kelly drive D-**1.** Such pins extend through openings **94** into the kelly drive and project inwardly into suitable openings near the top of the anchor shaft S which are registered with the openings **94.** It will be appreciated that these connecting pins are provided for securing the anchor shaft to the kelly drive but the non-circular kelly D-**1** rotates the anchor shaft to set the anchors.

As shown, the pins **92** and **93** are carried on pivotally mounted latch handles **96** and **97,** respectively. Once the anchor has been set, the release ring **99** is moved upwardly either manually by a driver or by other suitable means. When such ring engages the latch handles **96** and **97,** it moves them outwardly to withdraw the pins **92** and **93** from the openings **94** to thereby release the kelly drive D-**1** from the upper end of the anchor shaft S.

Shown in FIG. **2** of the drawings is a hollow cylindrical bit **102.** Such bit is provided with a hard surface edge extending circumferentially of the bottom of the cylinder. Also, shown in FIG. **3,** is a fishtail bit **103.** Such bit is either pinned, welded, screwed or otherwise attached to the lower end of the anchor shaft S. Thus, it will be appreciated that the bits **102** and **103** can be used to facilitate perforation of hard strata in placing the anchors.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

I claim:

1. A method of anchoring a submarine pipeline beneath a body of water comprising the steps of:

a. lowering an anchor drive apparatus from a supporting vessel at the surface to a position above the pipeline;

b. connecting a pull-down means from the anchor drive apparatus to the pipeline; and

c. urging the anchor drive apparatus downwardly by the pull down means while simultaneously driving the anchors into the bottom of the water body whereby any upward force on the anchor drive apparatus is countered by the downward urging of the pull down means.

2. An apparatus for anchoring pipelines beneath a water body comprising:

a. an anchor drive means;

b. means for supporting said anchor drive means from a supporting vessel at the surface of the water above the pipeline; and

c. pull-down means with said anchor drive means adapted to be connected to the pipeline for pulling the anchor drive means downwardly to counter any upward force on said anchor drive means while anchors are being driven into the bottom of the water body to secure such pipeline in place.

3. The invention of claim **2** wherein said pull-down means includes wench drive means with said anchor drive means and a line connected to said wench drive and connecting means on said line for securing said line

to the pipeline being anchored whereby said anchor drive means can be urged downwardly while said anchor drive means is driving anchors into the bottom to anchor said pipeline thereto.

4. The invention of claim **3** wherein said wench drive is hydraulically actuated and includes means for synchronizing said downward pull on said anchor drive apparatus with the operation of said anchor drive means.

5. The invention of claim **2** wherein said pull-down means includes hydraulically actuated pistons operably connected to a clamping means for connecting said piston to the pipeline for exerting a downward pull on said anchor drive apparatus while driving anchors into the bottom for securing the pipeline thereto.

6. The invention of claim **5** wherein said clamping means includes a movable jaw and hydraulic actuating means for moving said jaw into and out of engagement with the pipe for clamping and releasing same.

7. The invention of claim **2** wherein said anchor drive means includes two pair of anchor drive devices longitudinally spaced apart relative to the axis of the pipeline and with one of said pair of anchor drive apparatus disposed on the opposite side of the pipeline from the other one of said pair.

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